# CONTENTS:


**TITLE PAGE** 2

**KEYWORDS** 3

**ABSTRACT** 3

**DECLARATION** 4

**ACKNOWLEDGEMENTS** 4

**MAIN TEXT:**

**CHAPTER 1: INTRODUCTION** 7

**CHAPTER 2: PHARMACOLOGY OF DRUGS USED AND LITERATURE REVIEW** 9

**CHAPTER 3: THE OFFICE BASED FACILITY** 52

**CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY** 69

**CHAPTER 5: REASEARCH FINDINGS AND ANALYSIS** 100

**CHAPTER 6: SUMMARY AND CONCLUSIONS** 124

**CHAPTER 7: BIBLIOGRAPHY** 145

**APPENDIX** 151

# TITLE PAGE:

## MSc. (Sedation and Pain Control)
## THE SAFETY AND EFFICACY OF THE PROPOFOL / ALFENTANIL / KETAMINE BOLUS TECHNIQUE IN MIDAZOLAM PRE-MEDICATED PATIENTS UNDERGOING OFFICE BASED PLASTIC OR RECONSTRUCTIVE SURGERY.

**Submitted by**
**Dr. J. C. Venter**

**M B Ch B; M Fam Med**
**Diploma Sedation and Pain Control**
**(University of Stellenbosch)**



**STUDENT NO 2652708**

**A thesis submitted in partial fulfilment of the requirements for the degree of Magister Scientiae (Sedation and Pain Control) in the Discipline of Anaesthesiology and Sedation of the University of the Western Cape.**

**Date of submission: April 2007**

**Supervisor: Prof. J.A. Roelofse**

# KEYWORDS:

Office based plastic and reconstructive surgery
Intravenous sedation
Midazolam
Ketamine
Propofol
Alfentanil
Lignocaine
Bupivacaine
Epinephrine
Frizelle sedation scale
Target controlled infusion

# ABSTRACT:

Degree: MSc. (Sedation and Pain Control) Discipline of Anaesthesiology and Sedation, University of the Western Cape.

Student Name: Dr. J.C. Venter

Student Number: 2652708

April 2007

The purpose of this research project was to assess the safety and efficacy of a combination of drugs for conscious sedation in patients undergoing office based plastic and reconstructive surgery.

A pilot study was done to determine the safety of the co-administration of the drugs used in the sedation technique.
In this study project midazolam, propofol, alfentanil, and ketamine were used to achieve conscious and deep sedation.
To assess the safety and efficacy of the sedation technique, one hundred and five midazolam (7.5 mg) pre-medicated ASA I and II patients received the same propofol / alfentanil (4 mg/kg/hr) and ketamine bolus, 0.25-0.3m/kg, sedation technique.
The patients were monitored to evaluate cardiovascular and respiratory response, level of sedation and side effects during and after the procedures.

An evaluation was done as to the patient and surgeon's satisfaction with the sedation technique.
A cost assessment was done comparing, a breast reduction under sedation in an office based setting, to the same procedure under general anaesthesia.
Literature surveys were done to determine what international standards exist for office based surgical facilities and what the mortality and morbidity statistics for such facilities were.
Final conclusions and recommendations were made regarding a safe sedation technique in the office based setting for plastic and/or reconstructive surgery.

## DECLARATION:

I declare that this MSc. (Sedation and Pain Control) is my own work, that it has not been submitted for any other degree or examination at any other University, and that all the sources I have used and quoted have been indicated and acknowledged by complete references.
Full name: Jacob Cloete Venter Date April 2007



Signed …….

## ACKNOWLEDGEMENTS:

I would like to thank the Dr IC Mc Gibbon for his support and professionalism.

I would also like to thank Prof. James Roelofse for his guidance and for sharing the sedation vision with his students.

# MAIN TEXT:

**CHAPTER 1: INTRODUCTION** 7

**CHAPTER 2: PHARMACOLOGY OF DRUGS AND LITERATURE REVIEW** 9

**A. PHARMOCOLOGY** 10
**B. RATIONALE FOR COMBINING DRUGS** 31
**C. LITERATURE REVIEW** 32

**CHAPTER 3: THE OFFICE BASED FACILITY**

**A. INTRODUCTION** 52
**B. THE AMERICAN MODEL** 55
**C. DISCUSSION** 63



**CHAPTER 4: RESEARCH METHODOLOGY**

**A. PATIENT SELECTION** 69
**B. PREOPERATIVE INSTRUCTIONS TO PATIENTS** 70
**C. PRE – SEDATION EVALUATION** 72
**D. INTRAVENOUS SEDATION PROCESS** 75
**E. LOCAL ANAESTHETIC DRUGS** 76
**F. MONITORING** 77
**G. EVALUATATION CRITERIA** 80
**H. DISCHARGE CRITERIA** 85
**I. POSTOPERATIVE INSTRUCTIONS TO PATIENTS** 85
**J. THE SURGICAL FACILITY** 86
**K. FACILITY RESUSCITATION PROTOCOLS** 89

## CHAPTER 5: RESEARCH FINDINGS AND ANALYSIS


**A. AGE, ASA CLASSIFICATION, GENDER, WEIGHT** 100
**B. PROCEDURE** 102
**C. PROCEDURE TIME** 102
**D. DRUG USAGE DURING SEDATION PROCESS** 103
**E. DRUG USAGE DURING LOCAL ANAESTHESIC PROCESS** 104
**F. ACTUAL AND RECOMMENDED DOSES USED AND PERSONAL EXPERIENCES** 109
**G. PATIENT RESPONSE TO LOCAL ANAESTHESIA** 113
**H. SEDATION LEVELS DURING SEDATION PROCESS** 114
**I. SEDATION TECHNIQUE** 115
**J. SURGEON'S PERSPECTIVE ON THE QUALITY OF INTRAOPERATIVE CONDITIONS DURING THE SEDATION PROCESS** 116
**K. PATIENT SATISFACTION WITH SEDATION PROCESS** 117
**L. ADVERSE EVENTS** 118
**M. COST** 121

**CHAPTER 6: SUMMARY, CONCLUSION AND RECOMMENDATIONS** 124

**CHAPTER 7: BIBLIOGRAPY** 145

**APPENDIX** 151

# CHAPTER 1:

## INTRODUCTION

Intravenous sedation has gained popularity among many plastic surgeons because of its efficacy, cost efficiency and for the flexibility it offers to both surgeon and patient. When intravenous sedation is combined with highly effective local anaesthesia, the use of sedation has extended to cases previously performed only under general anaesthesia.

As a sedation practitioner working with a plastic and reconstructive surgeon in an office based surgical facility one needs to answer the following questions:

Is the sedation technique we use safe and effective?
What literature can be used as evidence to support a specific sedation technique?
Is the sedation technique cost effective?
What is an ideal office based surgical facility?
Which procedures can safely be done in such a facility?
What are the morbidity and mortality statistics for other similar office based surgical facilities?
What are the procedural and sedation complications seen in office based facilities and how can they be anticipated and prevented?

The American Society of Anaesthesiologists has defined four levels of sedation:

1. Minimal sedation (anxiolysis), which is a drug induced state characterised by a normal response to verbal stimuli, but with a reduction in anxiety. This level may impair cognition and co-ordination, but ventilation and cardiovascular responses remain unchanged.
2. Moderate sedation / analgesia or conscious sedation, is defined as a minimally depressed level of consciousness that allows the patient to maintain protective reflexes, maintain a patent airway independently and continuously and is able to respond appropriately to physical stimulation and verbal command.

3. Deep sedation is defined as a medically controlled state of depressed consciousness from which the patient is not easily aroused which is accompanied by a partial or complete loss of protective reflexes, and may include the inability to maintain a patent airway.
4. General anaesthesia is a drug-induced loss of consciousness, during which the patient cannot be aroused, with loss of airway reflexes and depressed cardiovascular responses.

The following definitions are of importance in a research project like this:

Safety is defined as a condition of being safe, free from danger or risk.
Efficacy is defined as producing the desired effect.
Dissociative anaesthesia is defined as a state in which a drug blocks signals to the conscious mind from other parts of the brain, typically, but not limited to the physical senses. Such a sensory deprivation can facilitate hallucinations and dreamlike states of mind.
Analgesia is the reduction or elimination of the patient's experience of pain.
Amnesia is the inability to remember an event or experience.
Continuum of sedation is characterised by a state of sedation that fluctuates between the different levels of sedation depending on the sensitivity of the patient to the sedative used, or the dosages of drugs administered. A wide patient to patient variability exists during this continuum. A sedative agent which can cause conscious sedation for one patient, can cause deep sedation or general anaesthesia for the next patient.

## In this research project the academic aim was:

To determine whether a combination of drugs could be used:

Safely.
Effectively.
In an office based setting.
For patients undergoing plastic and reconstructive surgery.

## The strategic aim was:

To assess how the standards set for an office based surgical facility impacts on patient safety and cost.

# CHAPTER 2:

# PHARMACOLOGY OF DRUGS USED AND LITERATURE REVIEW

## A. PHARMACOLOGY

1. **MIDAZOLAM**
2. **KETAMINE**
3. **PROPOFOL**
4. **ALFENTANIL**
5. **LIGNOCAINE**
6. **BUPIVACAINE**
7. **EPINEPHRINE**
8. **HYALASE**

## B. RATIONALE FOR COMBINING DRUGS



## C. LITERATURE REVIEW

1. **CO-ADMINISTRATION OF PROPOFOL AND ALFENTANIL**

2. **CO-ADMINISTRATION OF PROPOFOL AND KETAMINE**

# A. PHARMACOLOGY.

## INTRODUCTION

Total intravenous anaesthesia was historically administered through manual bolus injections. Such manual control of an infusion was not so effective due to the fact that it did not allow for:

- The accumulation of the intravenous drugs.
- The estimation of blood concentrations.
- The ability to change anaesthetic depth in a controlled manner.

Total intravenous anaesthesia was seen as more difficult to administer effectively than inhalation anaesthesia.

The concept of total intravenous anaesthesia got a boost during the late 1980's due to the introduction of:

- The highly effective sedative hypnotic propofol, and short acting intravenous opioids such as alfentanil, remifentanil and sufentanil. These drugs were commonly used together to produce rapid hypnosis /anaesthesia and quick recovery.
- Intravenous infusion pumps that allow the sedation practitioner to make alterations to the target concentration of drugs in order to provide a rapid, titratable sedation without over-sedation.

The concept of total intravenous sedation became a very important tool in the hands of the sedation practitioner for office based surgery.

To achieve the goal of ideal sedation for plastic and cosmetic surgery in an office based setting, the objectives were as follows:

- Preoperative anxiolysis and amnesia.
- A smooth and titratable induction to the level of conscious sedation.
- Complete analgesia by the introduction of local anaesthesia into the operative field.
- Rapid, clear headed emergence without side effects postoperatively.

Unfortunately no single drug has all the characteristics to achieve all these objectives. To achieve as near as to the ideal, drugs had to be combined and their synergistic properties had to be exploited.
When combining the drugs together one however has to realise that you are not dealing with the characteristics of each individual drug, but that the combination creates a new drug altogether.

The drugs used in combination in such an ideal sedation technique should have the following properties:

Safety.
Minimal cardiovascular and respiratory depression.
A rapid onset of action and recovery.
A low side effect profile.



THE FOLLOWING DRUGS WERE USED IN THIS RESEARCH PROJECT AND WILL BE DISCUSSED INDIVIDUALLY.

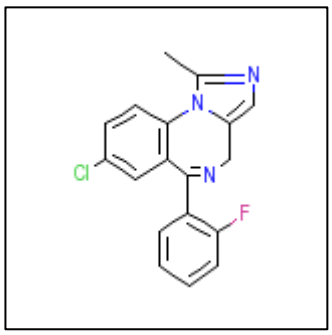
1. Oral Midazolam
2. Intravenous Ketamine
3. Intravenous Propofol
4. Intravenous Alfentanil

For Local Anaesthesia:

5. Lignocaine
6. Bupivacaine
7. Epinephrine
8. Hyalase

1. **MIDAZOLAM**

CHEMICAL STRUCTURE




Like other benzodiazepines, midazolam, a water-soluble imidazo benzodiazepine, has anxiolytic, sedative and anticonvulsive characteristics. These characteristics are based on its bond with receptors in the central nervous system. These receptors cause an increased inhibitory effect of g-aminobutyric acid (GABA).



PHARMACOKINETICS

Midazolam is water soluable because the imidazole ring is open at pH values under 4. When injected where the pH value is 7.4, the imidazole ring closes and it becomes more lipid soluble, facilitating rapid uptake into nerve tissue.
Bioavailability shows great variability with a 30-70% fluctuation.
Bioavailabilty is 90% after intramuscular injection.
Peak plasma level is reached within 30 minutes. It has a pKa of 6.15 and is therefore predominantly unionised (>90%) at physiological pH accounting for its rapid onset of action and its high protein binding in the blood (up to 97%).
Plasma half-life: 2 to 5 hours. The half-life can be significantly longer in the elderly (up to 22hrs).
The volume of distribution ranges from 0.7 – 1,2 l/kg.
Midazolam is metabolised via the hepatic cytochrome P450 enzyme 3A3/3A4.

Alpha-hydroxymidasolam is the only active metabolite, which has a half-life of 0.8 to 1.0 hours. It is then glucuronidated before being excreted via the kidneys.

DOSAGE AND DIRECTIONS FOR USE

Dose range for pre-medication is 7.5 – 15 mg taken orally one hour before surgery.

SIDE EFFECTS AND SPECIAL PRECAUTIONS

Psychiatric and paradoxical reactions: Reactions such as restlessness, agitation, irritability, aggressiveness, delusions, rages and hallucinations are known to occur when taking midazolam. These side effects can be reversed with flumazenil (0.1 mg/kg intravenously repeated every 2 minutes until a maximum dose of 1 mg).
Midazolam can unmask pre-existing depression and can lead to an emotional preoperative patient.
Effects like fatigue, confusion, dizziness, muscle weakness, ataxia and double vision are rare but can be encountered.
Consent forms for surgical procedures should be signed on the day before surgery due to the fact that midazolam causes sedation, amnesia, impaired concentration and muscular function. The patient should be advised not to drive once they have taken their pre-medication.
Cimetidine, ranitidine, erythromycin, diltiazem, verapamil, ketoconazole and saquinavir all inhibit the cytochrome P 450 enzyme 3A.These drugs can all prolong the action of midazolam.
Midazolam used in combination with central nervous system depressants may have a synergistic effect.

[MARTINDALE: The Complete drug reference- 34th edition; http://redpoll.pharmacy.ualberta.ca/drugbank/cat-browse.htm; MANUFACTURERS PACKAGE INSERT]

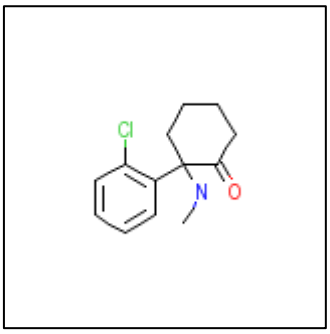
## 2. KETAMINE

HISTORY

Ketamine was introduced in 1965 by Domino and Corsen. It proved to be a promising new agent, particularly in field situations. A related

compound, phencyclidine was used in anaesthesia, but was withdrawn because of the high incidence of hallucinations.

## CHEMICAL STRUCTURE




Ketamine is 2-0-chloropphenyl-2-methylaminocyclohexanone hydrochloride. It is a white crystalline substance with a characteristic smell. The product is readily soluble in water at a pH value of 3.5 – 5.5. The pKa is 7.5.



## PHARMACOKINETICS

Drug Category:

Analgesics
General Anaesthetics

## PHARMOCOLOGY

Ketamine is a rapid-acting general anaesthetic agent, producing in sub-anaesthetic doses an anaesthetic state characterized by profound analgesia, normal pharyngeal-laryngeal reflexes, normal or slightly enhanced skeletal muscle tone, cardiovascular and respiratory stimulation, and occasionally a transient and minimal respiratory depression.

The anaesthetic state produced by ketamine has been termed “dissociative anaesthesia” in that it appears to selectively interrupt association pathways of the brain before producing somatic sensory blockade.

Ketamine has several clinically useful properties, including analgesia and less cardiorespiratory depressant effects than other anaesthetic agents. Ketamine also causes some stimulation of the cardiovascular system. Arterial blood pressure can increase by as much as 25% with ketamine use. Myocardial oxygen demand increases as well as myocardial sensitivity to epinephrine.

It interacts with N-methyl-D-aspartate (NMDA) receptors, opioid receptors, monoaminergic receptors, muscarinic receptors and voltage sensitive calcium channels. Unlike other general anaesthetic agents, ketamine does not appear to interact with GABA receptors.
Ketamine is rapidly absorbed following parenteral administration. After an intravenous injection it can cause anaesthesia within 30- 60 seconds, and a bolus dose can produce dissociation for up to 15 minutes.
Protein binding of ketamine is 20-25% and the drug undergoes hepatic biotransformation.
Ninety percent of ketamine is excreted via the kidneys.
Half life: 2.5-3 hours.
Interactions of Ketamine: Prolonged recovery time may occur if barbiturates and/or narcotics are used concurrently with ketamine.



SIDE EFFECTS AND SPECIAL PRECAUTIONS

Emergence reactions in recovery are common, including vivid and often unpleasant dreams, hallucinations and irrational behaviour. These unpleasant side effects can be reduced by the co-administration of benzodiazepines.
Children and the elderly appear less sensitive. Patients may also experience increased muscle tone that could resemble a seizure.
Respiration may be depressed during rapid intravenous injection and apnoea and laryngospasm have occurred.
Diplopia and nystagmus is a common occurrence.
Nausea and vomiting, lacrimation, hypersalivation, and raised intra-ocular and cerebrospinal fluid pressures have been reported.
Hypersalivation can be reversed using an antisialogogue such as glycopyrrolate.
The necessary equipment for airway support, intubation and resuscitation should be readily available when using ketamine.

Special precautions should be taken when administering ketamine to patients with a history of epilepsy, psychiatric illness or porphyria.

DOSAGE AND DIRECTIONS FOR USE

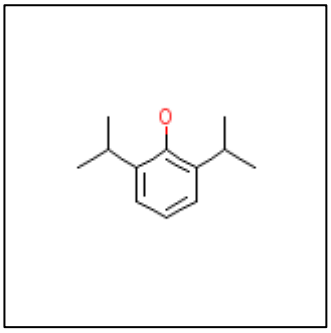
Dosages should be individualised.
Ketamine can be given intravenously, intramuscularly, orally, nasally and rectally.
The intramuscular dose is 5- 10 mg/kg which produces an anaesthetic effect within 3 – 4 minutes, and lasts for 15 – 25 minutes.
With intravenous use the recommended dose is 1 – 2 mg/kg which causes an anaesthetic effect in 30 seconds and lasts between 5 – 10 minutes. It is recommended that the intravenous injection be given slowly over 60 seconds.
For intravenous sedation lower doses are used.

[MARTINDALE: The Complete drug reference- 34th edition; http://redpoll.pharmacy.ualberta.ca/drugbank/cat-browse.htm; MANUFACTURERS PACKAGE INSERT]



**3. PROPOFOL:**

CHEMICAL STRUCTURE




Propofol (2,6-diisopropylphenol) is produced as a 1% and 2% solution in an aqueous emulsion of 10% soya bean oil, 2.25% glycerol and 1.2% purified egg phosphatide.

## PHARMACOLOGICAL ACTION

Propofol is a short–acting sedative hypnotic with a rapid onset of action of approximately 30 seconds. Maintenance of anaesthesia can be achieved by either continuous infusion or intermittent bolus injections.

## PHARMACODYNAMIC PROPERTIES

A single bolus dose of propofol 2-2.5 mg/kg produces unconsciousness within one minute in the majority of patients, although the dose may be reduced in older patients and by premedication with opioids and sedatives.
Recovery from propofol anaesthesia is rapid.
Psychomotor impairment following recovery is minimal.
Induction doses of propofol (2mg/kg) reduces systolic and diastolic blood pressure by 16 and 11% respectively in unpremedicated patients.
These actions of propofol are potentiated by the co-administration of opioids and sedatives.
It has been shown that propofol produces a low incidence of postoperative nausea and vomiting.
Induction doses of propofol can cause apnoea, which can last up to 60 seconds.

## PHARMACOKINETIC PROPERTIES

Following a bolus injection of propofol, the blood concentrations decline rapidly. Administration by infusion produces an initial rapid increase in concentration followed by a slower rise to a steady state.
Propofol distributes rapidly and extensively from the blood with distribution half-life of approximately 2 – 4 minutes.
An open 3-compartment model best describes propofol distribution.
Propofol is metabolised rapidly, with 88% of an administered dose appearing in the urine as a propofol conjugate, 4-hydroxy propofol.
Elimination of propofol is a biphasic process, with a first stage half-life of 25-56 minutes and a terminal half-life of 184 – 309 minutes, following a single bolus dose, and 277 to 403 minutes following an infusion.
Total clearance and volume of distribution are reduced in the elderly.

The concomitant use of an opioid, fentanyl, reduces propofol's volume of distribution, elimination half-life and also reduces propofol clearance by about one third.
Under the usual maintenance regimens, significant accumulation of propofol does not occur.

## INDICATIONS FOR USE

Propofol is a sedative-hypnotic agent for use in induction and maintenance of anaesthesia, and increasingly, for sedation in adults and children.

## WARNINGS

Propofol can cause apnoea during induction of anaesthesia and special care should be exercised when propofol is used with other respiratory depressants such as the opioids and benzodiazepines.
The most frequent side effect of propofol is veno-irritation ( burning ) during injection. This is experienced by about 30% of patients when veins on the dorsum of the hand are used, but by only 8% of patients if administration is into a larger vein in the forearm or antecubital fossa. The co-administration of lignocaine is recommended to alleviate this problem.
Propofol may cause a generalised systemic reaction, which may be anaphylactic in nature.
Exitatory effects are seen in about 14% of patients.

Propofol is a lipid emulsion and bacterial growth can occur. All open vials should be discarded within 6 hours of use.

## DOSAGE AND DIRECTIONS FOR USE

Propofol has been safely used with the following agents without pharmalogical incompatibility:
Opioids
Premedications
Neuromuscular blocking agents
Spinal and epidural anaesthesia

Inhalation agents.
Dextrose 5%
Sodium chloride 0.9%

The recommended dose of propofol for sedation purposes is between 3 and 6 mg/kg/hr.

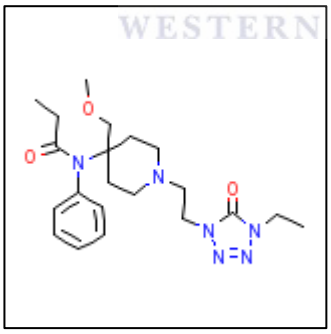
Propofol is increasingly used for sedation
It has a rapid onset of action and produces a smooth induction.
It has a short duration of action and causes a clear-headed euphoric emergence, which contributes to patient comfort and acceptability in the recovery room.

[MARTINDALE: The Complete drug reference- 34th edition; http://redpoll.pharmacy.ualberta.ca/drugbank/cat-browse.htm; MANUFACTURERS PACKAGE INSERT]



## 4. ALFENTANIL

CHEMICAL STRUCTURE:



PHARMACOLOGICAL ACTION

Alfentanil is classified as a short acting opioid with analgesic activities.
Alfentanil interacts predominantly with the opioid mu-receptor. These mu-binding sites are distributed in the human brain, spinal cord, and other tissues.
In clinical settings, alfentanil exerts its principal pharmacologic effects on the central nervous system. Its primary actions of

therapeutic value are analgesia and sedation. Alterations in mood, euphoria and dysphoria, and drowsiness have been reported.
Opiate receptors are coupled with G-protein receptors and function as both positive and negative regulators of synaptic transmission via G-proteins that activate effector proteins As the effector system is adenyl- cyclase and c-AMP located at the inner surface of the plasma membrane, opioids decrease intracellular c-AMP by inhibiting adenyl-cyclase. Subsequently, the release of nociceptive neurotransmitters such as substance P, GABA, dopamine, acetylcholine and noradrenaline are inhibited.
Opioids also inhibit the release of vasopressin, somatostatin, insulin and glucagon. Alfentanil's analgesic activity is, most likely, due to its conversion to morphine.

## PHARMACODYNAMIC PROPERTIES

Alfentanil is a synthetic opioid analgesic derivative of fentanyl.
It differs from fentanyl in the following ways:

- It is four times less potent as an analgesic.
- Its depressant effect on the respiratory and alveolar ventilation is shorter.
- Its onset of action is four times faster.
- Its duration of action is three times shorter.



Alfentanil has a fast onset of action with the peak analgesic and respiratory depressant effect occurring within one minute.
At high doses (> 120µg/kg) alfentanil can induce sleep and be used as an anaesthetic induction agent.
The induction is smooth, pain free and devoid of cardiovascular and hormonal stress responses to intubation.
Alfentanil depresses the respiratory centre, depresses the cough reflex, and constricts the pupils.
Recovery after alfentanil is rapid and smooth.
All actions of alfentanil are immediately and completely reversed by naloxone.
Alfentanil maintains cardiovascular stability and has been shown not to cause histamine release.

## PHARMACOKINETICS PROPERTIES

Alfentanil is rapidly eliminated after intravenous administration. Sequential distribution half-lives of 0.4 – 2.2 minutes, and 8 – 32 minutes, and terminal half lives of 83 – 223 minutes have been reported.
The low degree of ionisation (11% at pH of 7.4) contributes to a rapid but limited tissue distribution.
Plasma protein binding of alfentanil is 92% and the drug is mainly metabolised in the liver.
Only 1% of unchanged alfentanil is found in the urine.
Alfentanil metabolites are inactive and 70 – 80% of them are eliminated via the urine.
Accumulation of alfentanil can occur with prolonged continuous infusions and with repeated bolus dosing for patients with reduced plasma clearance.

## SIDE EFFECTS



The most common adverse reaction that may occur with the use of alfentanil is respiratory depression. This reaction is more likely when the intravenous doses are given too rapidly. Respiratory depression occurring in this way may be treated with assisted controlled respiration. This will normally provide adequate ventilation without a reversing agent.
Respiratory depression and analgesia may continue into or even recur during the postoperative period. The patient should therefore be closely monitored during the recovery period.
Alfentanil may induce myoclonic movements and may cause chest wall muscle rigidity. This can be prevented by slow intravenous injections.
All opioids including alfentanil can cause hypotention in the hypovolaemic patient. Adequate fluid resuscitation becomes essential for patients undergoing procedures where there are large fluid shifts as seen during large volume liposuction.
Alfentanil may cause euphoria.
Allergic reactions and laryngospasm may occur but are infrequently encountered.
Alfentanil may cause bradycardia, an effect that may be marked and rapid in onset, but can be antagonised by the use of atropine. The

bradycardia may be more pronounced when alfentanil is used with other anaesthetic agents that depress the heart rate and increase vagal activity. Asystole can occur and the manufactures advise that atropine should be administered if the heart rate is slow.
Alfentanil can cause nausea and vomiting.
Medicines such as benzodiazipines, neuroleptics, barbiturates and other central nervous depressants such as alcohol may potentiate the respiratory depression of the opioids.
Alfentanil is metabolised via the cytochrome P450 3A4-enzyme system, which is affected by drugs such as erytromycin, fluconazole and certain antiretrovirals. These products can increase the risk of prolonged respiratory depression.

DOSAGE AND DIRECTIONS FOR USE

The dose of alfentanil should be individualised and titrated to effect. The initial dose should be decreased in the elderly patient and should be higher in children. The effect of the initial dose should be taken into account to determine subsequent doses.
Alfentanil in small doses is considered useful for minor painful surgical procedures and for outpatient surgery.
Infusion rates of 1 µg/kg/min have been suggested for alfentanil when used as a sole agent.

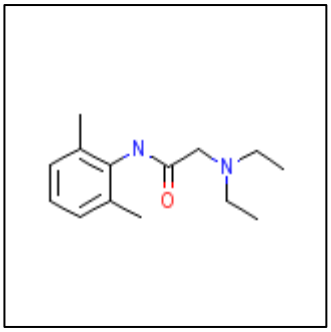


[MARTINDALE: The Complete drug reference- 34th edition; http://redpoll.pharmacy.ualberta.ca/drugbank/cat-browse.htm; MANUFACTURERS PACKAGE INSERT]

## 5.LIGNOCAINE

Lignocaine was introduced in 1943 and over the past 60 years has proven internationally to be a reliable and effective local anaesthetic agent.

CHEMICAL STRUCTURE




## PHARMACOKINETIC PROPERTIES

Lignocaine is classified as a medium acting amide.
Lignocaine reversibly blocks impulse condution along nerve axons, it reduces the rate of firing and formation of action potentials by blocking sodium channels in neuronal membranes. It also suppresses automaticity of mycocardial conduction tissue by increasing the electrical stimulation threshold of the ventricles.
Lignocaine has a rapid onset of action and in its plain form can produce analgesia from 30 to 120 minutes.
The half-life of lignocaine is 1-2 hours and is 70% protein bound.
The drug is metabolised in the liver and 10% is excreted unchanged in the urine.
The time to peak concentrations after lignocaine injection is 10 minutes without epinephrine and 20 minutes with epinephrine. The peak plasma concentrations reached at these times are 4.8 µg/ml without eprinephine and 3.7 µg/ml with eprinephine.

## PRECAUTIONS

Lignocaine is contraindicated in patients with heart block and conduction disorders, hypovolaemia and for patients with hepatic impairment.
Cimetidine and beta-blockers reduce lignocain metabolism with increased risk of toxicity.

Opioid analgesics used perioperatively may have additive respiratory and cardiac depressant effects.
The young and elderly have an increased risk for systemic toxicity and doses should be reduced accordingly.
Sedation may mask the warning clinical signs that are indicative of the development of toxicity.
Toxic effects have been reported with blood plasma levels of between 2 – 6 μg/ml.
In plastic and reconstructive surgery done under sedation, the combination of sedative drugs with maximum lignocaine doses has a high potential for toxicity.
Adequate patient monitoring, a high index of suspicion for toxicity and early treatment should be part of the sedation practitioner's management plan for local anaesthetic toxicity.
The adverse effects of lignocaine are dose related and often result from the inadvertent intravascular administration.
Central nervous system effects may include dizziness, lightheadedness, restlessness, agitation and euphoria. With increasing toxicity there may be drowsiness, respiratory depression and convulsions.
The cardiovascular signs of toxicity range from a prolonged PR interval on the ECG to complete heart block and asystole.
The cardiovascular signs of toxicity may include bradycardia, hypotension and cardiac arrythmias.
Occasionally lignocaine can cause the patient to present with nausea, chills and transient tinnitus.

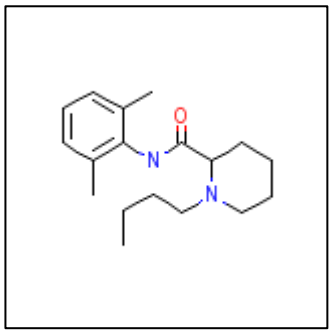
## DOSE AND DIRECTIONS FOR USE

Generally a total dose of 4.5 mg/kg (maximum dose of 300mg in an adult) on any one occasion should not be exceeded.
If combined with a vasoconstrictor, the maximum dose is 6.5mg/kg (not more than 500mg).

[MARTINDALE: The Complete drug reference- 34th edition; http://redpoll.pharmacy.ualberta.ca/drugbank/cat-browse.htm; MANUFACTURERS PACKAGE INSERT]

## 6. BUPIVACAINE

CHEMICAL STRUCTURE




PHARMACOLOGICAL ACTION

Bupivacaine is a long acting local anaesthetic of the amide type. Bupivacaine blocks the generation and the conduction of nerve impulses, presumably by increasing the threshold for electrical excitation in the nerve, by slowing the propagation of the nerve impulse, and by reducing the rate of rise of the action potential. The 0.5% solution is chiefly indicated for peripheral nerve blocks.

PHARMACOKINETIC PROPERTIES

The onset of action of bupivacaine is slow, taking up to 25-30 minutes for optimal effect. When bupivacaine is used with epinephrine, the time to optimal effect can take up to 60 minutes.
The duration of action is usually 8 hours, but for some peripheral nerve blocks it ranges from 2-24 hours depending on the dose and site of injection.
Bupivacaine is 82-96% bound to plasma proteins, and has a half-life of 1.5 to 5.5 hours.
It is metabolised extensively in the liver.

DOSAGE AND DIRECTIONS FOR USE

Dosages vary and depend on the area to be anaesthetised, the vascularity of the tissues, the number of neuronal segments to be blocked, the individual tolerance and the technique of anaesthesia. The duration of anaesthesia is such that for most indications only one dose is sufficient.
The maximum recommended dose for bupivacaine is 150 mg and 2 mg/kg body mass should not be exceeded.

PRECAUTIONS

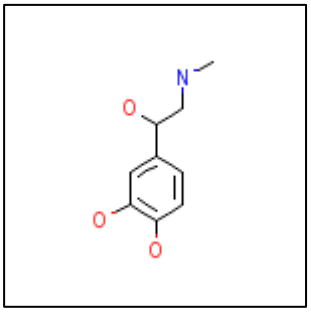
At blood concentrations achieved with therapeutic doses, changes in cardiac conduction, exitability, refractoriness, contractility, and peripheral vascular resistance is minimal. However, toxic blood concentrations depress cardiac conduction and exitability, which may lead to atrioventricular block, ventricular arrhythmias and cardiac arrest. In addition, myocardial contractility is depressed and peripheral vasodilatation occurs, leading to decreased cardiac output and arterial blood pressure. Following systemic absorption, bupivacaine can produce central nervous system stimulation and or depression. Bupivacaine is contraindicated for intravenous regional anaesthesia.



[MARTINDALE: The Complete drug reference- 34th edition; http://redpoll.pharmacy.ualberta.ca/drugbank/cat-browse.htm; MANUFACTURERS PACKAGE INSERT]

## 7. EPINEPHRINE

CHEMICAL STRUCTURE



Towards the end of the nineteenth century, Braun recommended the admixture of a suprarenal extract, “suprarenin” (eprinephine) to cocaine mixtures to reduce the high toxicity of cocaine by retarding its systemic absorption.

## PHARMACOLOGICAL ACTION

When local anaesthetics with vasodilatory tendencies like lignocaine and bupivacaine, are injected in anatomical regions which have a rich blood supply, the rapid absorption by the circulatory system from the area of injection could lead to the development of toxic blood levels. The rapid absorption also prevents a sufficient concentration of anaesthetic from reaching the targeted nerve. Epinephrine was then added to local anaesthetic solutions to reduce toxicity.
Epinephrine has the following beneficial effects:

It prevents the rapid development of toxic local anaesthetic levels.
It ensures sufficient quality and duration of nerve anaesthesia.
It restricts bleeding in order to obtain a clear operative field.



## PHARMACOKINETIC PROPERTIES

As a vasoconstrictor in local anaesthetic solutions, epinephrine is used in concentrations that range from 1: 30 000 to 1: 200 000.
In this form, epinephrine elicits the same systemic effects as the physiologically released hormone, and the receptor sensitivity is approximately the same for alpha and beta-receptors.

With epinephrine administration there is an increase in heart rate and force of contraction, with a resultant increase in cardiac output and myocardial oxygen demand. At low doses, the predominantly alpha-receptors in vessels, mucous membranes, skin and kidneys will cause constriction, while vessels in the muscle will dilate, resulting in a rise in systolic blood pressure with no change or a decrease in diastolic pressures.
The plasma concentration threshold for epinephrine, when haemodynamic effects such as increased heart rate, contractility and

systolic blood pressure changes are expected is 0.2 μg/ml, translating into a maximum adult safe dose of 0.5mg.
The systemic effect of epinephrine as a vasoconstrictor lasts for approximately 5-10 minutes.
The inactivation of epinephrine is dependent on an extraneuronal enzyme, catechol-O-methyltransferase, and the end products of this process are excreted in the urine.

PRECAUTIONS

The overdose of vasoconstrictors will usually occur in combination with an overdose of local anaesthetic and the presence of adrenaline can oppose the depressant effect of the local anaesthetic, but given the short duration of action of adrenaline the opposing interaction can be only temporary.
Adrenaline may produce a wide range of adverse effects, most of which mimic the results of excessive stimulation of the sympathetic nervous system.
The central effects of adrenaline include fear, anxiety, restlessness, tremor, and irritability and psychotic states.
Stimulation of the alpha-receptors produce vasoconstriction, which could result in hypertension which, can cause cerebral haemorrhage and pulmonary oedema.
There may also be a reflex bradycardia, but stimulation of the beta-1 receptors of the heart may produce tachycardia, angina, palpitations and cardiac arrest.
Extravasation of parentally-administered adrenaline may result in tissue necrosis and sloughing.
Other effects that may occur with adrenaline include urine retention postoperatively, disturbance in glucose metabolism, sweating, hypersalivation and headaches.

[MARTINDALE: The Complete drug reference- 34th edition; http://redpoll.pharmacy.ualberta.ca/drugbank/cat-browse.htm; MANUFACTURERS PACKAGE INSERT]

## 8.HYALASE

Hyalase is a purified and standard preparation of the enzyme hyaluronidase in the form of a sterile, freeze dried powder. Each ampoule contains 1500 international units of hyaluronidase.

### PHARMACOLOGICAL ACTION

Hyaluronidase has a temporary and reversible depolymerising action on the polysaccharide hyaluronic acid, which is present in the intracellular matrix of connective tissue. This intercellular "cement" is hereby made more permeable, permitting the rapid dispersal and absorption of injected substances, the reduction of tissue tension, and the dispersal of extravascular fluid in joint and tissue damage.

### INDICATIONS AND DOSAGE

As an aid to the efficacy of local anaesthesia, hyalase is given with:

Lignocaine
Epinephrine



Hyalase permits rapid dispersal and absorption of these two drugs in the injected area, enhancing the local anaesthetic effect of lignocaine and the vasoconstrictor effect of epinephrine.

The solution is prepared as follows:
Hyalase - 1500 international units.
Eprinephrine hydrochloride – 0.5 ml of a 1:1000 dilution.
Lignocaine 20 ml of a 2% solution.

### CONTRA INDICATIONS

Not to be used to reduce swelling of bites or stings or at sites where infection or malignancy is present.
Not to be used for intravenous injection.

### SIDE EFFECTS AND SPECIAL PRECAUTIONS

For all practical purposes hyalase is a non-toxic preparation.

The administration of salicylates inhibits the spreading action of hyalase.

[MARTINDALE: The Complete drug reference- 34th edition; http://redpoll.pharmacy.ualberta.ca/drugbank/cat-browse.htm; MANUFACTURERS PACKAGE INSERT]

# B.RATIONALE FOR COMBINING DRUGS FOR SEDATION AND ANALGESIA

An ideal sedation regimen for anaesthesia and analgesia for plastic and reconstructive procedures should follow the following principals:

Ensure patient safety and comfort during the procedure.
Reduce or eliminate patient apprehension/fear.
Be prompt in onset.
Reduce or eliminate the pain associated with the injection of local anaesthetics.
Ensure patient immobility during the procedure.
Reduce or eliminate patient recall of the operation.
Permit rapid return to discharge readiness.
Minimal side effects.



As no single agent is able to meet all of the above objectives, one would look at a combination of drugs to achieve adequate anaesthesia and analgesia.
To reduce patient apprehension a benzodiazepine would be a good choice. It can be given as a premedication and has anxiolytic, hypnotic and amnestic properties.

The injection or infusion of large volumes of local anaesthesia during plastic and reconstructive procedures is often painful. To enable the patient to be oblivious to these injections, would require drugs with a short onset of action with potent analgesic properties. Ketamine with its analgesic and sedative properties would fit the profile. Alfentanil, an opioid, could be used to compliment the action of ketamine.

Propofol as a sedative and hypnotic agent has unique induction and recovery characteristics.

The rationale for the use of an opioid such as alfentanil, is to provide further sedation and analgesia to further enhance patient comfort during the procedure.

Among the intravenous sedative/analgesic agents, the following combinations have been studied in humans and their interactions evaluated:

Propofol, midazolam and alfentanil – Short et al. [40] showed that the drugs work synergistically in combination.
Propofol and alfentanil – Vinnik [44] postulated that alfentanil does not potentiate the hypnotic effect of propofol.
Midazolam and alfentanil – Kissin [24] showed that alfentanil potentiates midazolam induced unconsciousness in subanalgesic doses

In this research project the intention was to combine sedative/analgesic drugs in combination with local anaesthesia, to try to meet the requirements of an ideal sedation regimen.

# C. LITERATURE REVIEW

A literature review was done to answer the following questions:

Is there any evidence to support the use of a combination of drugs?
What other synergistic properties are described in the literature?
What are the most commonly used dosing regimes?
What would be the ideal drug combination in plastic and reconstructive surgery?



THE CO-ADMINISTRATION OF PROPOFOL AND ALFENTANIL

To evaluate the safety and efficacy of the drugs used in this research project, the following literature review was done for relevant evidence to support the co-administration of propofol, alfentanil and ketamine.

The findings in two publications were used to support the concurrent use of propofol and alfentanil in the sedation technique.

Short et al [40] evaluated the hypnotic and anaesthetic interactions between midazolam, propofol and alfentanil. They studied the interactions between the three drugs using the two endpoints of light sedation and general anaesthesia.

They studied 400 female patients undergoing elective gynaecological surgery.
They showed a significant interaction between the drugs for light sedation
The decrease in the expected $ED_{50}$ (50% of the effective dose) for the various combinations were:

Midazolam - propofol = 37%
Midazoslam - alfentanil = 46%
Propofol - alfentanil = 20%
Midazolam - propofol - alfentanil = 42%

They showed that while all the responses to the two drug combinations were synergistic, the three-drug combination led to a response that was less than expected.
For general anaesthesia, the authors could not demonstrate dose-related effects for midazolam or alfentanil when they were used alone.
The decrease in the $ED_{50}$ (50% of the effective dose) of the propofol in the presence of the other drugs was:

Midazolam-propofol=52%
Propofol – alfentanil = 73%
Propofol-midazolam-alfentanil = 82%



The authors conclude that the degree of synergism observed with the combinations vary markedly between the two sedative end-points, and could not be predicted for the drugs alone.

Avramov [3] published a study on the combination of alfentanil and propofol for outpatient anaesthesia to determine the optimal dosing regimen. In this publication the authors conducted a double blind, randomised study to evaluate the effect of different propofol infusion rates on alfentanil requirements, level of sedation, intraoperative recall, respiratory and cardiovascular variables and recovery.

For the study, seventy-two ASA physical status I and II female outpatients, undergoing breast biopsies under local anaesthesia, were randomly assigned to one of four treatment groups.

All the patients received midazolam 2mg intravenously as premedication. Propofol was infused at 0, 25, 50, and 75 μg / kg / min during the operation.

Two minutes before the infiltration of local anaesthesia, a bolus of 2.5 μg /kg of alfentanil was given as an intravenous bolus followed by a maintenance infusion of 0.5 μg / kg / min.
Sedation was evaluated using the Observer's Assessment of Alertness/Sedation (OAA/S)[1] scale at 5-minute intervals by a blinded observer. Pictures were shown to the patients at the start of the propofol infusion, upon initiating the alfentanil infusion and, 45 minutes after the skin incision to evaluate recall of intraoperative events.

The relevant findings of the sedation study, as reported by them showed the following:

> The infusion of propofol produced a dose-dependant increase in the sedation score compared with the control group (alfentanil only).
> The propofol effect was evident within 5 minutes in the 50 and 75 μg /kg/ min groups, and peak effects were achieved after 15 – 20 min.
> The level of sedation decreased after 45 minutes in the 0 to 25 μg / kg / min group, presumably as a result of declining midazolam levels.
> Propofol produced an opioid sparing effect and decreased the alfentanil dose requirements by 30 – 50%. This opioid sparing effect further reduced opioid induced postoperative nausea and vomiting.
> After discontinuation of the drug infusions, recovery was equally rapid in all four groups, and sedation scores returned to baseline values within 15 minutes after discontinuation of the infusions.
> Discharge times were similar in all the groups.
> The dose-dependant increase in sedation produced by propofol was followed by an increase in the incidence of bradypnoea (transient decrease in respiratory rate < 8 breaths per minute) and oxygen saturation of < 90 in the larger dose propofol groups.
> In the control (alfentanil only) group, the visual analogue scale for the incidence of nausea was significantly increased at discharge, compared with the preoperative values. There was no intraoperative nausea, but 33% of patients in the control group had an emetic episode after the surgery.

---

[1]Chernik DA, Gillings D, Laine H, Hendler J, Silver JM, Davidson AB, Schwam EM, Siegel JL Validity and reliability of the Observer's Assessment of Alertness/Sedation Scale: Study with intravenous midazolam. Journal of Clinical Psychopharmacol. 1990 Aug; 10(4) : 244-251

None of the patients receiving 50 – 75 μg / kg / min of propofol had any nausea symptoms, suggesting that subhypnotic doses of propofol possess anti-emetic activity.

At discharge the patients in the propofol group reported an increased visual analogue scale for pain and lower anxiety scores.
The use of a continuous infusion of propofol, at 25 – 75 μg / kg / min for patients premedicated with 2mg of intravenous midazolam, produced increasing levels of sedation and amnesia during breast biopsy performed under local anaesthesia. The addition of low dose alfentanil infusion enhanced patient comfort with a low incidence of side effects.
Compared with the alfentanil alone, the combined use of alfentanil with propofol significantly reduced the opioid dose requirements, and the incidence of postoperative nausea and vomiting.
The triple drug regimen of midazolam, propofol, and alfentanil provides effective intraoperative amnesia during monitored anaesthesia care.
In this study the authors comment on the evaluation of the respiratory effects of the treatment regimens based on the continuous measurement of end-expiratory carbon dioxide concentration. They felt that although this clinical method was frequently used to monitor the respiratory rate during monitored anaesthesia care, the technique underestimates the true end- tidal carbon dioxide concentration and its impact on central ventilatory drive. They comment that the use of pulse oximetry should facilitate the detection of any clinically significant respiratory depression produced by this sedative-opioid combination.
They concluded that the sedation technique provided excellent intraoperative sedation, analgesia, and amnesia with a low incidence of perioperative side effects during ambulatory surgery performed under local anaesthesia.

The second publication by Pavlin et al. [34] evaluated the effects of combining propofol and alfentanil on ventilation, analgesia, sedation and emesis in healthy human volunteers.

In this elegant study the authors investigated the pharmacokinetic and pharmacodynamic interactions between propofol and alfentanil at sedative concentrations
Specific attention was paid to:

Ventilatory effects when combining the drugs.
How propofol influences opioid induced analgesia, and various opioid induced side effects.
How alfentanil influences the sedative properties of propofol.

The study was designed to enrol ten healthy male volunteers and subject each of them to steady state infusions on three separate days.

On day one they would receive propofol alone.
On day two they would receive alfentanil alone.
On day three they would receive a combination of the two drugs. The target plasma concentrations for propofol were 150, 300, and 600 ng / ml for one hour at each concentration.
The target plasma concentration for alfentanil was 40 ng/ml for 3 hours.



Assessments included serial measurements of:

Ventilatory function - minute volume, carbon dioxide production, end-tidal carbon dioxide,ventilatory response to rebreathing 7% carbon dioxide ;
Analgesia - subjective pain report in response to graded finger shocks and evoked potential amplitude.
Sedation - subjective rating, observer scores
Nausea - visual analogue scale, on a scale of 0 - 100.

The study showed:

When propofol and alfentanil were administered together, the propofol concentrations were consistently higher than when propofol was used alone, and exceeded the target by 19 – 29 %. This finding of “alfentanil induced elevation of plasma propofol levels” could be related to altered propofol distribution, and / or metabolic clearance.
A tendency to a greater alfentanil concentration during the combined propofol / alfentanil group versus the alfentanil group, that was

significant at the higher concentrations of propofol. There are several reasons to suspect that propofol interferes with the kinetics of alfentanil. Propofol has been reported to inhibit the oxidative metabolism of alfentanil by the microsomal cytochrome P450 enzyme in vitro.

A decreased uptake of alfentanil in the lungs due to competative binding might also promote elevated plasma concentrations of alfentanil.

The sedation produced by the two drugs in combination was greater than that observed by either drug alone. The authors felt that the enhancement of propofol – induced sedation by alfentanil was related to the elevated plasma concentrations of propofol.

That propofol, when administered on its own as a continuous infusion to attain moderate levels of sedation, permits adequate spontaneous ventilation. Even at the highest plasma levels of propofol (600 – 800 ng / ml), end-tidal carbon dioxide was not significantly elevated during the infusion with propofol alone, and there was only mild depression of the ventilatory response to the inhalation of 7% carbon dioxide (22 % reduction ). There was also no evidence of desaturation (< 95% saturation) with pulse oximetry.

With serial blood measurements (baseline before drug infusion, and at 5, 15, 30, 45, and 55 minutes, and at 1, 3, 5, 7, 10, 20, 30, 60, 90, 120, 150, and 180 minutes during the drug washout) that the average rate of infusion to maintain a constant plasma level propofol at 633 ng / ml was approximately 43 μg / kg / minute.



When alfentanil was infused alone, it caused significant depression of the carbon dioxide response curve, and modest carbon dioxide retention, due to a decline in the minute ventilation.

Although the addition of propofol to alfentanil caused greater depression of the carbon dioxide response curve and a greater decline in minute ventilation than was seen with alfentanil alone, the depression of minute ventilation was offset by a similar decline in the rate of elimination of carbon dioxide which prevented any further rise in the end tidal carbon dioxide levels.

The study of the adequacy of ventilation was done with the patients in a semi-recumbent position with a mouthpiece airway in place, which prevented airway obstruction.

That propofol caused a significant enhancement of analgesia when combined with alfentanil, compared to analgesia when alfentanil was used alone. Alfentanil, at a steady state plasma concentration of 40 ng / ml, caused mild analgesia (28 % in subjective pain report).

In the current study, propofol alone also caused mild analgesia at the highest plasma concentration studied (633 ng / ml) - this was equivalent to the analgesia reported by the 40 ng / ml of alfentanil plasma concebtrations alone.
When the two drugs were combined, a 50% reduction in pain report was recorded. The authors speculated that the enhancement of analgesia by combining the two drugs could be a result of a specific pharmacological action on nociceptive neurotransmission, or a non-specific side effect of sedation but could not explain the phenomena.
The ability of propofol to offset the emetic symptoms that accompanied alfentanil infusions in 50% of the subjects confirms other findings that propofol temporarily relieves the symptoms of postoperative nausea and vomiting at sub-sedative doses. The site of action of propofol remains unknown but one hypothesis postulates blockade of dopaminergic receptors in the brain.
Propofol failed to prevent or diminish pruritis, a known side effect of opioids that occurs in the majority of cases receiving alfentanil.

The authors conclude that the combination of propofol and alfentanil has multiple advantages over either drug alone, with the one exception that ventilation is impaired by the presence of an opioid.



## THE CO-ADMINISTRATION OF PROPOFOL AND KETAMINE

The findings of the following articles were used to support the co-administration of propofol and ketamine in this research project.

In the first article “The Propofol – Ketamine Technique” by Friedberg [16], the author presents case reports which demonstrate a new, safe, and simple intravenous technique for outpatient sedation.
The hypothesis that is tested in this article is whether sub-hypnotic doses of propofol would prevent ketamine hallucinations. Once the initial hypothesis was confirmed, consideration was given to reducing the cost of propofol by determining the effect of midazolam premedication on propofol requirements.

In this study 50 ASA I and II adults were evaluated. All the patients were told of the history and hallucinogenic effect of ketamine before giving consent.

The group of 50 was divided into 3 smaller groups:

Group 1. Those receiving no premedication.
Group 2. Those receiving 5 mg of midazolam.
Group 3. Those receiving 10mg (or more ) of midazolam.

Once an intravenous line was established, those receiving premedication were given 1-2mg via an intravenous line. A loss of lid reflex was then induced by continuous propofol infusion. Once the patient was asleep 50 mg/ml of ketamine was administered. Two minutes were allowed to lapse prior to giving the local anaesthetic. The patients were kept at a hypnotic level with propofol for at least 20 minutes.

The results of this clinical series were as follows:

The majority of the patients had plastic surgery.
The average anaesthesia time was 122 minutes.
Fourteen patients had no premedication (Group 1).
Nineteen patients were lightly premedicated (Group 2 ).
Seventeen patients were heavily premedicated (Group 3 ).
Group 1 required 134 μg / kg / min of propofol to sustain hypnosis.
Group 2 patients required 95 μg / kg / min of propofol to sustain hypnosis.
Group 3 patients required 84 μg / kg / min of propofol to sustain hypnosis.
Eight complications occurred in the group of 50 patients.
Two patients had dysphoria post operatively.
Four patients experienced nystagmus.
Two patients experienced prolonged somnolence.
No hallucinations were experienced. A few pleasant colourful dreams were reported.
Oxygen saturation levels remained above 90% in all patients.
Satisfactory operating conditions were obtained in all 50 cases.

On questioning the patients after emergence it appeared that both the premedicated and the unpremedicated group had no hallucinations.
Both premedicated groups required less propofol. More impressive was the decrease in the range of propofol requirements between the first two groups and the third group.This indicates that heavily premedicated patients were both easier to induce and maintain at a steady level of propofol hypnosis.

From this series the author concludes that the technique is safe, simple and well tolerated. It greatly simplifies the anaesthetic equipment needed for outpatient surgery. He concludes that propofol alone does block ketamine – induced hallucinations and that it is possible to reduce the propofol requirements by the addition of midazolam premedication.

Friedberg [17] published an article on the effect of a dissociative dose of ketamine on the bispectral index during propofol hypnosis. The objectives of this descriptive study were:

> To compare the effects of a standardised stimulus during propofol-only hypnosis on the bispectral index (BIS) with ketamine - propofol hypnosis.
> To determine whether ketamine increases the level of propofol hypnosis when used in dissociative doses.

The method followed in this study was to induce hypnosis in 30 ASA I and II patients using a propofol infusion at 4mg/kg/hr.
Hypnosis was measured using the BIS monitor as an adjunct to traditional vital signs and verbal contact. Patients were engaged in verbal contact and BIS readings were taken when verbal contact was lost.
A standard stimulus of 0.3 ml of 1% lidocaine was injected into the area of the supraorbital nerve. The highest BIS value was noted. When the BIS had returned to baseline hypnosis level, a 50mg dissociative dose of ketamine was administered intravenously. Thereafter the local anaesthetic for the proposed surgery was injected. The BIS value in response to the surgeon's injection was noted.

The results showed that:

> There was a consistent rise in the BIS values when the local anaesthetic was injected into the supraorbital nerve under propofol-only hypnosis.
> After the BIS was allowed to return to baseline values the intravenous injection of 50 mg of ketamine had no effect on the baseline BIS value.
> No change in BIS value was detected while the surgeon was injecting the local anaesthetic after administration of ketamine.

In another article by Friedberg [18] titled the propofol – ketamine techinique: dissociative anaesthesia for office surgery (A 5 year review of 1264 cases), he discusses the merits of the propofol-ketamine technique he used on 1264 patients over a five year period.

The technique that was used in all cases was as follows:

After an intravenous line was established, 0.2 mg of glycopyrrolate was given.
Midazolam as a 2mg bolus was then administered for sedation.
The propofol infusion was started and titrated until non-responsiveness was achieved.
Once hypnosis was achieved a bolus dose of 50 mg of ketamine was administered intravenously.
The local anaesthetic was administrated 2 minutes after ketamine. If the patient made purposeful movements (wincing or reaching of the hand to the injected area) in response to the injection of the local anaesthetic the injection was stopped. A second dose of ketamine ( 25 – 50 mg ) was then administered.
Patients were maintained on the propofol infusion until the end of the procedure.
No opioids, $H_2$ receptor antagonists, anihistamines, or anti-emetics were administered.
When the procedure was likely to produce post-operative pain, analgesia (meperidine in 20 mg increments) was administered in the last hour of surgery.
All patients were questioned postoperatively about hallucinations.



The results from the study showed that for the female patients:

The average age was 43 years and the average weight 60 kg.
The average dose of midazolam was 2.9 mg.
An average of 1437 mg of propofol and an average of 96 mg of ketamine was used in an average operative time of 151 minutes.

In male patients the study showed that:

The average age was 46 years with an average weight of 84 kg
The midazolam requirements for this group averaged out at 3.2 mg.
The average propofol use was 1523 mg, and their average ketamine use was 115 mg.
No hallucinations were reported.
Less than 1 % of patients reported colourful pleasant dreams.
Sixty percent of the patients received no prophylactic or rescue analgesia.
Seven patients experienced nausea, and five had a single episode of vomiting postoperatively.
Two episodes of vomiting occurred intraoperatively without aspiration.
Three of the patients that vomited had received meperidine.
One case of vomiting occurred in recovery after the patient had experienced 2 hours of nystagmus, after receiving an unusually large dose of ketamine (650 mg).
No patient required airway support or supplemental oxygen in recovery.
The majority of patients regained consciousness in 10 – 15 minutes after discontinuation of the propofol infusion.
The majority of patients were discharged alert in the first postoperative hour.
The total anaesthetic drug cost per case was $ 103.52.



In a study by Badrinath et al [6] the authors evaluate the impact of ketamine as an adjunct to propofol sedation on analgesia, sedation, and recovery after ambulatory surgery.

One hundred female patients undergoing breast biopsies under local anaesthesia participated in a randomised, double – blinded, placebo controlled study.
After premedication with 2mg of midazolam intravenously, patients received an infusion of a solution containing propofol (9.4 mg / ml) in combination with either:

Group 1- placebo (saline).
Group 2 - ketamine 0.94 mg / ml.
Group 3 - ketamine 1.88 mg / ml .
Group 4 - ketamine 2.83 mg / ml.

During surgical procedures performed under local anaesthesia and sedation, supplemental analgesics are commonly administered to enhance analgesia and improve patient comfort. Opioids however when administered with a sedative-hypnotic, may produce significant respiratory depression, and increase the incidence of postoperative nausea and vomiting. The authors of this article used ketamine, whose analgesic effect is present at plasma concentrations significantly lower than those producing hypnosis (0.2 μg / ml vs. to 2.5 μg / ml respectively).

The methods used for the trial was as follows:

> One hundred ASA I and II female patients undergoing breast biopsies under local anaesthesia were randomised to the different groups.
> A propofol – ketamine mixture was prepared by an assistant not involved in the study.
> A standard volume of 1.2 ml containing 0, 20, 40, or 60 mg of ketamine in saline was added to 20 ml of propofol. Thus the study drug consisted of propofol 9.4 mg/ml and ketamine 0, 0.94, 1.88, or 2.83 mg / ml respectively.
> The level of sedation of OAA/ S 4, was achieved in all patients before infiltrating the operative field with the local anaesthetic 0.5% ligocaine.
> The patient's response to local anaesthetic infiltration was closely observed.
> Patients responding to pain were treated with a rescue bolus of 2.5 μg sufentanil.
> The recovery room nurses, who were blinded to the study medication, were asked to assess side effects.
> Before discharge the patients were asked to complete a visual analogue scale about their recall of intraoperative events, dreams and unusual psychological experiences.
> In a telephone interview on the first postoperative day the patients were asked to rate their overall experience and whether they would have chosen the same technique again.

The results of the study show that ketamine produced a dose dependant reduction in the incidence of patient's responsiveness to the local anaesthetic.

Forty-four percent of patients in group 1 needed rescue sufentanil, an opioid.
Eight percent in group 2 and none in Group 3 and 4 needed sufentanil.
There were no incidents of apnoea or oxygen desaturation.
Chin lift, to relieve airway obstruction, was required in 52% of the group 1 patients versus only 20% of patients in group 4.
The anaesthetic technique was highly satisfactory for the surgeons in 90% of the cases. The most common reason for dissatisfaction was patient movement during local anaesthetic infiltration.
The patients in group 3 and 4 were found to be more sedated than those receiving placebo in the recovery phas**e.**
Psychotomimetic effects (dreams and hallucinations) and visual disturbances (diplobia, nystagmus) were experienced predominantly in group 4 patients.
Postoperative nausea and vomiting was related to higher doses of ketamine, with most emetic episodes occurring once the patient had been discharged from the surgical facility.
At the interview 24 hrs after discharge, patients did not report any delayed psychotomimetic-type reactions, and more than 90% of patients were satisfied with the anaesthesia, and were willing to receive the anaesthetic again.



The study thus showed the following pertinent observations about the co-administration of propofol and ketamine:

Subhypnotic doses of ketamine (9 - 18 μg /kg/min) administered in combination with propofol for sedation, contributed to significant analgesia without hemodynamic and respiratory depression or troublesome psychotomimetic side effects.
Larger doses of ketamine (24 μg /kg/min) were associated with a clinically increase in postoperative nausea and vomiting and troublesome psychotomimetic side effects.
Ketamine-induced tachycardia and hypertension were not evident in the hemodynamic responses of the patients treated with this combination.
The hemodynamic stability of this mixture makes it suitable for use in outpatient anaesthesia.
Even though deeper levels of sedation were maintained in this study there were no incidents of oxygen desaturation, however, support of the airway was required in 20% to 56% of all patients.

Mortero el al. [32] evaluated the effects of a small dose of ketamine on propofol sedation and how it affects:

Respiration.
Postoperative mood.
Perception.
Cognition.
Pain.

The authors tested the hypothesis that the combination of propofol and ketamine produces superior analgesia than propofol alone, and that the combination is associated with improved spontaneous ventilation and faster recovery of postoperative cognitive function.

The study design was as follows:

Forty outpatients scheduled for elective surgery were recruited to participate in a randomised, double blinded study.
The patients were assigned to two groups:



Group A - The propofol group received a 10 mg / ml solution of propofol at 4mg/kg/hr.
Group B - The combined group received a combination of propofol 9.8 mg / ml and small doses of ketamine mixed to 0.98 mg / ml.

Midazolam 1-3 mg was given as premedication intravenously.
Fentanyl 50 μg was given intravenously on arrival in the operating room.
The infusion rate was set at 4 mg/kg/hr.
The infusion rate was adjusted to attain the Observer's Assessment of Alertness / Sedation score of 4.
Fentanyl was given in 50 μg increments for pain during surgery.
Ventilation was assessed by recording respiratory rate, end-expiratory carbon dioxide and oxygen saturated levels.
Pain intensity was assessed with a visual analogue scale.
Sedation was assessed using the five point Observer's Assessment of Alertness / Sedation Scale[1].
Drowsiness was assessed using a visual analogue scale.

Perceptual changes were assessed in eight categories (body, surroundings, time, reality, colours, sounds, voices and meaning) by using a visual analogue scale.
Mood states (anxious / composed / unsure / confident / tired / energetic / confused / clearheaded) were assessed using a visual analogue scale.
All assessments were done prior to premedication.
Assessment of drowsiness, OAA/S score, blood pressure, heart rate, end- tidal carbon dioxide and oxygen saturation levels and respiratory rate was repeated every 15 minutes during surgery.
The assessment of the visual analogue scores, vital signs, and OAA/S was repeated on arrival in the recovery room.
Patients were discharged when they could walk without dizziness, pain and nausea.

The results of the trial showed that:

The end-tidal carbon dioxide values were lower in the propofol ketamine group, showing less effect on ventilation.
Respiratory rate was higher in the combination group.
There were no differences in blood pressure, heart rate, oxygen saturation, OAA/S scores and number of adverse events between the two groups.
There were no statistical differences in the time spent in recovery prior to discharge.
The visual analogue pain scores were higher in the propofol only group.
The postoperative mood scores were higher in the combination group.
Mild perceptual changes were noted in surroundings, time, colours and sounds in the propofol group.
The amount of opioid used after discharge was lower in the combination group.

Frizelle et al. [19] published a study where they compared propofol with propofol – ketamine for sedation during spinal anaesthesia. Frizzelle was especially interested in the impact that ketamine has on the hemodynamic stability during spinal anaesthesia.

In this study, 40 ASA I and II patients, aged 18 – 80 years, undergoing spinal anaesthesia for urological and orthopaedic procedures, were studied.

The patients were randomly allocated to two groups:

Group 1. - Twenty patients received a combination of propofol and ketamine given intravenously. A loading dose of 0.4 mg / kg of propofol and 0.1 mg / kg of ketamine given intavenously prior to spinal anaesthesia was followed by a continuous infusion rate of 1.2 mg / kg /hr and 0.3 mg / kg / hr, respectively.

Group 2. – Twenty patients received a bolus of 0.5 mg / kg of propofol alone intravenously, followed by an infusion rate of 1.5 mg / kg / hr.

The level of sedation was recorded every 5 minutes. Subsequent infusion rates were titrated to a predetermined level (Level 3 – eyes closed, but rousable to commands) on a 5 point sedation score.
The anaesthesiologist assessing the level of sedation was blinded to the sedative infusion.
Hemodynamic and respiratory indices were recorded at specific intervals.
Oxygen was administered a to those patients whose oxygen saturation values dropped below 95%.
Epinephrine was administered in 3 mg increments if there was a reduction in mean arterial pressure of 25 % from baseline, or < 60 mmHg.
Sedation was stopped if the respiratory rate was less than 8 breaths per minute.
The sedation was stopped at the end of the surgical procedure, and total sedative requirements were noted.
Observations (heart rate, blood pressure, oxygen saturation levels) were evaluated in the recovery room at 15 minute intervals.
All patients were closely observed for hallucinations or other emergence phenomena.
The postoperative pain experience was assessed with a visual analogue scale.



The results of the study show that:

The total dose of propofol administered was similar in each group.
Mean arterial pressures were significantly lower in the propofol only group.
The requirements for supplemental epinephrine were similar in both groups.
There were no statistical differences between the groups regarding respiratory rate, end- tidal carbon dioxide levels, oxygen saturation levels, or need for supplemental oxygen.
The incidence of postoperative complications was similar in both groups.
Four patients in each group experienced a hypotensive episode in the recovery room.
Nausea was a greater problem in those patients receiving the propofol-ketamine combination.
No patients suffered from hallucinations.
The postoperative pain experience was similar in both groups.

Frey et al. [15] published an article on the comparison between propofol versus propofol – ketamine sedation for retrobulbar nerve block.
In this study the authors investigated whether ketamine compliments propofol sedation. They looked at the quality of sedation, cardiopulmonary stability, recovery characteristics and changes in intraocular pressure in patients who received propofol alone, compared to those receiving a combination of propofol and ketamine.

The study design was as follows:

A retrospective, randomised, double blinded pilot study in a surgical population of ASA I to III patients, undergoing cataract extraction and intraocular lens implantation on an ambulatory basis.
No premedication was given.
The propofol group (Group P) received a combination of 0.6 ml of normal saline and 10 ml of propofol ( 10 mg / ml ).
The drugs for patients in the propofol-ketamine group (Group PK) were 30 mg of ketamine (0.6 ml of a 50 mg / ml solution) mixed with 10 ml (100 mg) of propofol.
Before the study drug was administered, baseline vital signs were monitored, and intraocular pressure measured with a tonometer.

The assigned drug was administered in a dose of 0.03 ml / kg as a bolus. Additional study drug was administered in 0.5 ml increments 20 seconds apart, until the patients' eyes closed and they were unresponsive to verbal commands. This dose was called the hypnotic dose.
The intraocular pressure was again measured at this point.
The surgeon then started the local anaesthetic injection. If the patient showed grimacing or extremity movement, further needle insertion was withheld. More of the study drug was administered in 0.5 to 1 ml increments 15 seconds apart until little or no patient movement or grimacing occurred with advancement of the needle.
Efficacy of the block was evaluated when the patients were awake and responsive to verbal commands.

The sedation characteristics that were assessed were:

The hypnotic doses were recorded.
The quality of sedation at hypnotic level was recorded as:

Grade (a) - No movement or grimacing.
Grade (b) - Grimacing and minimal movement.
Grade (c) - Grimacing and movement requiring restraining.



The time to completion of the retrobulbar block.

Cardiopulmonary variables measured were:

Baseline mean arterial pressure.
Degree of respiratory depression and airway patency evaluated through monitoring oxygen saturation levels.

Recovery characteristics looked at were:

Recovery time.
Patient satisfaction with sedation.
Adverse events.

Results:

More patients in Group PK had a Grade (a) quality of sedation at the hypnotic dose, and fewer required supplementation of drugs for the retrobulbar block. This translated into a significantly faster onset of acceptable sedation in Group PK.
Both groups experienced similar reductions in intraocular pressure after administration of the hypnotic dose. No increase in intraocular pressure was observed in any of the patients.
Airway intervention (jaw thrust) was required more frequently in Group P than in Group PK .
None of the patients in Group PK required ventilatory assistance, but two patients in Group P required mask ventilation to overcome airway obstruction.
Four patients in Group PK had a brief episode of coughing immediately after the retrobulbar block.
All patients were discharged within 60 minutes of arrival in the recovery room.
Two patients in each group had vague recollections of the block, none reported pain or discomfort.
No postoperative complications were observed.
Patient satisfaction with the sedation was rated 10\10 by all patients.

Angelini et al.[2] reviewed sedatives and analgesic medications most commonly administered in medical and surgical intensive care units in the United States of America.

Their review on ketamine and propofol showed the following:

A. KETAMINE

Provides bronchodilatation and cardiovascular stimulation through activation of the sympathetic nervous system.
Is contra-indicated for patients with ischaemic heart disease.
Can cause hallucinations, delirium, excessive salivation, lacrimation, increased intracranial pressure, increased cerebral metabolism and petit mal seizures.
Concurrent administration of benzodiazepines attenuates the hallucinatory side effects.
Glycoppyrrolate limits excessive salivation.
Can be used in the intensive care unit to facilitate the performance of brief painful procedures, such as changing burn dressings.

Tolerance develops quickly, requiring progressively increased doses.

B. PROPOFOL

A sedative and hypnotic agent.
Rapid onset and offset.
At higher doses can cause general anaesthesia.
No analgesic properties.
Provides some antegrade amnesia but not as reliable an amnestic as benzodiazepines.
Is often supplemented with narcotics and benzodiazepines.
Prolonged use of more than 12hrs causes accumulation and slower recovery.
Discontinuation of propofol infusion leads to a decrease of 50% of the serum drug level within 10 minutes, after which the excretion rate becomes more variable, based on the duration of therapy and total dose given.
As predicted by the rapid decrease in serum drug levels, most patients were able to respond to verbal commands within 10 minutes.
Even after seven days of continuous infusion, patients could be weaned from mechanical ventilation within an hour of discontinuation, with full recovery of ability to follow commands and subsequent extubation.
Hypotention develops frequently with bolus administration of propofol but is usually transient or readily corrected or limited by careful drug titration, repletion of intravascular volume deficits, and judicious patient selection.
For patients with obstructive lung disease there is some suggestion that propofol may decrease airway reactivity.
Nausea is an uncommon side effect and some suggestion of an antiemetic effect.
Propofol decreases intra-ocular pressures.
No drug withdrawal or development of physical dependence reported.
Decreases cerebral metabolism, and a decline in cerebral blood flow that causes raised intracranial pressure.
At high doses propofol suppresses seizure activity.

# CHAPTER 3:

# THE OFFICE BASED SURGICAL FACILITY

INTRODUCTION

In 1977 a French movie actress asked plastic surgeon Dr.Yves–Gerard Illous in Paris to remove a large lipoma, without leaving the usual long scar. Dr. Illouz decided to try liposuction. Following the success of this patient, he soon used the procedure in many more cases. Initially, he used a "dry technique". A few years later he introduced his wet technique.

The area to be suctioned was injected with 100 to 300 ml of hypotonic saline containing hyalluronidase to soften the fat and to make it easier to aspirate. No epinephrine was used in this solution, so blood loss continued to be a major stumbling block. Aspirate analysis showed 70% fat and 30% blood. The procedures were performed under general anaesthesia, and the removal of more than 1500 ml of aspirate was not recommended because of too much blood loss.

In October 1982, Illouz presented his results of more than 3000 patients at the American Society of Plastic and Reconstructive Surgery Annual meeting in Hawaii. Plastic surgeons from around the world began performing suction lipectomies and in 1983, the epinephrine containing wet technique was used. A volume of ephedrine-containing wetting solution (usually 100 to 300 ml) was injected into the area to be aspirated. Subsequently blood loss was reduced significantly, and larger volumes of aspirate could be removed under general anaesthesia.

In 1987, Dr Jeffrey Klein, a dermatologist, developed and introduced the technique that would revolutionise liposuction – the tumescent, or "wet technique", where large volumes of wetting solution was injected subcutaneously. The solution contained highly-diluted lignocaine and epinephrine. The tumescent technique provided three main advantages:

1. It dramatically reduced blood loss.
2. It provided local anaesthesia.
3. It facilitated fluid resuscitation.

Aspirate blood content was reduced from 30% to less than 1% allowing for much greater volumes of aspirate to be suctioned safely. The local anaesthetic effect allowed the procedure to be performed without a general anaesthetic, and therefore could be done under sedation. Liposuction soon became the most commonly performed cosmetic procedure in North America.

Subsequently larger and larger volumes of aspirate were being removed routinely from patients. Procedures that were normally performed in hospitals (because of the requirement of an anaesthesiologist) were now being done in ambulatory surgeries, and even in doctor's offices. By 1997 nearly half of the 250 000 liposuction procedures in North America were being performed in office based facilities by doctors with little more training than a weekend seminar. As volumes of aspirate increased so did the occurrence of serious complications, such as:

Deep vein thrombosis.
Pulmonary embolus.
Fluid overload.
Pulmonary oedema.
Lignocaine toxicity.
Necrotising fasciitis.



Soon deaths occurred during liposuction with De Jongh [14] reporting 39 liposuction –related deaths from Internet searches. They analysed five other studies with death rates ranging from 2.6 /100 000 to 100 / 100 000 procedures.

In 1999 the largest study, a random survey by the American Society of Aesthetic Plastic Surgeons, showed 95 deaths in 496 000 procedures for an incidence of 20.6 / 1000 000.
Pulmonary embolism appeared to be the leading cause of liposuction related deaths, followed by viscus perforation.

Due to the unusually high morbidity and mortality rates a ninety-day moratorium was placed on office based surgery in Florida for offices using sedation, beyond conscious sedation. The American Society of Plastic Surgeons [46] then provided guidelines for optimum levels of safety for patients undergoing tumescent liposuction.

According to the guidelines liposuction was not to be considered as a treatment for general obesity, and was only to be a treatment option for healthy patients without significant underlying medical problems, and who are within 30% of their ideal body weight.

The guidelines addressed the standard of care and monitoring for all patients undergoing liposuction under intravenous sedation. This would involve careful assessment and recording of the patient's haemodynamic parameters:

Cardiac rate.
Blood pressure.
Respiration rate.
Oxygen saturation.
Body temperature.
Level of consciousness.

It was recommended that all injected fluids be warmed to body temperature. If deep sedation was to be used an anaesthesiologist was recommended to monitor the patient.

Certain guidelines [7] for fluid resuscitation were given for operations with low to medium volumes of aspirates (1000 to 4000 ml)
More extensive in-hospital guidelines were provided for large-volume aspirations (> 5000 ml). [37]

Particular attention was given to the lignocaine levels used with tumescent liposuction. Questions were raised about the potential role of lignocaine cardiotoxicity that can occur during lignocaine administration for liposuction.

Several questions arise from this historical review of liposuction:

What is an office based facility?
Which cosmetic and reconstructive procedures are commonly done in these surgical facilities?
What are the morbidity and mortality statistics for these facilities?
How and why do deaths occur during elective cosmetic or reconstructive procedures and could they have been prevented?
What where the most common complications and how can these procedural and sedation complications be anticipated?

## THE AMERICAN MODEL

To answer these questions, and to understand the evolution of the ambulatory surgical facility, a literature review was done on what transpired in the field of plastic and reconstructive surgery in the United States of America from the early 1980's.
When Dr. Jeffery Klein developed the "super wet" or tumescent technique that would dramatically reduce blood loss, while at the same time provide local anaesthesia during liposuction, the ambulatory surgical facility was borne.

A plastic surgeon could now perform a procedure in his office, which in the past could only have been done in a hospital theatre.
Liposuction could now safely be done in an office based facility.
Liposuction soon became the most commonly performed cosmetic procedure in the United States.
The illusion of technical simplicity led to a widespread perception that the procedure was atraumatic and risk free. As larger and larger volumes of aspirate were removed, more serious complications and deaths occurred which culminated in an article published by De Jongh [14] in which they showed that most deaths (47.7%) during liposuction occurred when the procedure was done in a physician's office.



At around this time the Americans did some introspection. They formed an association called The American Association for the Accreditation of Ambulatory Facilities (AAAASF) [46]. The aim of this organisation was to develop an accreditation program. This would improve the quality of medical and surgical care in ambulatory surgical facilities. Their mission was to develop a standard for patient care with the accreditation program. The AAAASF then provided a forum for discussing new concepts in ambulatory facilities. The idea was that the information gathered at accredited facilities would be shared with the medical community and the public.
Using the Internet the AAASF developed an Internet based quality improvement and peer review program in order to analyse the potential outcomes at these accredited facilities. Surgeons that were members of this association and operated in an accredited facility, had to report all unanticipated adverse events. An accepted peer review group then reviewed cases biannually. By certifying an ambulatory facility the AAAASF gave a

message to the medical community and the public that such a facility met recognised standards for patient safety and quality of care.

The facilities were inspected on registration and every three years thereafter, using an extensive checklist that required 100% compliance. Today more than 1000 facilities are accredited by the AAAASF in the USA and many more are in the process of registration.

In 1996 California became the first state to mandate accreditation for all facilities that administer sedation or general anaesthesia to patients in the office. As the standard was raised for these facilities in terms of requirements and patient care, so the safety record improved. In spring of 1999, recognising the importance of accreditation, the American Society of Aesthetic and Plastic Surgeons passed a mandate for all their members stipulating that members who perform outpatient operations under sedation or general anaesthesia do so in an accredited facility.

The design and management of these facilities required compliance with a nationally recognised standard in order to further safeguard patient safety.

The nationally recognised standard classified facilities into three different classes:



> In a class A facility all surgical procedures were to be done under local anaesthesia.
> In a class B facility intravenous, regional anaesthesia or dissociative drugs (excluding propopfol) was permitted without the use of endotrageal or laryngeal mask intubation, or inhalation gasses.
> In a class C facility intravenous propofol, spinal or epidural anaesthesia or the use of inhalation anaesthesia was permitted on condition that an anaesthesiologist or a Certified Registered Nurse Anesthetist administers it.

The standard clearly defined the general environment of such a facility. The operating room environment, facility procedures and policies which dealt with issues such as sterilisation, asepsis, maintenance and cleaning, necessary equipment, emergency power requirements, medical and hazardous waste disposal and general safety all required 100% compliance.

The Internet based reporting system for quality improvement and peer review enabled the American medical fraternity to continually evaluate quality of patient care, and to continually improve on surgical methods and anaesthetic techniques. The reporting also enabled them to identify and correct deficiencies within the facilities - all contributing to an improving model.

The peer review was performed every 6 months, and every facility had to present random cases and had to report unanticipated sequele. Every case report was evaluated for:

Thoroughness of pre-operative surgical and anaesthetic evaluation.
Type and efficacy of intravenous sedation or anaesthesia.
Type and efficacy of surgical procedure performed.

All unanticipated sequele like:

Unplanned hospital admissions.
Unscheduled return to the operating room for surgical complications.
Cardiac or respiratory problems during sedation or anaesthesia.
Allergies to medication.
Equipment malfunction that led to injury or death of a patient was documented and reviewed by a panel.



The Americans dealt with these unanticipated events by trying to resolve any problem that occurred. They identified and analysed the reason for the problem and suggested what the immediate treatment or outcome should have been. All this information was then statistically analysed and put onto the Internet so that other facilities could learn from the mistakes of their peers, thereby improving safety and quality of care of patients treated in their own facilities.

What emerged from this program was a wealth of information about safety and efficacy, and established a platform for expanding knowledge about surgical and anaesthetic outcomes in ambulatory surgical facilities. In addition to morbidity and mortality statistics, the American model also allowed them to focus on the patient's postoperative functional status as a means of assessing overall quality of patient care.

The American model showed that there was power in data, as the information gathered showed that the ambulatory facility had clear-cut advantages and disadvantages.

The first advantage that emerged from data was that the accredited facilities had an excellent safety record.

In 1996 the AAAASF conducted a voluntary survey of all their facilities to assess outcomes of surgical care. The directors of surgical centres were asked to complete a questionnaire about unanticipated sequele that occurred in their facilities. Of the 418 accredited facilities at the time 241returned anonymous questionnaires. In 1997 Morello [31] published the findings of their survey**.**

The following findings were of interest:

> 4110675 procedures were reported on during a five-year period from January 1991 to December 1996.
> Significant complications (haematoma, hypertensive episodes, wound infection, sepsis and hypotension) where infrequent, numbering 1877 for an occurrence of 1 in 213 cases or 0.47%.
> Seven deaths occurred. A death occurred in 1 in 58810 procedures, or 0.0017%. The overall risk of death was comparable whether the same procedure was performed in an AAAASF facility or hospital surgical facility.

A further review by Bitar [8], in 2003, published the results of 3615 consecutive patients undergoing 4778 plastic or reconstructive procedures. They were performed, under sedation, by surgeons in a single accredited facility between May 1995 and May 2000. They reported no deaths or life threatening complications. Outcomes measured included:

> Airway complications.
> Hypotention.
> Venous thrombosis.
> Pulmonary emboli.
> Protracted nausea lasting longer than 24 hours.

The results showed that multiple procedures were done on 24.8% of the patients. The vast majority of patients were either ASA I or II. The average operation time was 111 minutes, using monitored sedation with midazolam, propofol and a narcotic.

There were no deaths, ventilation requirements, deep vein thrombi or pulmonary emboli.
Of the complications that did occur:

0.05% of the patients had dyspnoea that cleared spontaneously.
0.2% of the patients had protracted nausea.
0.05% of the patients had an unplanned hospital admission.

It was shown that office based surgery performed by a qualified surgeon and a nurse anesthetist was safe and that the following constituted the basis for safe efficacious office based surgery:

Appropriate accreditation.
Safe anaesthetic protocols.
Proper patient selection.



Warner [43] and his colleagues from the Mayo Clinic studied 45 090 ambulatory surgery patients after short case (< 1 hr) plastic surgery procedures. The findings showed that the four deaths that were recorded were comparable to the incidence of deaths in the general population, and that there was no increased risk for ambulatory surgery.

By using the Internet based system, Keyes [23] showed that the American model was now being used to evaluate every possible aspect of plastic surgery. In April 2005 Keyes reported on the safety of silicone breast implants done on 246 552 patients in more than 900 accredited facilities. There were no reported operative deaths. Two postoperative deaths were recorded:

One death occurred as a result of asthma.
A second death occurred 5 days postoperatively following a pulmonary embolis. This patient had a breast augmentation as well as an abdominoplasty and liposuction.

There were 1730 unanticipated sequele for an incidence of 0.7%. The majority of sequele were due to:

Haematoma formation (1059).
37 cases of pneumothorax.
10 cases of postoperative infection.

The second advantage of the ambulatory surgical facility was the continuity of care. Usually the same nurse followed the patient from the initial consultation through to postoperative recovery, allowing the patient to gain confidence for the procedure, the facility and with the nursing staff.

The nursing staff was able to use personal knowledge of their patient's family psychology and socio-cultural factors to promote privacy and confidentiality, during the procedure and in the postoperative recovery period. The patient privacy and confidentiality was another major advantage in office based surgery. Because the office based surgeries are smaller than hospitals, it was easier to offer the patient privacy, from the consultation room to the post anaesthetic care room.

A decrease in exposure to nosocomial agents was a further advantage for office-based surgery, as most the cases done in these facilities were "clean cases", and the risk for contamination from the previous patient is much less.

The medical profession has been besieged for some time by concerns of escalating costs. Due to the fact that a hospital outpatient surgery is generally not cost competitive with programs offered by office surgery facilities, these office based facilities have become popular amongst the public.

In 2004, 8.5 million plastic and reconstructive procedures were done in the USA, with 45% (3825000) of these procedures being done in office based facilities. It is estimated that this number will increase to 10 million procedures by 2005, with an ever-increasing percentage of these procedures being performed in office based surgical facilities.

There were also several distinct disadvantages to office based surgery that all increased the risk for injury and death:

The tendency to operate on patients who did not meet the operating criteria, for outpatient operations, led to complications due to incorrect patient selection.

The tendency to operate on patients who needed complex surgery and patients with many co-morbid conditions, were being done in office based facilities to contain costs.

In March 2004 a review by Dr. Brett Coldiron [12], a medical safety expert on anaesthesia-related standards for surgery, found that death or injury was more likely when general anaesthesia was used in the office setting.
Dr. Coldiron based his conclusion on a prospective study on incidents reported over a three-year period (2000-2003) in Florida, where the reporting of death or injury related to office surgeries is mandatory. These findings, together with reports of two deaths of healthy patients undergoing plastic surgery under general anaesthesia in an office setting, prompted the American Society for Dermatological Surgery to adopt a different view. They encourage patients to opt for procedures that can be performed under local anaesthesia, in order to avoid the potential risks of general anaesthesia.

Dr. Coldiron's report published in the Archives of Dermatology showed:

Thirteen procedure-related deaths.
Forty-three procedure related complications that resulted in hospital transfer.
Seven of the deaths involved cosmetic procedures, five of which were performed under general anaesthesia, and two were done under intravenous sedation.

Of the 43 procedure related complications:

Thirteen followed liposuction or abdominoplasties or both.
Seven followed breast augmentation.
Six followed face/brow/neck lifts.

With respect to liposuction, the researches found all the liposuction deaths and injuries were associated with liposuction under general anaesthesia or deep sedation. In contrast, there were no deaths or injuries associated with liposuction using high volume dilute local anaesthesia.
The Florida data suggested that office based liposuction, using high volume dilute tumescent anaesthesia together with conscious sedation, was safe.

The following were causes of the reported seven deaths:

Patient 1 had liposuction and an abdominoplasty under general anesthesia - she died from a pulmonary embolus.
Patient 2 had a breast reduction, developed asthma under general anesthesia and died due to asthma related complications.
Patient 3 had an abdominoplasty under general anesthesia, developed shortness of breath the following day, and died from a pulmonary embolus.
Patient 4 had a rhinoplasty and chin lift, developed a bradycardia under deep sedation, and died from a myocardial infarction.
Patient 5 underwent laser resurfacing and liposuction under general anaesthesia and died from pulmonary emboli related complications.
Patient 6 had a dual procedure – hernia repair, neck lift and abdominoplasty under general anaesthesia. The patient collapsed and died two days postoperative from a pulmonary embolus.
The last patient had a facelift under intravenous sedation and went into cardiopulmonary arrest. The resuscitation process was unsuccessful.



The reasons for hospitalisation for cosmetic procedures were as follows:

Recurrent haematoma after facelift under general anaesthesia.
Second degree burn during skin cancer treatment under sedation.
Acute congestive heart failure in a patient with cardiomyopathy undergoing liposuction under general anaesthesia.
Pneumothorax during a breast augmentation under general anaesthesia.
Hypotension after liposuction under general anaesthesia.
Myocardial infarction during liposuction under general anaesthesia.
Bronchospasm after rhinoplasty under general anaesthesia.
Haematoma and hypotension following a facelift under general anaesthesia.
Haematoma in a patient with gynecomastia undergoing liposuction under intravenous sedation.
Pneumothorax in a patient undergoing a breast augmentation under sedation.
Possible malignant hyperthermia during breast augmentation under general anaesthesia.

Possible transient ischaemic attack in a patient undergoing skin cancer excision under local anaesthesia.
Hypotension after liposuction under deep sedation.
Gastric aspiration and laryngospasm during liposuction under deep sedation.
Respiratory failure and acute pulmonary oedema in a patient undergoing an eyelid and neck lift under general anaesthesia.
Urinary retention during an abdominoplasty under general anaesthesia.
Ventricular tachycardia during breast augmentation under intravenous sedation.
Atrial fibrilation two hours postoperatively in a patient having basal cell cancer removed under local anaesthesia, using 0.4 ml of a 2% lignocain solution.
Sinus arrhythmia and hypotension in a patient undergoing abdominoplasty under general anaesthesia.
Atrial fibrilation after a facelift in a patient with a history of atrial fibrilation under general anaesthesia.
Hypotension after abdominoplasty under general anaesthesia.

DISCUSSION



One death during an elective plastic or reconstructive procedure is a death too many. What emerged from the American data was that the thrombo-embolic phenomena, including deep vein thrombosis and its feared sequele of pulmonary emboli, was a major cause of deaths. Four of the deaths occurred as a result of this phenomena. Two of the deaths, and two of the hospital transfers, occurred as a result of myocardial arrhythmias under sedation and local anaesthetic block

The safety data accumulated allowed the American medical profession to develop ten core principles, which were intended to inform and guide decision-making by legislative, regulatory and administrative bodies. These principles, which represent a wide consensus within the medical profession, were intended to be used collectively to promote consistency in the safety and quality of healthcare services for in-office procedures requiring moderate sedation/analgesia, deep sedation/analgesia, or general anaesthesia.

CORE PRINCIPLES

1. Guidelines or regulations for office-based surgery should be developed by the individual states according to the level of sedation/anaesthesia defined by the American Society of Anaesthesiologists.

2. Physicians should carefully select patients for office-based surgery using moderate sedation/analgesia, deep sedation/analgesia or general anaesthesia based on the ASA Physical Status Classification criteria.

3. Physicians who perform office-based surgery should have their facilities accredited.

4. Physicians performing office-based surgery must have admitting privileges at a nearby hospital, or maintain an emergency transfer agreement with a nearby hospital.

5. State guidelines for informed consent should be followed.

6. Office-based surgery adverse incident reporting requirements and periodic peer review should be mandatory.

7. The physicians performing surgery in an office-based facility should be registered with the relevant health professional council, and the procedure must be one that is generally recognised by this council as falling within the scope of training and practice of the physician providing the care.

8. The physician performing office-based surgery must show competency for the procedures they perform in the office setting by maintaining core privileges at a licensed hospital.

9. For office-based surgical procedures, at least one physician who should be credentialed in advanced resuscitative techniques (e.g. ATLS , ACLS, APLS ), must be present or immediately available with appropriate resuscitative equipment, until the patient has met the criteria for discharge from the facility. In addition, other medical personnel with direct contact should at a minimum be trained in Basic Life Support.

10. Physicians administering or supervising moderate sedation/analgesia, deep sedation/analgesia or general anaesthesia should have appropriate education and training.

The American Association of Plastic and Reconstructive Surgeons then also convened a task force on sedation and analgesia in the ambulatory setting Their findings and recommendations were summarised by Iverson **[**22**].** The findings from the task force represented an extensive review of the literature and existing guidelines and a critical analysis of clinical experience.

The guidelines that followed defined the different levels of sedation.

> Conscious sedation being defined as a minimally depressed level of consciousness that allows the patient to maintain protective reflexes, maintain a patent airway independently, and continuously, and to respond appropriately to physical stimulation and verbal command. Deep sedation was defined as a medically controlled state of depressed consciousness from which the patient is not easily aroused, which was accompanied by a partial or complete loss of protective reflexes, and may include the inability to maintain a patent airway.

Planned deep sedation was only to be administered by an anaesthesiologist or a certified registered nurse anesthetist under the direction of an anaesthetist or an operating physician. The guidelines defined the appropriate level of anaesthesia, based on the nature and complexity of the procedure, and the patient's ability and willingness to co-operate during the procedure. The importance of appropriate patient selection was constantly emphasised in the clinical guidelines

The guidelines suggested that the physician should have the primary responsibility for the patient receiving sedation. All sedations were to be ordered and supervised by the physician privileged for the procedure, and privileged for the administration of sedation and analgesia. It was stipulated that at least two qualified health care providers needed to be present during the procedure, one of whom had to be the physician. At least one of these providers was to be skilled in advanced airway management and cardiac life support. At least one person was to have the sole responsibility of monitoring the patient.
Sedation was only to be administered by personnel specifically trained in the pharmacokinetics and pharmacodynamics of the agents used during

sedation, and who understand the role of the pharmacological antagonists that may be used with opioids and benzodiazepines. Because primary sedation complications are related to depression of cardio-pulmonary function, the individual responsible for monitoring the patient is to be trained to recognise complications, and be able to establish a secure airway to maintain ventilation.

The guidelines stipulated the necessary equipment requirements for sedation, and how the equipment should be checked prior to use. The guidelines also addressed the requirements for preoperative evaluation and gave advice on the appropriate selection of pharmacological agents based on the procedural requirements. Pre-operative fasting protocols and intraoperative guidelines for record keeping, monitoring, and emergency care were provided for. Appropriate recovery care protocols and discharge criteria were also covered by the guidelines of the task force.

The task force felt that if these guidelines were followed carefully it would contribute to providing safe sedation and analgesia for plastic surgery patients in all types of outpatient settings.

The facts that emerged from the American model showed how the power of data enhances patient safety:



- The ambulatory facility evolved from a doctor's treatment room to a facility that had to meet the highest standards.
- These standards were determined by an independent external source for doctors working in an ambulatory facility.
- The aim of the standards was to provide the best possible quality of medical and surgical care in ambulatory facilities.
- The Internet based reporting of unanticipated adverse events and the peer review led to the accumulation of safety data for these facilities.
- The model allowed a group of doctors to constantly review what they and their peers were doing.
- The safety data also allowed these doctors to identify and improve on problem areas in their facilities.
- The data that emerged on types of procedures done, the type of anaesthesia performed, and unanticipated sequele in the ambulatory facility, led to the identification of risk areas.

The identification of risk areas allowed for the formulation of clinical sedation guidelines and core principles that would further enhance patient safety in the ambulatory facility.
The Internet based reporting allowed for transparency, through public access, as to what the standard and expected quality of care should be for a patient in these facilities.
Safety data was then also used in legislative and regulatory processes that would further improve patient safety in ambulatory surgical facilities.

Despite all these efforts to improve patient safety and reduce risk during plastic or reconstructive surgery, deaths from pulmonary emboli and local anaesthetic toxicity remained problematic.

A review of the relevant literature by Lofsky [25] showed some interesting facts about the thrombo-embolic phenomena and pulmonary emboli:

The American Society of Plastic Surgeons extrapolated existing data to estimate that over 18000 cases of deep vein thrombosis may occur in plastic surgery patients each year. Pulmonary embolism was the leading cause of death following liposuction, accounting for 23% of the deaths in one study.
When liposuction was combined with other procedures, the mortality rate increased from 1in 47415 cases to 1 in 7314 cases.
Of all the common plastic surgery procedures, abdominoplasty has the highest rate of thrombo-embolic complications, with a 1.2 % incidence of deep vein thrombosis, and 0.8% incidence for pulmonary embolism.
During facelift procedures the incidence of deep vein thrombosis was 0.35 % and 0.14 % for pulmonary embolism. The combined incidence for this procedure was 0.49 %.
The average plastic surgeon might therefore expect 1 case of either deep vein thrombosis or pulmonary embolism for every 200 facelifts performed.
A major survey showed that general anaesthesia was used in 84% of patients who developed thrombo-embolism - suggesting an increased relative risk for facelifts performed under general anaesthesia.
Belt lipectomies (circumferential panniculectomy ) reported a pulmonary embolism rate of 9.3 % , even with the use of prophylactic measures.

Lofsky also reported that in twelve medical malpractice claims involving pulmonary emboli after plastic surgery in an office based setting, eight of the twelve claims involved abdominoplasties. Six of these were combined with other procedures performed at the same time. Half of the claims were performed under general anaesthesia provided by a Certified Registered Nurse Anesthetist, and half were performed under intravenous sedation. Nine of the patients died because of pulmonary embolism, while three survived.

Several risk factors where shown to increase the risk of postoperative thrombosis. These include:

Smoking.
Obesity.
Advanced age.
The use of hormone replacement therapy or oral contraceptives.
Congestive heart failure.
Immobilisation (bed rest or casts).
Malignancy.
A history of previous thrombo-embolism.
Inherited hypercoagulable states.



General anaesthesia was shown to be an independent risk factor because the immobility reduced muscle tone and reduced venous return from the legs and the pelvic areas. After the first hour of general anaesthesia, there appears to be a linear relationship between the procedure time and the incidence of postoperative deep vein thrombi. Because of the risks involved, a plastic surgery task force on the issue concluded that “when possible, procedures longer than three or four hours should be performed under local anaesthesia combined with intravenous sedation.”

# CHAPTER 4:

# RESEARCH DESIGN AND METHODOLOGY

**A. PATIENT SELECTION**
**B. PREOPERATIVE INSTRUCTIONS TO PATIENT**
**C. PRE SEDATION EVALUATION**
**D. INTRAVENOUS SEDATION PROCESS**
**E. LOCAL ANAESTHETIC PROCESS**
**F. MONITORING**
**G. EVALUATION CRITERIA**
**H. DISCHARGE CRITERIA**
**I. POST OPERATIVE INSTRUCTIONS TO PATIENTS**
**J. THE FACILITY**
**K. FACILITY RESUSCITATION PROTOCOLS**



## A. PATIENT SELECTION

Patient selection was influenced by the following:

1. Surgeon / Operator.
2. Procedure.
3. Patient fitness.
4. Time frame to complete study.

1.SURGEON / OPERATOR

The surgeon selected all the patients who qualified for treatment.
The surgeon was familiar with the sedation technique and was responsible for the administration of local anaesthesia.
The surgeon was aware of any possible sedation – related adverse effects.

2. PROCEDURES.

The following procedures were deemed suitable by the surgeon for sedation / local anaesthesia in an ambulatory facility:

- Breast augmentation.
- Rhytidectomy / face lift.
- Abdominoplasty.
- Liposuction.
- Mastopexy.
- Breast reductions.
- Blepharoplasty.
- Excision of skin tumours with skin grafts.
- Calf implant.
- Rhinoplasty.

3. PATIENT FITNESS

All patients for the study had to be fit and healthy and classified as American Society of Anaesthesiologists status I and II where:

- ASA I represents a healthy patient.
- ASA II represents a patient with mild systemic disease with no functional limitations.



The patients had to be over 18 years of age.
Patients were excluded from the study if they were allergic to midazolam, propofol, alfentanil, ketamine or any of the drugs to be used.

4. TIME FRAME

The patients were selected for the study between the 22nd January 2003 and 7th September 2005.

## B. PREOPERATIVE INSTRUCTIONS TO PATIENT

INFORMATION REGARDING THE PROCEDURE PROVIDED TO THE

PATIENT BY THE SURGEON:

A detailed description of the surgical procedure and possible complications.
A detailed description of sedation and its combination with local anaesthesia.
Verbal and written consent for the procedure.
The financial implications of the procedure.
Date and time of the procedure.
Time of arrival at the facility.
The duration of the surgery.
Time spent after the procedure in the recovery facility in the care of the recovery personnel.
Written postoperative care instructions were to be given during recovery.

2. WRITTEN INFORMATION PROVIDED TO THE PATIENT BY THE SEDATION PRACTITIONER:

All patients were given an envelope by the surgeon that contained the following:

An information leaflet explaining the concept of sedation and the combination of sedation and local anaesthesia.
Information regarding the use and possible side effects of the drugs.



---

**AN EXAMPLE OF THE WRITTEN INFORMATION SUPPLIED TO THE PATIENT BY THE SEDATION PRACTITIONER**

Dear patient,

Your operation will be done using a combination of conscious sedation and local anaesthetic injections.

Conscious sedation is an intravenous technique, which enables you to have an operation without anxiety or recall. You will not be unconscious during the procedure, but may sleep. Conscious sedation will allow for a rapid, clear-headed recovery after the operation.
The sedation practitioner will infuse intravenous medication, using a computerised infusion pump, which is set against your weight. It is therefore important to weigh yourself prior to the operation.

No operation can be done under conscious sedation alone, as it would be too painful. A local anaesthetic injection will be given into the operation area once the sedation has started. You will neither feel nor recall that such an injection had been given.

In the envelope you are offered a tablet (Midazolam 7.5 mg), which decreases anxiety prior to the procedure.

In all cases the tablet must be taken at least one hour prior to the procedure with a small amount of water. The tablet may make you drowsy, and may result in some memory loss of the procedure. It is therefore important to note the following:

Arrange transport for yourself while using the medication.
Be fully convinced as to the nature of the procedure prior to taking the tablet.
Do not drive or use alcohol within 6 hrs of taking the tablet.
Do not eat or drink anything for 2 hrs prior to your procedure.
Sign a consent form before the procedure.



After the operation you will be moved to the recovery area where you will be monitored until you have made a full recovery.

On leaving the recovery room you are not allowed to:

Drive or operate heavy machinery for 12 hrs.
Go home by yourself – you must have an escort.
Your prescribed medication must be taken regularly.

---

## C. PRE-SEDATION EVALUATION

All patients were asked to complete the following medical questionnaire prior to their surgery:

Name and Surname:…….
Age:……..
Weight:……..kg

If the answer is yes to any of the following questions, please provide details.

Have you had previous surgery?
Have you had any anaesthetic complications?
Is there a family history of anaesthetic complications?
Have you ever been anaemic?
Do you smoke?
Do you use any medication?
Do you get nausea easily?
Do you suffer from depression?
Are you allergic to medication?
Do you have asthma or other lung disease?
Do you suffer from porphyria
Do you have high blood pressure?
Do you have diabetes mellitus?
Do you have any heart problems?
Do you have a cold or flu now?
Have you had a cold or flu in the last two weeks?
Do you have a cough?
Do you have any false teeth?
Please provide any other details that you might think relevant to your surgery or anaesthetic.



In the preoperative waiting area the patients underwent a pre-sedation evaluation on the day of surgery which included:

A medical and anaesthetic history with emphasis on previous episodes of post operative nausea and vomiting.
A physical examination with emphasis on the upper and lower airway and cardiovascular system.
Weight assessment.
Medication history.
The effect of the midazolam premedication (The patients who exhibit excessive drowsiness would probably also be sensitive to the other drugs used in the sedation process.)

The main concern of patients during the pre-sedation interview was whether they would experience pain during the procedure. It was necessary to spend time, reinforcing the concept, that the local anaesthesia would cause

analgesia, and that the sedation would take away anxiety. It was necessary to explain to the patients that the net effect of the combination of the local anaesthesia and sedation was that they would neither feel nor remember anything of their surgical procedure. The patient was then encouraged to ask questions they may have, regarding the sedation process.
From the interviews with the patients in this study it was found that the typical patient who had plastic or reconstructive surgery, had the following in common:

Their mindset was positive towards the surgery.
The patients viewed the surgery as an event that required a lot of thought, soul searching and often internet research.
Privacy was regarded as an essential element in their decision making for surgery.
The patients were generally very healthy and motivated for their surgery.

Once the pre-sedation evaluation had been completed the surgeon would complete his final evaluation of the patient. This included:

Answering any remaining questions regarding the procedure.
Preoperative photography.
Preoperative body marking.



The patient was then taken to the operating room where intravenous sedation process was started.

## D. THE INTRAVENOUS SEDATION PROCESS

### 1. THE PATIENT

The patient was positioned in a comfortable position on the operating table and covered with a space blanket to prevent hypothermia. A small pillow was placed under the patient's neck to cause slight extension of the neck in order to prevent airway obstructions.

### 2. EQUIPMENT AND INTRAVENOUS DRUGS

Once the patient was positioned on the operating table, intravenous access was established (see Appendix picture 1):

The patient's arms were positioned at right angles to the body
The venous access was made into a large antecubital fossa vein using a 22 gauge Jelco intravenous catheter.
A 1 litre solution of Ringer-Lactate was administered via an administration set with an injection port.

The infusion of pre-warmed intravenous fluids was started as soon as the intravenous infusion was set up.

The following was prepared for all the patients:

A 20ml syringe filled with 20 ml of propofol (10mg/ml) and 2 ml of alfentanil (0.544 mg / ml). This syringe is attached to a 2ml intravenous line.
A 5ml syringe filled with ceftriaxone (Rocephin 1gr).
A 2ml syringe filled with 20 mg of ketamine.

3. MONITORS



Once the intravenous access was established, a Welsch Allyn Atlas monitor (see Appendix picture 4) was used with:

A three lead ECG.
An automated blood pressure device.
Pulse oximetry.

4. THE SEDATION PROCESS

The 20 ml premixed propofol / alfentanil syringe was attached to a Graseby 3400 infusion pump and the following information was programmed into the infusion pump (see Appendix picture 3):

The patient's weight.
The infusion rate of 4 mg / kg / hr.
The concentration at 10 mg / ml.

The 20 ml syringe was attached to the administration set injection port via the extension set. The intravenous antibiotic was given as a bolus dose at this point of the proceedings.

Once the Graseby pump had been programmed, the infusion of the co-induction agents was started and the time recorded. In the mean time the following was started:

The operative field was cleaned with pre-warmed betadine solution.
The patient was draped with sterile surgical drapes.
The surgeon prepared the local anaesthetic injections.

At this point 20 mg of ketamine was injected intravenously as a bolus. The bolus injection was timed so that 2 minutes would elapse before the surgeon started with the administration of local anaesthesia into the surgical field. An absent lid reflex would be the signal that the patient had reached a state of dissociative anaesthesia and that the local anaesthetic could be administered.

The multidrug infusion was continued and titrated up to the end of the surgical procedure after which the infusion pump was turned off and the time recorded.

The patient was then moved onto a recovery bed and wheeled to the recovery area.



**E. THE LOCAL ANAESTHETIC PROCESS**

With the loss of the eyelid reflex during the dissociative phase of ketamine induced anaesthesia the surgeon administered the relevant local anaesthetic for the procedure:

For breast augmentations and face lifts the following medications were mixed in 100 ml of normal saline:

1. 20ml lignocaine 2%.
2. 20ml bupivacain 5mg / ml.
3. 0.5mg of epinephrine 1:1000.
4. 1ml hyalase 1500iu / ml.

This was administered with a 10 ml syringe and a spinal needle. Maximum dose of 40- 50 ml / breast or 20 ml / cheek was given.

For liposuction and abdominoplasties the following medications were mixed into a 1000 ml of Ringers Lactate solution:

1. 50 cc 2% lignocaine.
2. 1mg/ml epinephrine 1:1000.
3. 12.5ml sodium bicarbonate 8.5%.

The wetting solution was administered under continuous pressure of 200 mmHg to a maximum dose of 2 litres. Approximately 15 to 20 minutes was allowed to lapse after the infusion of the tumescent solution before the surgeon started with the relevant procedure. This allowed for the full effect of the local anaesthesia.

For the breast reductions a combination of the above was infiltrated to produce local anaesthesia.

For smaller procedures such as blepharoplasties and local excisions, lignocaine with epinephrine was the local anaesthetic of choice.

Supplemental doses of local anaesthesia were given if the patient expressed pain during the surgical procedure.



**F. MONITORING**

The following baseline observations were recorded prior to the patient's surgery:

Pulse rate.
Blood pressure.
Oxygen saturation.
A three lead electrocardiogram trace.

During the procedure the following observations were recorded and documented at 15 minute intervals:

Pulse rate.
Blood pressure.
Oxygen saturation.
Heart rate and rhythm.

The following were also documented:

The time the infusion of drugs started.
The amount of propofol and alfentanil given.
The time ketamine bolus was given.
The time the local anaesthetic was administered.
The duration of the surgical procedure.
The time the infusion of drugs was discontinued.
The volume of intravenous fluid given.
The volume of fat aspirated during liposuction.
The discharge time.

---

**THE FOLLOWING IS AN EXAMPLE OF THE INTRAOPERATIVE RECORD KEPT ON ALL PATIENTS:**

---

Patient name and surname……
Procedure……..
Date of procedure……..
Doctor performing procedure……

Sedation process started @ Sedation process ended @

| TIME IN MINUTES | 0 | 15 | 30 | 45 | 60 | 75 | 90 | 105 | 120 | 135 | 150 | 165 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| BLOOD PRESSURE | | | | | | | | | | | | |
| OXYGEN SATURATION | | | | | | | | | | | | |
| PULSE RATE | | | | | | | | | | | | |
| RHYTHM | | | | | | | | | | | | |
| SEDATION LEVEL* | | | | | | | | | | | | |
| PROPOFOL/ALFENTANIL | | | | | | | | | | | | |
| KETAMINE BOLUS 20mg | | | | | | | | | | | | |
| INFUSION RATE | | | | | | | | | | | | |
| VOLUME OF FLUIDS | | | | | | | | | | | | |



NOTES

EQUIPMENT USED:

SYRINGES
EXTENSION SET
ADMINISTRATION SET
RINGER LACTATE
JELCO

DRUGS USED:

ROCEFIN gr
PROPOFOL mg
KETAMINE mg
ALFENTANIL mg
FLUMAZENIL mg
NALOXONE mg
GLYCOPYROLATE mg
METACLOPRAMIDE mg

---

## G. EVALUATION CRITERIA

All patients were evaluated using the following parameters:

Age.
ASA classification.
Gender.
Weight.
Procedure.
Preoperative observations: Blood pressure, pulse rate, heart rhythm, oxygen saturation.
Premedication.
Time of sedation.
Drugs used during sedation process.
Drugs used during local anaesthetic process.
Patient's response to the injection of local anaesthesia.
Sedation levels using Frizzelle sedation scale.[19]
Surgeon's perspective on the quality of intraoperative conditions.
Patient satisfaction with sedation.
Discharge criteria.
Complications.
Total cost of sedation process.



The following symptoms / signs were seen as complications:

Episodes of apnoea.
Hypotensive episodes (25% drop in either systolic or diastolic levels).
Hypertensive events ( 25% rise in either systolic or diastolic levels).
Desaturation below 90% requiring airway intervention.
Hypersalivation.
Unacceptable movement during surgery.
Emergence dysphoria.
Pruritis.
Hiccups.
Emesis.
Hallucinations.
Laryngospasm.
Nystagmus.

Prolonged somnolence.
Pain at propofol infusion site.
Signs of local anaesthetic toxicity (generalised seizure, respiratory arrest, hypotention, bradycardia, sinus or ventricular tachycardia, ventricular fibrilation or asystole).
Signs and symptoms of anaphylaxis due to local anaesthetic toxicity/ drugs (angio-oedema, urticaria, or repiratory arrest).
Signs and symptoms of thrombo-embolism such as calf pain and tenderness, leg oedema and venous engorgement.
Signs and symptoms of pulmonary embolism such as chest pain, dyspnoea, hemoptysis, tachycardia, and tachypnoea.
Hospital transfers for sedation or surgical complications
Deaths related to sedation or surgical complications.

**THE FOLLOWING IS AN EXAMPLE OF THE CASE REPORT FORM USED IN THIS RESEARCH PROJECT:**

---

# CASE REPORT FORM:

## PROPOFOL/ALFENTANIL/ KETAMINE BOLUS IN MIDAZOLAM PREMEDICATED PATIENTS UNDERGOING PLASTIC AND RECONSTRUCTIVE SURGERY



**PPREMEDICATION:** MIDAZOLAM 7.5 mg.
**MIXTURE USED:** PROPOFOL 200 mg.
ALFENTANIL 1mg.

**BOLUS DOSE:** KETAMINE 20 mg

**DATE:** ……..

**PATIENT NUMBER:** ……..

**PROCEDURE:** ……...

**SEX:** **MALE / FEMALE**

**WEIGHT:** ……..

# PREOPERATIVE OBSERVATIONS:

**PREMEDICATION**
**TAKEN Y/N?** ……
**EFFECT** ……

**BLOOD PRESSURE** ……
**PULSE RATE** ……..
**HEART RHYTHM** ……..
**OXYGEN SATURATION LEVEL** ……..

**SEDATION**

**TIME STARTED** ……..
**TIME ENDED** ……..
**TOTAL TIME** ……..

# INTRA OPERATIVE OBSERVATIONS AT 15 MINUTE INTERVALS:



**BLOOD PRESSURE** ……..
**PULSE RATE** ……..
**HEART RHYTHM** ……..
**OXYGEN SATURATION** ……..

**FRIZZELLE SEDATION SCALE**

1. Fully awake and orientated patient.
2. Drowsy patient.
3. Eyes closed but arousable on command.
4. Eyes closed but arousable to mild physical stimulation.
5. Eyes closed but unarousable to mild physical stimulation.

**COMPLICATIONS** ……..

**PATIENT'S RESPONSE TO LOCAL ANAESTHESIA**
Verbal response
Presence of body movement

1. none ……
2. mild ……
3. moderate ……
4. severe ……

## POST OPERATIVE OBSERVATIONS AT 15 MINUTE INTERVALS:

**BLOOD PRESSURE** ……
**PULSE RATE** ……
**OXYGEN SATURATION** ……
**COMPLICATIONS** ……

## DISCHARGE CRITERIA:

- **STABLE VITAL SIGNS. Y/N**
- **DRIPS REMOVED. Y/N**
- **ORIENTATED. Y/N**
- **PASSED URINE. Y/N**
- **NAUSEA OR VOMITING. Y/N**
- **MINIMAL WOUND DRAINAGE. Y/N**
- **COMPLICATIONS.**



## FLUID ADMINISTRATION:

**TYPE OF FLUID.** ……
**VOLUME OF FLUID.** ……

**SURGEON'S PERSPECTIVE ON INTRAOPERATIVE CONDITIONS:**

1. Highly satisfactory. .....
2. Satisfactory. ……
3. Unsatisfactory. ……

**PATIENT'S SATISFACTION WITH SEDATION; TELEPHONIC INTERVIEW ON FIRST POSTOPERATIVE DAY.**

1. Very satisfied. **……**
2. Satisfied. **……**
3. Dissatisfied. **……**

**WILL YOU CHOOSE THE SAME SEDATION TECHNIQUE IF YOU REQUIRE THE SAME SURGICAL PROCEDURE IN FUTURE? PATIENT INTERVIEW ON FIRST POSTOPERATIVE DAY:**

**YES** **……**
**NO** **……**

## TOTAL AMOUNT OF DRUGS USED PER PATIENT.

**MIDAZOLAM…….mg.**
**PROPOFOL…….mg.**
**ALFENTANIL…….mg.**
**KETAMINE…….mg.**
**LIGNOCAINE…….mg.**
**BUPIVACAINE……mg.**
**EPINEPHRINE……mg.**
**HYALASE…….mg.**
**OTHER……..**



## AVERAGE INFUSION RATE **…….....mg/kg/hr**

## TOTAL SEDATION COST:

**DRUGS** **……**
**EQUIPMENT** **……**

---

## H. DISCHARGE CRITERIA

Once the patients were transported from the operating room to the recovery area they were observed for 2 hours postoperatively.
Observations were done at 15-minute intervals by the nursing staff. The observations included assessment of:

Blood pressure.
Oxygen saturation.
Heart rate.
Wound drainage.

The patients were considered ready for discharge when:

Vital signs were stable.
Orientated.
Drips removed.
Were able to pass urine.
There was no nausea or vomiting.
There was minimal wound drainage.
Their postoperative analgesics had been taken.



Once the patient had been in the recovery area for one hour they were offered a refreshment, and the responsible person (escort) contacted.

## I. POSTOPERATIVE INSTRUCTIONS TO PATIENT

All patients received detailed postoperative instructions regarding their procedure with emphasis on:

Expectations regarding the surgery.
How to recognise complications.
Who to call in case of a sedation or surgical complications including the telephone number.
How to deal with dressings and drains.
When to return to normal daily activities and exercise.
Follow up visit dates.

## J. THE FACILITY

The office based facility is located in Langenhoven Street in George (Western Cape, South Africa). The facility director is Dr. I.C. Mc Gibbon, a qualified plastic and reconstructive surgeon who is registered with the Health Professionals Council of South Africa and a member of the Association of Plastic and Reconstructive Surgeons of South Africa. Dr. Mc Gibbon has valid, unrestricted admitting privileges at two nearby hospitals in George and has an emergency transfer agreement with these hospitals.

All procedures done in the facility are either done under local anaesthesia or local anaesthesia and sedation. The sedation practitioner is a medical practitioner who did a two-year diploma in sedation and pain control and has successfully completed the Advanced Cardiac Life Support and Advanced Paediatric Life Support courses. He is present throughout all procedures requiring sedation, and has age and size appropriate resuscitation equipment readily available until the patient has met the criteria for discharge. The other medical personnel with direct patient contact are trained sisters with basic life support skills.



The facility meets the minimum physical and building services criteria for such a facility, as set out by the Department of Health in a gazetted article in June 2001[38]. These criteria are:

A comfortable waiting room with toilet facilities for the patients.
Suitable change room facilities for male and female staff working at the facility.
An examination room that is separate from the operating room.
A washing and cleaning room.
A storage room for clean linen and sterile packs.
A sterilisation and disinfection room.
A staff room.
An operating room.
A recovery area.

The different rooms and exit areas are clearly marked.

The facility has appropriate lighting and the entire facility is temperature controlled for personnel and patient comfort. The entire facility is regularly cleaned, adequately maintained and smoking is prohibited.
The staff working at the facility are all trained to ensure the comfort, safety and welfare of the patients admitted to the facility.

The operating room is physically and distinctly separate and separated from the rest of the facility and is used only as an operating room. The room is well ventilated and temperature controlled. The area is cleaned before and after each procedure with disinfectants to prevent cross-contamination. The operating table is in the centre of the room with 3 meters of clear space on each side of the table to accommodate emergency personnel and equipment if necessary. The operating room has two surgical light sources, which are both powered by a generator in case of power failure.
All electrical devices in the operating room are run off power from the generator (Welch Allyn Monitor, Diathermy, Fibre Optic Light Source, Graseby 3400 Infusion Pump and Defibrillator). The power generator has sufficient capacity to run these essential devices for a period of three hours and starts to operate immediately in the event of a power failure.

The following equipment is always available in the operating suite:



ECG monitor with a pulse read-out.
Pulse oximeter and blood pressure monitoring device (available in operating room and recovery area for simultaneous use).
A standard deribrillator, which is checked weekly and kept in working order.
Age appropriate oral airways, laryngeal masks and endotracheal tubes.
A working laryngoscope with age appropriate blades and extra bulbs.
An ambu bag with oxygen reservoir for positive pressure ventilation.
Oxygen source, a suction device and a cautery.

The operating room ceiling, walls and floor are washable and free of particulate matter that can contaminate the area.

The recovery area is next to the operating room, readily accessible to handle emergencies should they arise. The patient in recovery is under direct observation of trained facility staff until they meet the criteria for discharge. A doctor trained in advanced cardiac life support is also available until the patient is ready for discharge. A recovery room record is maintained for the

facility, recording vital signs, medications and adverse events. All patients are provided with written post-operative instructions and are only discharged when they meet established written and recorded criteria for discharge.

The facility has one autoclave, which uses high-pressure steam and heat to sterilise instruments. High-level disinfection is used for non-autoclavable endoscopic equipment. Spore tests are done on a regular base and an appropriate action protocol exists in case a test is positive. Sterile supplies are stored in closed cabinets and appropriately labelled to indicate sterility.

In order to maintain asepsis in the facility the instrument handling and sterilising area are cleaned and maintained daily. There is strict separation of dirty surgical equipment and instruments from those that have been cleaned. A wall separates the instrument preparation room from the instrument cleaning area. Scrub suits, hair covers, operative gowns, masks are used for all procedures. A sterile field is used during all surgery. All body fluids are cleaned with germicides indicated as virucidal, bacteriocidal and fungicidal. All the hazardous waste generated in the facility is stored in appropriate containers and separated from the general refuse for special collection and handling.



A Facility Safety Manual compiled by Dr Mc Gibbon, provides employees with information regarding:

Fire drill procedures.
How to deal with security emergencies that could be a threat to the staff of the facility.
Who to call when there is an unplanned or emergency return of a patient.
The role of the staff during cardiopulmonary resuscitation.
What to do if the surgeon or sedation practitioner becomes incapacitated.
How to respond to power failure emergencies.
How to transport patients in emergencies.
A plan for emergency evacuations.

## K. THE FOLLOWING RESUSCITATION PROTOCOLS ARE IN PLACE IN THE FACILITY

ANTICIPATION AND PREVENTION OF COMPLICATIONS:

Careful patient assessment and selection prior to procedures.
Staff to be well versed in emergency management.
Careful patient monitoring throughout stay in surgical facility.
Patients are only to be discharged when they meet discharge criteria.

EQUIPMENT AND EMERGENCY DRUGS AVAILABLE FOR RESUSCITATION:

Oxygen cylinder with pressure gauge attached to face mask.
Reserve oxygen cyclinder.
Bag mask valve with reservoir to provide 100% oxygen.
Laryngoscope with different blade sizes and working lights.
Laryngeal masks.
Oropharyngeal airways sizes 0-2.
Entracheal tubes from sizes 5-8.
Emergency drugs:



1. Epinephrine.
2. Atropine.
3. Naloxone.
4. Flumazenil.
5. Hydrocortizone.
6. $Beta_2$ - Agonists
7. Theopylline.
8. Succinylcholine.
9. Intralipid.

Intravenous fluids: Normal saline and Ringer Lactate solution.
Intravenous cannulas, syringes, needles, swabs.
Working defibrillator that is checked monthly.
Suction apparatus.
Glucose monitor.
Magill's forceps.
Space blankets.

THE FOLLOWING PROTOCOLS ARE IN PLACE IN CASE OF AN EMERGENCY:

Stop surgery.
Stop sedation.
Assess the airway.
Assess breathing.
Consider possible causes.
Manage airway and breathing problems.
Assess pulse, blood pressure, heart rate and rhythm on ECG.
Consider possible causes.
Manage circulation problems.

THE A-B-C-D APPROACH TO SEDATION - RELATED MEDICAL EMERGENCIES[2] IN PLASTIC AND RECONSTRUCTIVE SURGERY:

A. AIRWAY.
B. BREATHING AND RESPIRATORY PROBLEMS.
C. CIRCULATION AND CARDIOVASCULAR COMPLICATIONS.
D. DRUG COMPLICATIONS / DEFIBRILATE.



AIRWAY:

Warning signs of airway compromise may be:

Snoring – be aware that obese patients may have obstructive sleep apnoea.
Paradoxical chest movements.
Dropping oxygen saturation.
Cyanosis, which is a late sign.

Possible causes:

Airway obstruction – one patient was found to be chewing gum during pre sedation assessment. Always ask about dentures.
Laryngospasm – especially during winter months when the patient has a cold and is given ketamine.

[2] Fighting Heart Disease and Stroke ; American Heart Association Advanced Cardiac Life Support Provider Manual 2005 edition.

Apnoea due to the combination propofol/alfentanil/midazolam and ketamine.
Local anaesthetic toxicity causing respiratory depression
Anaphylaxis.

A. BREATHING:

Warning signs of breathing problems may be:

Snoring.
Paradoxical chest movements, no air entry.
Dropping oxygen saturation levels.
Cyanosis.

Possible causes:

Apnoea / hypoventilation due to co-administration of drugs.
Apnoea due to a rapid bolus dose of ketamine.
Muscle rigidity from the opioids.
Pneumothorax during breast augmentation / liposuction.
Respiratory depression due to local anaesthetic toxicity.
Bronchospasm, angio-oedema, urticaria and repiratory arrest due to anaphylaxis from local anaesthesia.

AIRWAY MANAGEMENT

Open airway with chin lift or jaw thrust manoeuvres.
Remove airway obstruction.
Provide 100 % oxygen.
Secure airway with oral airway.
Provide positive pressure ventilation with bag mask valve.
Intubate and ventilate with oxygen attached to bag mask valve if necessary.

C.CIRCULATION

Warning signs of circulatory problems may be:

Hypertension.
Hypotension.
Arrhythmias.
Bradycardia.
Sinus tachycardia.
Venticular fibrillation.
Asystole.

Possible causes:

Arterial blood pressure can increase by as much as 25% with high ketamine use.
Epinephrine can cause a transient rise in systolic blood pressure with no change or a decrease in diastolic pressures.
Intranasal cocaine used during rhinoplasty can cause hypertension and tachycardia.
Hypotension has been attributed to propofol and alfentanil during surgery.
The first signs of local anaesthetic toxicity for a sedated patient could be hypotension, bradycardia and asystole. The cardiovascular signs that develop as a result of continued toxic levels are as a result of myocardial depression (reduction of contractility via a reduction of sodium entry) with the local anaesthetic having a negative inotropic effect on the myocardium. Local anaesthetics also have a direct peripheral vasodilatory effect, which can cause resistant life threatening hypotension. Opioid analgesics used perioperatively with local anaesthetics may have additive respiratory and cardiac depressant effects.
Any drug with cardiovascular or central depressant effects, when used in combination with local anaesthetics, should be regarded as potentiators of toxicity.
Bradycardia may be one of the side effects of alfentanil.
Bradycardia can develop as a result of hypoxia.
Sinus tachycardia is commonly associated with lignocaine toxicity.
Ventricular fibrilation is associated with bupivacaine toxicity.

Managament of circulatory complications:

Hypertension -
The initial blood pressure should be verified.
Make certain at the preoperative evaluation that a hypertensive patient has taken his/her anti-hypertensive medication.

Treat the cause.
Reduce intravenous fluid administration.
Consider a combination of an Alfa and Beta-blocker.
Consider a nitroglycerin drip at 10 – 20 µg / min.

Hypotension -
Treat the cause (make a diagnosis).
Hypotention should be managed aggressively with intravenous fluids.
Crystaloids or colloids should be given if there is hypovolaemia.

Bradycardia -
A bradycardia (less than 50 beats per minute) with a low blood pressure may have to be treated with atropine 0.5- 1mg i.v.

Tachycardia -
If tachycardia is due to lignocaine toxicity the patient should be admitted to high care unit until the effects of the local anaesthetic drugs have worn off.



Ventricular fibrillation -
Perform CPR until the defibrilator is attached.
Defibrilate up to 3 times at 200J, 200-300J, 360J.
Continue CPR.
Give adrenalin 1mg i.v.bolus repeated every 3-5 minutes.
Defibrilate at 360J 30-60 seconds after each dose of medication.

Asystole -
Continue CPR
Intubate immediately
Give adrenalin 1mg i.v. every 3-5 minutes
Give 3mg atropine

LOCAL ANAESTHETIC TOXICITY

Because local anaesthesia is such an important part of analgesia during sedation the following considerations are important:

There are contra-indications to using local anaesthetics. Patients should be screened for known allergies to local anaesthesia, heart block, liver disease and hypovolaemia. There should also be caution with patients who have associated illnesses. As with any drug, the best way to prevent toxicity is to use the lowest possible concentration and volume to produce the desired effect and to add epinephrine to slow vascular uptake through vasoconstriction.

Even though local anaesthetic agents were a major factor in the office based revolution, the prevention and management of local anaesthetic toxicity to maximise patient safety should remain a priority.

As many plastic surgery cases are done using a combination of local anaesthesia and sedation, the sedation could mask many of the early symptoms of toxicity.
The central nervous system can either become stimulated or depressed by toxic local anaesthetic effects.
With stimulation the patient can develop:

Anxiety.
Restlessness.
Tachycardia.
Tremor.
Agitation.
Convulsions.



With central nervous system depression the patient could become comatose due to the toxic effects of the local anaesthetic on the respiratory and cardiovascular centres in the brain. It is important to note that both phases do not always occur together and only excitation or depression may occur.

The cardiovascular signs that develop as a result of continued toxic levels are as a result of myocardial depression (reduction of contractility via a reduction of sodium entry) with the local anaesthetic having a negative inotropic effect on the myocardium.

The clinical diagnosis of local anaesthetic toxicity should be anticipated and treatment should be instituted immediately by:

Stopping all local anaesthetic sources.

Supporting the airway with oxygen supplementation.
Treating seizures with benzodiazepines or barbiturates.
Intubation with mechanical ventilation may be necessary, secondary to induced respiratory depression or arrest.
Hypotention should be managed aggressively with intravenous fluids.
Ventricular arrythmias should be managed with the appropriate advanced cardiac life support algorithm.
The patient should be admitted to high care unit until the effects of the local anaesthetic drugs have worn off.

Rapid action should be taken to ensure patient safety if anaphylaxis occurs with symptoms and signs such as:

Angio-oedema.
Urticaria.
Bronchospasm.

It is advised that the following should be done:

The patient's airway should be secured with the administration of 100% oxygen.
The patient should receive intravenous epinephrine (0.5 – 1 ml of 1: 1000), which should be repeated after 10 minutes until the patient's arterial pressure and pulse improve.
Crystaloids or colloids should be given in the case of hypotension.
The secondary therapy should be started once the arterial pressures and pulse have improved by giving an anti-histamine as a slow intravenous injection.
For patients who have bronchospasm, nebulised salbutamol may be given. Aminophyllin 250 mg can be administered by slow intravenous injection in more resistant cases.
After a local anaesthetic reaction the patient should be admitted to hospital and observed for at least 24 hours after the reaction.

The keys to managing local anaesthetic induced complications are:

To prevent the problem by doing careful patient selection.
To prevent toxicity from occurring by using the lowest possible local anaesthetic doses.

To anticipate the complications by having all the resuscitation equipment and drug readily accessible (regular checks should ensure that the equipment function, batteries are charged and drugs have not passed expiry dates).

The fact that local anaesthetic toxicity can be:

unpredictable,
masked by the sedation process,
caused when used together with drugs that have cardiovascular or central depressant effects,

necessitate the presence of a clinician, at the patient's side throughout the procedure, dedicated to the early detection and management of this clinical problem.

In a recent interesting editorial by Picard [36] he discusses the merits of using a lipid emulsions, Intralipid®, to treat local anaesthesic toxicity.

Intralipid contains the following:



Soya oil.
Glycerol.
Egg phospholipids.

Propofol contains:

Soya oil
Glycerol
Egg phospholipids

Picard's editorial describes how rats were given varying doses of bupivacaine. When the rats became asystolic they received cardiopulmonary resuscitation followed by an intravenous dose of either:

Saline or Lipid

Comparison of the dose survival curves for the two groups showed:

The toxic bupivacaine dose was 50% higher in the group that received the lipid.
The universally fatal dose in the saline group was survived by all the rats in the lipid group.

The experiment was repeated with dogs with the same dramatic results.
All the dogs in the lipid group survived and regained a normal heart rhythm.

Picard postulates that the lipid could deactivate the local anaesthetic.
Based on their findings, he has recommended a dose regimen for clinical use in patients with local anaesthetic toxicity.
In cardiac arrest secondary to local anaesthetic toxicity, which is unresponsive to standard therapy, intravenous administration of Intralipid® 20% is recommended in the following regimen:

1. Give 1ml/kg over 1 minute.
2. Repeat twice more at 3-5 minute intervals.
3. Then convert to an infusion rate of 0.25 ml/kg/min, continuing until haemodynamic stability is restored.
4. When resuscitating an adult patient weighing 70 kg use the following regime:



Take a 500 ml bag of Intralipid® 20% and a 50 ml syringe.
Draw up 50 ml and give it as a stat intravenous dose, then draw up another 20ml and give that intravenously.
Repeat the 20ml dose twice as you give epinephrine.
Then attach the Intralipid® bag to an administration set and run it in over the next 15 minutes.

Picard feels that although there are shortcomings to this theory in terms of evidence, we have no choice but to consider this treatment option.
The fact that local anaesthetic toxicity is rare, unpredictable, severe and overwhelming makes controlled and ethical trials on humans impossible.

He also comments that a treatment such as this appears to benefit patients *in extremis,* and is therefore not susceptible to standard prospective randomised controlled trials. High-grade evidence will never be available.
The author compares this dilemma with dantrolene used for malignant hyperthermia where controlled trials were also impossible and dangerous to

carry out, yet it is currently widely used and the treatment of choice for this problem.
Picard [36] feels that the lipid emulsion should be available in all institutions where patients receive large bolus doses of local anaesthetics.

Our facility currently stocks Intralipid® in the fridge, as the risk for local anaesthetic toxicity is high with plastic and reconstructive operations done under local anaesthesia and sedation.

The author concludes that propofol is not a suitable "lipid" alternative because, to give a sufficient dose of the carrier lipid would constitute a propofol overdose.
An interesting question that is raised from this editorial is:

> Whether propofol infusion lends protection against local anaesthesia toxicity?

THROMBO-EMBOLISM

The literature survey on complications showed that postoperative thrombo-embolism remains a risk for patients undergoing plastic and reconstructive surgery. Several clinical steps, devices, and medications are available that have proven effective for the prevention of deep vein thrombosis. Statistics show that a number of patients who suffer an embolic event will die before potentially effective treatment can be initiated.
Graded elastic compression stockings that increase venous return by applying constant pressure to the legs have been shown to reduce the incidence of deep vein thrombosis.
Intermittent pneumatic compression devices, which apply variable and intermittent positive pressure to the legs, enhance venous return.

The relative risk of a deep vein thrombosis with the use of one of these devices is approximately 0.28 %. These devices have been shown to induce fibrinolysis and cause the release of antiplatelet aggregating factors. The devices have been described as being of low cost, leading to a suggestion that they should be used in any lengthy plastic surgery procedure.

Anticoagulants are also shown to be useful for patients with high risk of developing venous thrombosis.

The low molecular weight heparins such as enoxaparin (Clexane®) can also be useful. It is reported that there is a lower incidence of thrombocytopaenia and a lower rate of intraoperative bleeding. It has been shown that, if the first dose of these drugs are given two hours before surgery, the incidence of deep vein thrombosis can be reduced during the perioperative period. To further prevent thromb-oembolic phenomena, it is suggested that patients are to be questioned about risk factors for thrombosis such as a malignancy history, hormone usage and a family history of hypercoagulable states. It is also suggested that if high-risk patients undergo procedures that have a high incidence of thrombo-embolism the risks should be explained to them as part of the informed consent.

Once a deep vein thrombosis has been diagnosed, early and aggressive treatment is necessary. Untreated proximal deep leg vein thrombosis will lead to pulmonary embolism in nearly 50 % of patients. In treated patients it is less than 5 %. Because the symptoms of both deep vein thrombosis and pulmonary emboli are non-specific and may even be absent in some patients, it is important for the physician to have a high index of suspicion in patients complaining of suspicious symptoms, who have recently had any surgery. The symptoms and signs of a deep vein thrombosis may include:



Calf pain and tenderness.
Leg oedema.
Venous engorgement.

The signs and symptoms of pulmonary embolism are:

Chest pain.
Dyspnoea.
Hemoptysis.
Tachycardia.
Tachypnoea.

Once a pulmonary embolism is expected, immediate steps should be taken to confirm the diagnosis by a ventilation-perfusion lung scan and heparinisation should be started without delay.

# CHAPTER 5:

## RESEARCH RESULTS AND ANALYSIS

**A. AGE, ASA CLASSIFICATION, GENDER, WEIGHT.**
**B. PROCEDURE.**
**C. PROCEDURE TIME.**
**D. DRUG USAGE DURING SEDATION PROCESS.**
**E. DRUG USAGE DURING LOCAL ANAESTHESIC PROCESS.**
**F. ACTUAL AND RECOMMENDED DOSES USED AND PERSONAL EXPERIENCE**
**G. PATIENT RESPONSE TO LOCAL ANAESTHESIA.**
**H. SEDATION LEVELS DURING SEDATION PROCESS.**
**I. SEDATION TECHNIQUE**
**J. SURGEON'S PERSPECTIVE ON THE QUALITY OF INTRAOPERATIVE CONDITIONS DURING THE SEDATION PROCESS.**
**K. PATIENT SATISFACTION WITH SEDATION PROCESS.**
**L. ADVERSE EVENTS.**
**M. COSTS.**



### A. AGE, ASA CLASSIFICATION, GENDER WEIGHT

A total of 105 patients were assessed between 22nd January 2003 and 7thSeptember 2005 for this study; 100 female patients (95.2%) and 5 male patients (4.7%).
Only 8 of the patients (7.6 %) were over 65 and 4 of the patients were younger than 25 (3.8%)
The average age of the patients assessed was 46 years.
The average weight of the male patients was 85.12 kg.
The average weight of the female patients was 64.36 kg.
ASA I classification: 94 patients (89.5%).
ASA II classification: 11 patients (10.4%).

COMMENTS

The patients in this research project can be divided into two groups:

Those having cosmetic surgery.
Those having reconstructive surgery.

The patients having plastic or cosmetic surgery have a different attitude than those having reconstructive surgery.
The patients having plastic or cosmetic surgery have the following in common:

The surgical procedure is by choice.
The surgical procedure is usually carefully considered and well researched.
The patients have time to do mental and physical preparation for the surgery.
The patients arrive at the surgical facility in a positive frame of mind regarding the surgery.
Most of these patients are excited about the prospects of surgery.

The patients undergoing reconstructive surgery have a different attitude because of the following:

Their surgery was not by choice but due to necessity.
The surgical procedure was forced onto them by illness.
There is sometimes very little time to do mental and physical preparation.
The patients are more apprehensive on the day of surgery.
The patients do not look forward to the day of surgery.



## B. PROCEDURE

The procedure distribution was as follows:

- 128 procedures were done on 105 patients because many patients had multiple procedures.
- 39 breast augmentations.
- 4 breast augmentations with additional procedures (liposuction chin, mastopexy, upper and lower blepharoplasty, abdominoplasty).
- 12 breast reduction procedures.
- 1 removal of breast prosthesis due to infection.

- 1 re-implantation breast augmentation.
- 1 mastopexy with liposuction.
- 1 breast reduction with liposuction of the hips.
- 3 rhytidectomies (face lifts).
- 5 rhytidectomies with additional minor procedures (lower blepharoplasty, neck lift procedure, liposuction chin, chemical peel).
- 11 abdominoplasties with liposuction.
- 4 abdominoplasties with additional procedures (mastopexy, excision skin tumor, blepharoplasty).
- 1 upper and lower blepharoplasty.
- 1 blepharoplasty with excision of basal cell carcinoma of the face.
- 1 Z plasty of the neck with liposuction.
- 10 cases of liposuction.
- 5 cases were skin tumours were excised and grafts were done.
- 1 calf implant for a patient with calf atrophy due to polio.
- 4 rhinoplasties.

COMMENTS

Of the 128 procedures done, 23 involved more than one procedure during the same sedation. These procedures usually involved a major procedure and an additional minor procedure, so care was taken that the recommended dose for local anaesthesia was not exceeded.

## C. PROCEDURE TIME

The average surgery time was 135 minutes.
The shortest procedure was done in 45 minutes.
The longest procedure took 195 minutes.
A total of 14178 minutes was spent doing surgery on the 105 patients.

COMMENTS

Some patients enquired about the time during the procedure. The impression was that the patients experienced that time was passing quickly while under sedation.
For all the procedures the patient's arms were positioned at 90 degrees to their bodies on comfortable arm supports. The patients were told

that their arms would be strapped down during the procedure so that they would not inadvertently touch the sterile area while under sedation. All the patients accepted this explanation. Some patients complained of stiffness in their arm and shoulder areas during the procedure, after lying in this position for long periods. These patients were allowed to move their arms during the procedure. Their arms were then re-strapped and the procedure would continue.
A sheepskin covered with a plastic covering is placed on the operating table for all long procedures, to enhance patient comfort.

## D. DRUGS USED DURING THE SEDATION PROCESS

A syringe filled with 200mg of a 10 mg / ml propofol 1% solution and 2 ml of a 0.544 mg / ml alfentanil was placed in a Graseby pump. Once the contents of the 22 ml syringe had been administered to the patient it was replaced by another syringe containing propofol only.
In the research project 27671 mg of propofol was given at a rate of 4 mg / kg / hr.
This equates to 263 mg of propofol at an average of 2.5 ampoules per patient.
One 2 ml ampoule of the alfentanil (0.5 mg / ml) was used per patient.
A total of 2100 mg of ketamine was administered to the patients. The bolus dose of 20 mg worked out at between 0.25 – 0.3 mg / kg for the patients in this research project.
.

COMMENTS

At a dose of 20 mg of ketamine, the patients reached a Frizelle [19] 5 score (eyes closed, loss eyelid reflex, unarousable to physical stimulation) within 2 minutes of the bolus dose.
The period of dissociative anaesthesia (measured from the time of loss of eyelid reflex to the time the patient would start responding to verbal commands) on this dose lasted an average of 15.01 minutes.
This period allowed the surgeon adequate time to inject local anaesthesia into the surgical fields.

## E. DRUGS USED IN THE LOCAL ANAESTHETIC PROCESS

BREAST AUGMENTATIONS

In the local anaesthetic technique during breast augmentations the patients received 80 – 100 ml of a solution mixed as follows:

100 ml of normal saline.
20 ml of 2% lignocaine.
20 ml of bupivacaine 5mg/ ml.
0.5 ml of epinephrine 1mg/ml.
1ml of hyalase 1500 iu / ml.
The injections were given using a spinal needle.

The local anaesthetic doses used for breast augmentations in this research project were as follows:

- 226.4 – 283 mg of lignocaine, or 3.52 – 4.4 mg/kg for the average 64.36kg female patient.
- 58.6 – 71 mg of bupivacaine or 0.91 – 1.1 mg/kg for the average female patient.
- 0.32 – 0.4 mg of epinephrine.
  848 – 1060 iu of hyalase.



COMMENTS

When one uses the synergistic properties of the different drugs used for local anaesthesia one can contribute to patient safety. By using hyalase with bupivacaine and lignocaine the hyalase allows for rapid, widespread dispersal and absorption of the local anaesthetic. The hyaluronidase acts on hyaluronic acid which is present in the intracellular matrix of connective tissue, making the intercellular "cement" more permeable to injected substances and thereby causing a better spread of the local anaesthetic. The fast action of lignocaine and the longer duration of action of bupivacaine are both potentiated by epinephrine. Epinephrine almost doubles the duration of the local anaesthetic activity while also causing a decrease in bleeding in the

operative area. By using the synergy between these drugs a more complete block of the surgical field is established, using smaller doses. The long acting bupivacaine block also provides the patient with immediate post-operative analgesia. The smaller doses of local anaesthetic reduce the possibility of severe central nervous system or cardiovascular complications associated with the amide-type local anaesthetics.

BREAST REDUCTIONS

During breast reductions the patients received 80 – 100 ml of the following mixture:

100 ml of normal saline.
20 ml of 2% lignocaine.
20 ml of bupivacaine 5mg/ ml.
0.5 ml of epinephrine 1mg/ml.
1ml of hyalase 1500 iu / ml.

The injection was given using a spinal needle.
An additional 50 ml of tumescent was infused per breast under 200 mg Hg of pressure to anaesthetise the perforating intercostal nerves.
The local anaesthetic doses used for breast reduction procedures in this research project was as follows:

- 276.4 – 333 mg of lignocaine or 4.29 – 5.17 mg/kg for the average patient who weighed 64.36kg.
- 58.6 – 71 mg of bupivacaine or 0.91 – 1.1 mg/kg for the average female patient.
- 0.39 – 0.48 mg of epinephrine.
- 848 – 1060 iu of hyalase.

COMMENTS

The patients undergoing breast reduction were carefully selected by the plastic surgeon for the series.
Patients with breasts requiring a reduction of more than 500 grams, were done under general anaesthesia. The volume of local anaesthetic needed to anaesthetise the surgical field would exceed the maximum safe dose for local anaesthesia.

The efficacy of the local anaesthesia in larger breasts was considered suboptimal by the surgeon.

RHYTYDECTOMY - FACE LIFT

During rhitydectomies the patients received 40 ml of a mixture of the following solution:

100 ml of normal saline.
20 ml of 2% lignocaine.
20 ml of bupivacaine 5mg/ ml.
0.5 ml of epinephrine 1mg/ml.
1ml of hyalase 1500 iu / ml.

The local anaesthetic dose for a rhitydectomy was as follows:

- 113.2mg of lignocaine or 1.76 mg/kg for the average 64.36 kg female patient.
- 28.4 g of bupivacain or 0.44 mg/kg in a 64.36kg patient.
- 0.16 mg of epinephrine.
- 424 iu of hyalase.



COMMENTS

Most of the patients undergoing this 3 hour procedure were older woman with a higher ASA classification. These patients were all haemodinamically stable.

LIPOSUCTION

In the tumescent infusion solution for liposuction there was a mixture of the following drugs in a 1000 ml of Ringer Lactate solution:

50 ml of 2% lignocaine.
1ml of epinephrine 1mg / ml.
5ml of sodium bicarbonate 8.5%.

The average volume of tumescent infused was 1450 ml equating to:

- 1537 mg of lignocaine or 23.88 mg / kg for the average female patient weighing 64.36 kg.
- 1.45mg of epinephrine.
- 14.5 mg of sodium bicarbonate.

COMMENTS

The fluid management for these patients was calculated using the following formula:

The volume of fat aspirated.
The volume of tumescent fluid infused.

To balance the patient's fluid requirements during and after the procedure, the aspirated fat volume was multiplied by two, then deducted from the volume of tumescent fluid infused. The volume calculated was the volume of fluid that was needed to be given intravenously.
If 2000 ml of tumescent fluid was infused for a field block and 500 ml of fat was aspirated, the intravenous replacement fluid requirements would be:



- 2000 ml – 1000 ml (500x2) = 1000 ml.
- 1000 ml of intravenous fluid would be given to balance the patient's fluid requirements.

The most fat aspirated during this research project was 1100 ml.

ABDOMINOPLASTIES

The patients undergoing abdominoplasties received 1000 ml of a tumescent solution into the operative field containing:

50 ml of 2% lignocaine.
1ml of epinephrine 1mg / ml.
5ml of sodium bicarbonate 8.5%.

A further 40 ml of a mixture of the following solution was injected into the incision line:

100 ml of normal saline.
20 ml of 2% lignocaine.
20 ml of bupivacaine 5mg/ ml.
0.5 ml of epinephrine 1mg/ml.
1ml of hyalase 1500 iu / ml.

The total dose of lignocaine for patients undergoing an abdominoplasty was:

- Lignocaine 1160 mg at 18 mg / kg for the average 64.36 kg patient.
- Bupivacaine 40 mg at 0.6 mg / kg.

COMMENTS

To reduce the risk of postoperative thrombo - embolism, these patients' knees were flexed to approximately five degrees by placing a pillow underneath them. This simple procedure increases the popliteal venous return.



BLEPHAROPLASTIES

Each eyelid was injected with 2 ml of a of a mixture of the following solution:

100 ml of normal saline.
20 ml of 2% lignocaine.
20 ml of bupivacaine 5mg/ ml.
0.5 ml of epinephrine 1mg/ml.
1ml of hyalase 1500 iu / ml.

COMMENTS

The content of a 1.8 ml lignocaine dental ampoule was removed and replaced with this solution. The 2 ml of this solution was injected with a dental syringe into each eyelid. The long acting local anaesthesia provides excellent postoperative pain relief.

## F. ACTUAL AND RECOMMENDED DOSES USED AND PERSONAL EXPERIENCE

MIDAZOLAM

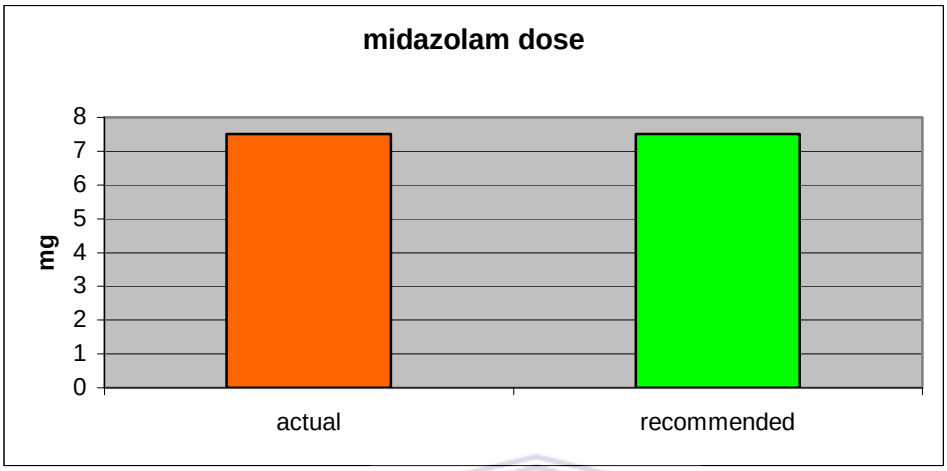



Chart 1.

The recommended dose for oral midazolam is between 7.5 and 15mg. The recommended oral dose of 7.5mg was adhered to in this research project.

When midazolam is used in combination with narcotic analgesics and hypnotics, they do have a synergistic effect. These synergistic properties are used to the advantage of the patient.

In my experience midazolam plays a vital part in the combination of drugs that can be used for sedation. On several occasions patients have forgotten to take their pre-medication, which has a profound effect on the quality of sedation. The unpremedicated patients are anxious preoperatively, the induction to a level of conscious sedation is not as smooth and the patient then needs more sedative hypnotic to achieve the desired effect. Midazolam can be given as an intravenous dose for these patients, at 0.3 mg/kg 5 minutes prior to the start of the propofol infusion.

On the flip side of the coin is the patient who is fast asleep from their pre-medication during the pre-sedation assessment. I use this as an indicator that the patients are sensitive to drugs and increase my vigilance for respiratory depression caused by the combination of a benzodiazipine, a sedative hypnotic and an opioid.

PROPOFOL

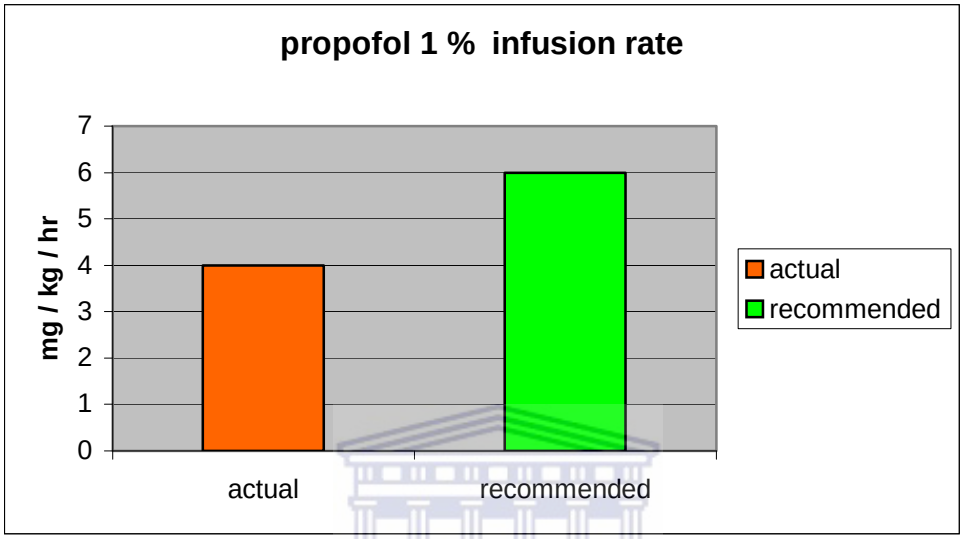



Chart 2.
All the patients in the research project received propofol 1% at the same infusion rate.



Propofol is increasingly used for sedation.
It has a rapid onset of action and produces a smooth induction.
It has a short duration of action and causes a clear-headed euphoric emergence, which contributes to patient comfort and acceptability in the recovery room.
Propofol (10mg / ml) at an infusion rate of 4 mg/ kg / hr keeps most the patients at Frizelle sedation level 3 and 4.

KETAMINE

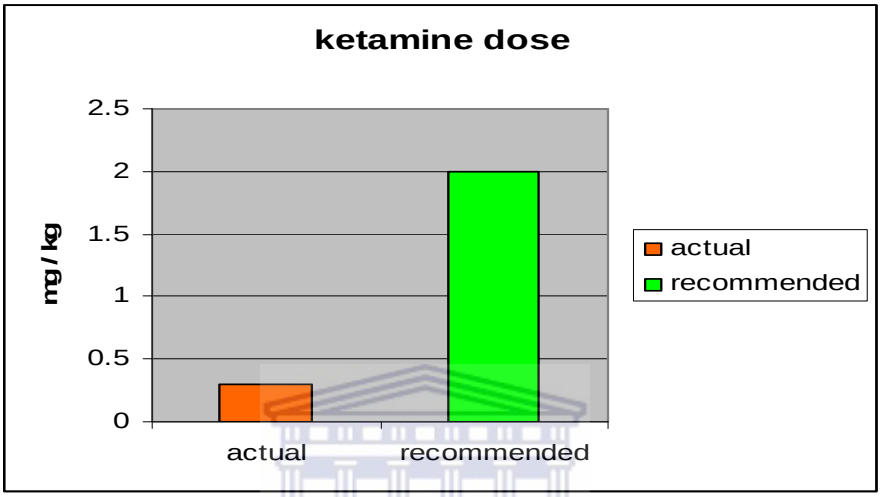



Chart 3. Ketamine was given as a 20 mg bolus injection.

I use ketamine as a bolus dose of 20 mg. This equated to between 0.25 – 0.3 mg / kg for all the patient's weights in this research project.
Ketamine produces an excellent window of dissociation in which the surgeon can introduce painful local anaesthetic injections to an oblivious patient. The onset of action is rapid with loss of eyelid reflexes occurring within 2 minutes after bolus injection. The dose of 0.25 – 0.3 mg/kg seldom causes hypersalivation and I do not routinely give an antisialogogue. I have not experienced any patients having hallucinations, unpleasant dreams or irrational behaviour at these doses.

Friedberg [16,17,18] used a bolus of 50 mg of ketamine intravenously in his propofol- ketamine technique.
With this dose of ketamine:

The incidence of postoperative nausea and vomiting is higher.
The patients are more talkative during the procedure.
There is a higher incidence of hypersalivation requiring an antisialogogue.
There is a higher incidence of hallucinations.

At a ketamine dose of between 0.25 and 0.3 mg / kg, the dose used in this study:

The incidence of postoperative nausea and vomiting was 4%.
The patients were less talkative during the procedure.
Only one patient required an antisialogogue.
No patients had hallucinations.
At this dose the dissociative phase was long enough for the surgeon to inject the local anaesthetic without patient discomfort.

ALFENTANIL

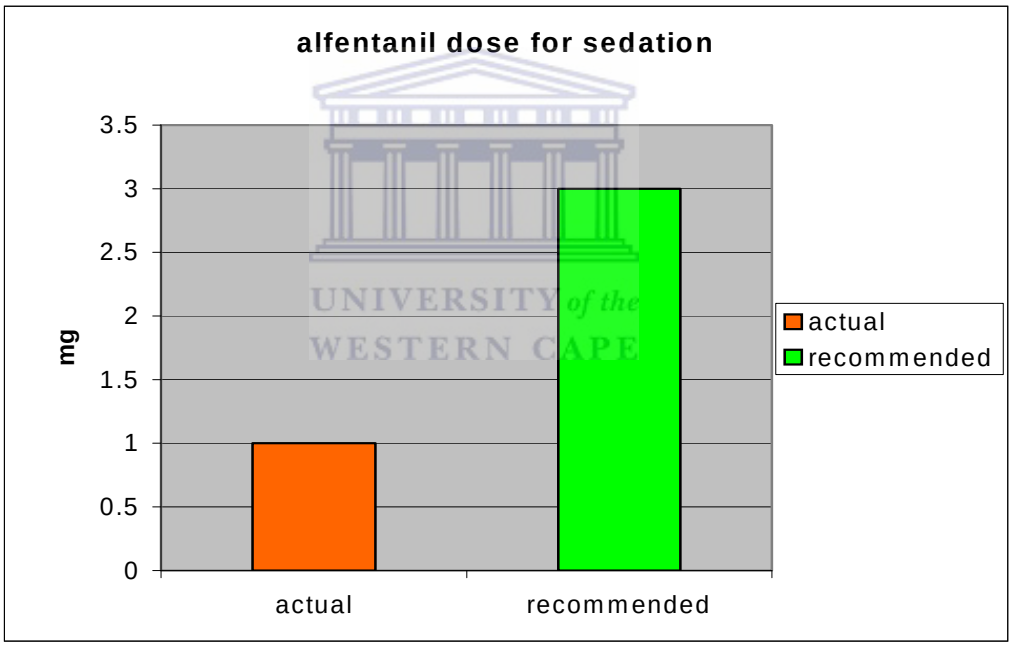



Chart 3.
One milligram of alfentanil was given to all the patients in the research project.

The alfentanil dose was also well below the recommended dose and was given slowly together with the propofol. One mg of alfentanil was premixed with 200 mg of propofol. There was never a need to use naloxone or atropine to prevent alfentanil related complications such as respiratory depression or bradycardia. Using a sedation technique without alfentanil

leads to more patient movement during the procedure, even with adequate field block. The patients are more aware of movement and pressure at the operating site. It is well known that the effects of alfentanil are potentiated by propofol.

The recommended dose for local anaesthesia was never exceeded in this research project. The combination of epinephrine, bupivacaine, lignocaine and hyalase provides a highly effective and safe local anaesthetic block.

## G. PATIENT RESPONSE TO LOCAL ANAESTHESIA

The patient's pain response to the injection, or infusion of local anaesthetic while under ketamine sedation was assessed using verbal response as an assessment tool. The response was assessed using a four point scale:

1 = none
2 = mild
3 = moderate
4 = severe

The patient responses can be seen in Chart 4



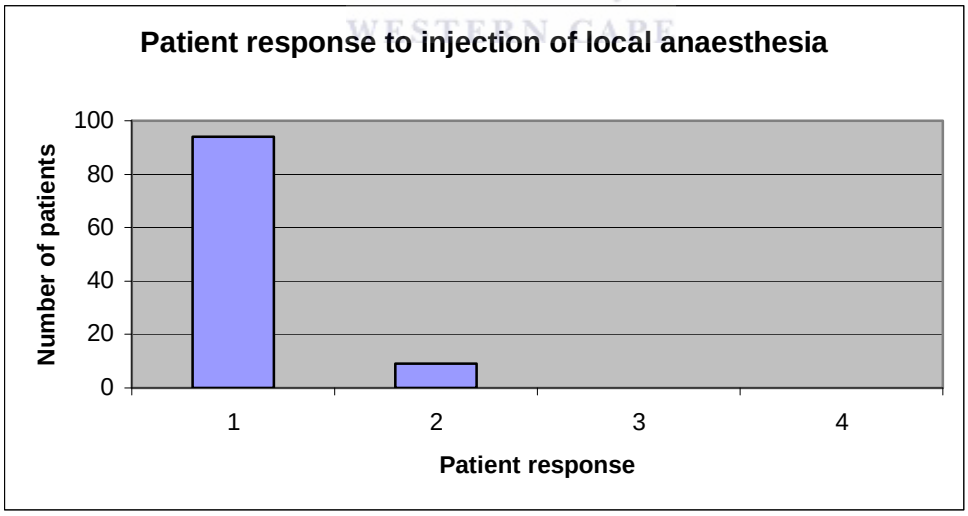



Chart 4

COMMENT

In the research project 98 (93.3 %) of the patients had no response to the injection or infusion of local anaesthesia, while the other 9 patients

(8.5 %) either frowned or moaned during the painful injection of local anaesthesia. None of the patients, who moaned or frowned during the injection of local anaesthesia, had any recollection of the injections afterwards.

## H. SEDATION LEVELS DURING SEDATION PROCESS

The following figure illustrates the different stages of sedation that the average patient (64 kg female patient undergoing a 135 minute procedure) would have gone through in this research project.
The sedation score is based on a five level sedation score published by Frizelle et al. [19] where different scores represent differing levels of sedation:

1. Fully awake and orientated patient.
2. Drowsy patient.
3. Eyes closed but arousable on command.
4. Eyes closed but arousable to mild physical stimulation.
5. Eyes closed but unarousable to mild physical stimulation.

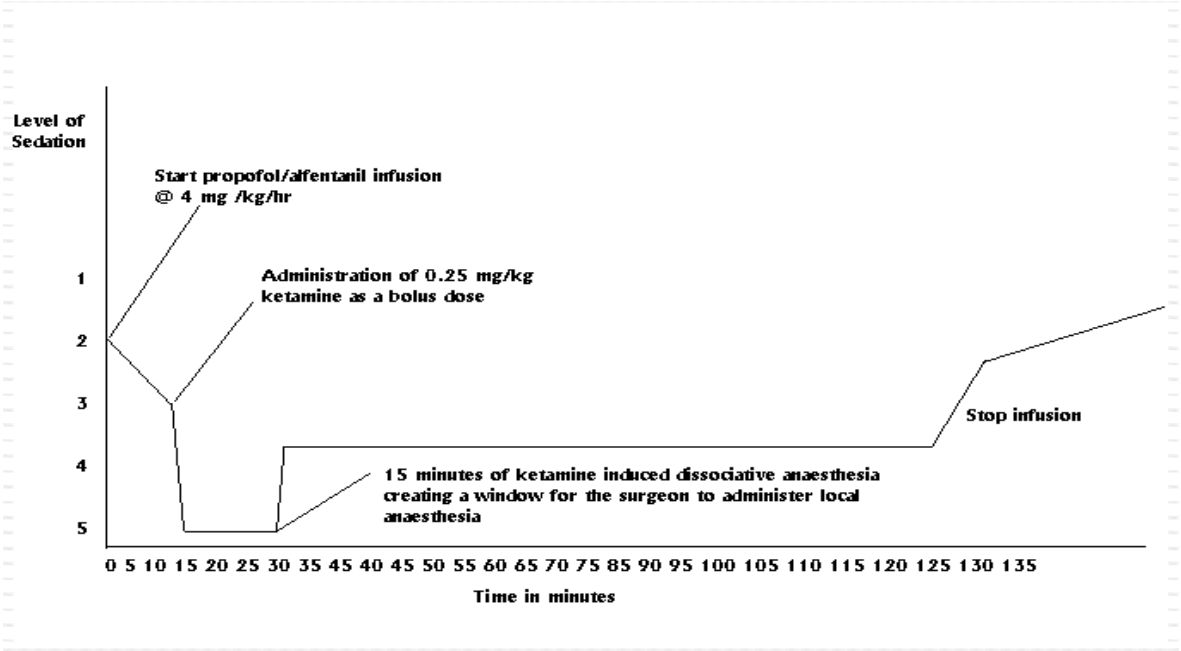



Figure 1.

## I. SEDATION TECHNIQUE

The propofol /alfentanil infusion was started as soon as the intravenous line had been set up on a drowsy, premedicated patient. The surgical field was then sterilised and the patient was draped. This process took about 10-12 minutes. During this time the sedation level dropped from level 2 to level 3. A predictable and reproducible level of hypnosis was achieved within 30 seconds of starting the infusion at 4 mg / kg / hr or 0.4 ml / kg / hr.

Once the surgeon started preparing the injections for local anaesthesia, the dissociative dose of ketamine was given. Two minutes after administration of ketamine, the surgeon proceeded with the injection of local anaesthesia. This dose of ketamine together with propofol / alfentanil produced a predictable window of time for the surgeon to inject relevant local anaesthetic via tumescence, field block, nerve block or a combination thereof.

Once the local anaesthesia was administered, the patients would spontaneously and predictably return to level of sedation 3 and 4, in which state they would either be talkative or quiet during the duration of the procedure. If the surgeon operated in an area with inadequate local anaesthesia the patient would either move or verbally indicate pain, prompting the surgeon to inject further local anaesthesia.

No change in the sedation technique was required, and none of the patients recalled any pain during any of the procedures.
No procedures were aborted due to the inability to obtain adequate local anaesthesia and sedation.

## J. SURGEON'S PERSPECTIVE ON THE QUALITY OF INTRAOPERATIVE CONDITION DURING THE SEDATION PROCESS.

The surgeon found the sedation technique to be highly satisfactorily in 95 % of the sedations as can be seen in Chart 8.

A three point scale was used to assess the quality of sedation:

1 = Highly satisfactory.
2 = Satisfactory.
3 = Unsatisfactory.

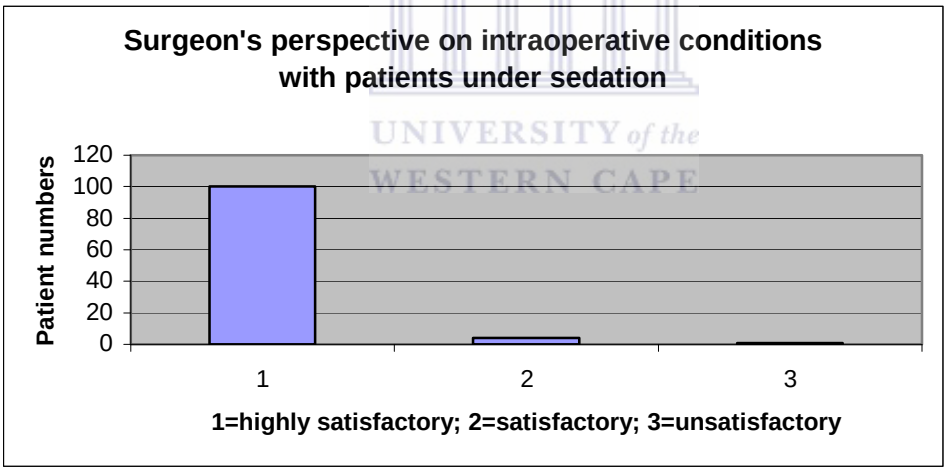



Chart 5

The surgeon was in a position to compare the sedation process used in the office based surgical facility to general anaesthesia for the same procedure. The surgeon commented that:

The lack of movement from the patient approximates that of general surgery.
He experienced less intraoperative bleeding in the surgical field under the sedation technique.

The same procedure done in theatre was not cost competitive compared to the procedure done in his office based surgical facility.
The sedation process allowed him to discharge the patient within hours from office based surgical facility, as opposed to an overnight stay when the procedure was done under general anaesthesia.
The patients experienced less postoperative pain when done under sedation versus general anaesthesia.
He was of the opinion that the patients had less postoperative nausea and vomiting after the sedation process.
The sedation process in an office based facility enabled him to offer the patients a level of privacy that he could not do in a hospital setting.
In his subsequent follow up of the patients, he found them to have had a positive sedation experience.

## K. PATIENT SATISFACTION WITH SEDATION PROCESS

Chart 6. shows patient satisfaction with the anaesthetic management on a 3 point scale:

1 = Very satisfied
2 = Satisfied
3 = Dissatisfied



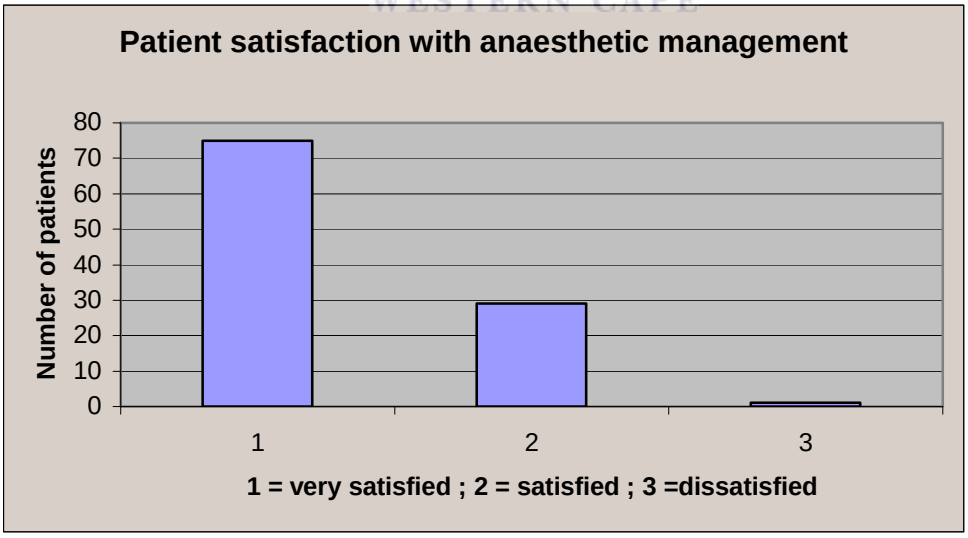



Chart 6.

The 104 patients were satisfied with the technique and would choose the same sedation technique again. The patients (3.8%) who had experienced nausea and vomiting were willing to undergo the same

sedation technique for subsequent procedures During the postoperative telephone interview one patient said that she was not satisfied with the technique, preferring to be done under general anaesthesia. None of the patients experienced nausea, dreams or unusual psychological reactions on the day after surgery. Most of the patients were experiencing pain on day one after surgery, but were responding to the prescribed analgesics. A combination of paracetamol and a non-steroidal anti-inflammatory drug were administered. No opiates were needed.

COMMENTS

In this study many patients were anxious about having the procedure done under sedation. Their apprehension stemmed from:

The concern that they may feel pain, or be aware during the procedure. The fact that sedation and analgesia is a relatively new concept to most patients.

This anxiety existed even after the surgeon had explained the concept of sedation and local anaesthesia, and after the patient had been given an information leaflet explaining the concept. This again shows that communication and reassurance are important before using any sedation technique.



## L. ADVERSE EVENTS

OXYGEN SATURATION

The average pre-operative saturation was 98% the average saturation levels during the procedures were between 98% to 92% breathing room air spontaneously.
In 15 % of patients the saturation dropped below 90%, which was corrected, with either a chin lift or jaw thrust airway support manoeuvre.
At no stage was supplemental oxygen required to increase the saturation.

The desaturation occurred especially after the ketamine bolus had been given.
This is a very important point when a ketamine bolus dose is used. With rapid administration administration of ketamine, oxygen saturation levels can drop significantly – ketamine crosses the blood – brain barrier quickly.

## BLOOD PRESSURE

The average preoperative arterial blood pressure of the patients in the study was 140.38 / 80 mmHg.
The arterial blood pressure varied between 140.38 / 80 mmHg to 124.08 / 71.91 mmHg. This represents an 11% drop in systolic blood pressure and a 11% drop in diastolic pressure.

There were no hypotensive episodes.
There were no hypertensive episodes.



## COMMENTS

The intravenous cannula was always placed in a large forearm vein in this study for the following reasons:

Fluid administration can be increased rapidly in case of a hypotensive episode from whatever cause.
Venoirritation is less common when the infusion of propofol is into a larger vein.
The placement of the needle is less painful when done in the antecubital fossa of the forearm, as opposed to the hand.

## POST OPERATIVE NAUSEA AND VOMITING

Postoperative nausea and vomiting (PONV) is a troublesome side-effect after general anaesthesia. In this study using a sedation technique:

Postoperative nausea and vomiting (PONV) occurred in 4 patients (3.8%) while in the recovery room.
There were no episodes of nausea or emesis intraoperatively.

Odansetron 4 mg/2ml intravenous injection (Zofran) or metaclopramide (Maxolon) 10 mg / 2ml were given to the patients with postoperative nausea and vomiting.
All the patients responded well to the anti-emetics administered. There was no delay in discharge.
Three patients (2.8 %) reported having pleasant dreams during the sedation.

OTHER COMPLICATIONS

Eight patients (7.6%) complained of pain at the infusion site, which was treated with a bolus injection of 5mg of lignocaine 1%.
An itchy nose, probably caused by alfentanil, was a problem during the research project. The patients were informed before the sedation process that their noses could itch.
Only one patient developed hypersalivation, requiring the administration of 1 mg of the anti-sialogogue glycopyrrolate 2mg / ml (Robinul).
Nystagmus was observed in 4 patients (3.8%) after the ketamine bolus injection.
No nystagmus was observed during recovery.
No cases were aborted or converted to continuous deep sedation or general anaesthesia.
There were no hospital admissions in this series.
Most patients experienced mild euphoria postoperatively.



Table 1. Summary of adverse events seen in the research project.

| | Patients |
|---|---|
| Episodes of apnoea. | 2/105 |
| Hypotensive episodes. | 0 |
| Hypertensive events. | 0 |
| Desaturation below 90% requiring airway intervention. | 16/105 |
| Hypersalivation. | 1/105 |
| Unacceptable movement during surgery. | 1/105 |
| Movement during injection of local anaesthetic. | 9/105 |
| Emergence dysphoria. | 3/105 |
| Emesis. | 4/105 |
| Pruritis | 45/105 |

| | |
|---|---|
| Hiccups. | 0 |
| Hallucinations. | 0 |
| Laryngospasm. | 0 |
| Nystagmus. | 4/105 |
| Prolonged somnolence. | 0 |
| Pain at propofol infusion site. | 8/105 |
| Signs of local anaesththetic toxicity. | 0 |
| Signs and symptoms of anaphylaxis due to local anaesthetic toxicity. | 0 |
| Signs and symptoms of thromboembolism. | 0 |
| Hospital transfers for sedation or surgical complications. | 0 |
| Deaths related to sedation or surgical complications. | 0 |

COMMENTS

In the research project there were no complications that required resuscitation.
The episodes of apnoea and episodes of desaturation were addressed using chin lift or jaw thrust manoeuvres.
There were no complications due to local anaesthetic toxicity.
The incidence of minor complications was 69%.
The incidence of complications requiring airway intervention was 17%.

## M. COST

A cost comparison was done for a breast reduction procedure done in:

A private hospital theatre.
An office based surgical facility.

A quote was obtained from a private clinic in George and from the office based surgical facility of Dr IC Mc Gibbon.
The quote for a breast reduction procedure was:
R29 000 in theatre.
R 17 000 in the office based facility.

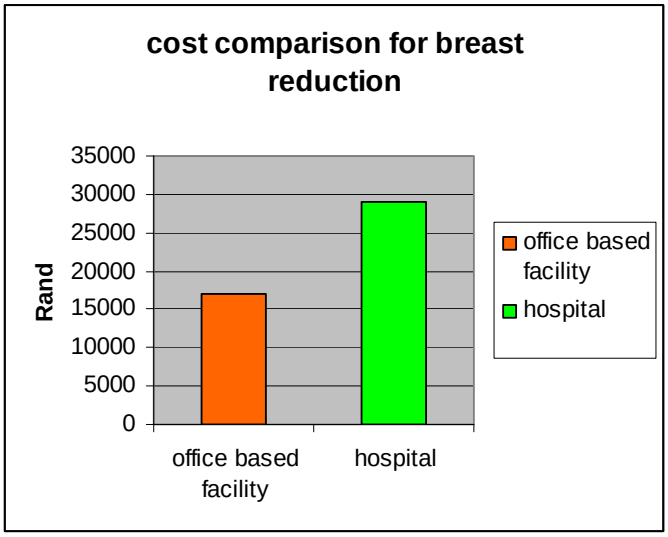



Chart 7

The theatre cost was R12 000 more expensive than the same procedure done in an office based facility. The reasons for this were due to the following:

The theatre charges R83.50 per minute for theatre time.
The cost for gasses used for such a procedure amounted to R1 100.
Sixty percent is then added to this fee to account for disposables and drugs used during the anaesthetic process.

The anaesthesiologist fee and surgeon fee were similar at both venues.

A cost analysis was done for the Propofol / Alfentanil / Ketamine technique. The cost analysis was for the average 64 kg female patient undergoing a 135 minute procedure. The prices obtained, were based on the 2006 single exit price for drugs and equipment used:

- 7.5 mg midasolam tablet as pre-medication R 2.88
- 2.5 propofol 20 ml ampoules per patient R 56
- 1 alfentanil 2 ml ampoule per patient R47.20
- 20 mg of ketamine per patient R 2.67
- One extension set R 12.46
- One Jelco IV catheter R 14.93
- 2 x 20 ml syringes , 1 x 3 ml syringe and hypodermic needles R 4.36
- 1 litre of Ringer-Lactate with administration set per patient R 26.21
- 1 gr Rocephin R36.21

The VAT inclusive cost per sedation was: R 231.33

# CHAPTER 6:

# SUMMARY, RECOMMENDATIONS AND CONCLUSION

## A. ACADEMIC AIMS

In this research project the four academic aims were to determine whether a multidrug sedation technique could be done:

Safely
Effectively.
For patients undergoing plastic and reconstructive surgery.
Using a combination of midazolam, propofol, alfentanil and ketamine.

## B. STRATEGIC AIMS

To assess how the standards set for office based surgical facilities impact on patient safety and cost.



## A. ACADEMIC AIMS

SAFETY

The first academic aim was to determine whether the multidrug sedation technique could be done safely (free from danger or risk). It is reasonable to say that this technique can be used safely. The study showed that:

There were no serious cardiovascular complications.
There were no serious respiratory complications.
There was no evidence of local anaesthetic toxicity.
None of the cases were aborted.
There were no hospital admissions.

At no time during the research project was it necessary to activate resuscitation protocols.
There was no evidence of postoperative thrombo-embolism.

## EFFICACY

The second academic aim of efficacy (producing the desired effect) was demonstrated by virtue of the fact that the use of the sedation technique:

Was able to reduce or eliminate patient anxiety in all of the cases. Midazolam provided excellent anxiolysis and amnesia for all the patients in this research project.
Was able to provide a smooth, titratable induction to an end-target of conscious sedation. The target controlled infusion pumps enable the sedation practitioner to make alterations in the target concentration of drugs used, and allowed for a rapidly titratable sedation state to be achieved without over-sedation. The precise titration of sedation depth could be determined, and a predictable and reproducible level of sedation was a prominent feature in this research project.
All the drugs used in the technique had a fast onset of action.
Provided complete analgesia with the administration of local anaesthesia into the operative field.
Ketamine (0.25-0.3 mg/kg), a rapid-acting dissociative anaesthetic drug, produces an anaesthetic state characterized by:

profound analgesia,
normal pharyngeal-laryngeal reflexes,
normal or slightly enhanced skeletal muscle tone,
cardiovascular and respiratory stimulation,
and occasionally a transient and minimal respiratory depression.

For the above reasons the drug was used in this research project.
Extensive literature surveys confirm the safety and efficacy of using ketamine for this purpose.
Results in this study showed that 98 (93.3 %) of the patients had no response to the injection or infusion of local anaesthesia, while the other 9 patients (8.57 %) either frowned or moaned at the painful

injection of local anaesthesia. This provided further evidence of ketamine's efficacy in this field.
The patients returned to a level of conscious sedation for the duration of the procedure.
The combination of propofol and alfentanil administered with an infusion pump at 4 mg/kg/hr at a concentration of 10 mg/ml achieved a predictable and reproducible level of sedation during the duration of the procedure.
Provided the surgeon with a co-operative patient who was oblivious to the surgical procedure. This feature contributed to the patient and surgeon's satisfaction with the technique.
Provided the patients with a clear-headed emergence with minimal side effects.
Allowed the patients to return home on the day of their surgery.
Patient satisfaction was very high with this technique.

FOR PLASTIC AND RECONSTRUCTIVE SURGERY

The third academic aim in this research project was to determine whether the multidrug sedation technique was suitable for patients undergoing plastic or reconstructive surgery.



The surgeon played an important role in this process. With his knowledge of the nature and scope of the procedures, he determined which procedures and patients were suitable to have plastic and reconstructive surgery under sedation.

This academic aim was achieved by virtue of the fact that:

105 patients were deemed suitable for the research project.
10 different plastic and reconstructive procedures were deemed suitable to be done using the multidrug sedation technique in combination with local anaesthesia.
None of the procedures were aborted.
None of the cases necessitated the conversion from sedation to general anaesthesia.
No serious complications were seen.

The following literature surveys support the safety and efficacy multidrug sedations technique for plastic and reconstructive procedures:

Bitar [8] reported on 3615 consecutive patients undergoing 4778 plastic or reconstructive procedures, performed by multiple surgeons under sedation. His findings showed there were no deaths or life threatening complications.
Friedberg [18] reported on safety and efficacy of 1264 plastic and reconstructive surgery cases done using his sedation technique.
Scarborough [39] reported on the safety and efficacy of sedation on more than 5000 patients under going liposuction.
Zol [45] reported on the safety and efficacy of 153 abdominoplasties performed under conscious sedation.
None of the studies report serious complications.

## COMBINATION OF DRUGS

The fourth academic aim was to establish whether sedation could be done safely using a combination of midazolam, propofol, alfentanil and ketamine.
A literature survey of the four drugs was done to establish their pharmacokinetic and pharmacodynamic properties as well as the recommended dosages and side effects.
The research showed the following, regarding the anticipated (reputed) and actual (seen during study) side effects for the four drugs used:

### Midazolam

Anticipated - reputed: Psychiatric and paradoxical reactions: restlessness, agitation, irritability, aggressiveness, delusions, rages, hallucinations.
Actual: The above side effects were not seen using 7.5 mg of midazolam and there was never a need to use flumazenil (0.1 mg/kg) intravenously to reverse respiratory depression or paradoxical reactions.

Anticipated - reputed : Midazolam can unmask pre-existing depression and can lead to an emotional preoperative patient.

Actual: Some of the patients were tearful during the pre-sedation evaluation - this was attributed to anxiety.

Antcipated- reputed: Effects like fatigue, confusion, dizziness, muscle weakness, ataxia and double vision.
Actual: Double vision was encountered in three patients during the pre-sedation evaluation – this was not troublesome to the patients as they were informed about this.

Anticipated- reputed: Cimetidine, ranitidine, erythromycin, diltiazem, verapamil, ketoconazole and saquinavir all inhibit the cytochrome P 450 enzyme 3A. No patient was on any of the drugs.
Actual: These drugs were screened for during the pre-sedation evaluation.

Anticipated- reputed: Midazolam, used in combination with central nervous system depressants, may enhance the central depressive effect.
Actual: This property of midazolam was used to our advantage to give the lowest possible doses of propofol, alfentanil, and ketamine (all central nervous system depressants).



It is also important to note that intravenous drugs were titrated – therefore we were not unduly worried about this possibility.

Short [40] showed that there can be a decrease in the expected $ED_{50}$ (50% of the expected dose) for the following drugs used in the research project:

Midazolam - propofol = 37%.
Midazolam - alfentanil = 46%.
Midazolam - propofol - alfentanil = 42%.
Friedburg [16] showed that it was possible to reduce the propofol requirements by the addition of midazolam premedication.

Ketamine

Anticipated- reputed: Emergence reactions in recovery including vivid and often unpleasant dreams, hallucinations and irrational behaviour.

Actual: These unpleasant side effects were not seen in this research project.

The reason for this can be explained by the following literature findings:
Propofol can block ketamine-induced hallucinations and that it is possible to reduce the propofol requirements by the addition of midazolam as premedication. Friedberg [16]
Midazolam reduces emergence phenomena after hetanil .

Anticipated- reputed: The elderly appear less sensitive to ketamine.
Actual: The same dose of ketamine was used for all the patients, both the elderly and the young. It was shown that 98 (93.3 %) of the patients had no response to the injection or infusion of local anaesthesia while the other 9 patients (8.3 %) either frowned or moaned at the painful injection of local anaesthesia. None of the patients, who moaned or frowned during the injection of local anaesthesia, had any recollection of the injections afterwards.

Anticipated- reputed: Patients may experience increased muscle tone that could resemble a seizure.
Actual: At the doses used in this research project (0.25 – 0.3mg/kg) this side effect was not encountered.

The fact that ketamine increases muscle tone and the fact that patients never lose muscle tone during this sedation technique could protect the patient against the development of postoperative deep vein thrombosis. This may be one of the biggest advantages of this sedation technique when used during plastic and reconstructive surgery, as literature shows:

Pulmonary embolism is the leading cause of death following liposuction, accounting for 23% of the deaths in a study done by Warner [43].
When liposuction was combined with other procedures, the mortality rate increased from 1in 47415 cases to 1 in 7314 cases.
Of all the common plastic surgery procedures, abdominoplasty has the highest rate of thrombo-embolic complications, with estimates as high

as 1.2 % incidence for deep vein thrombosis, and 0.8% incidence for pulmonary embolism.
During facelift procedures the incidence of deep vein thrombosis was 0.35 % and 0.14 % for pulmonary embolism. The combined incidence for this procedure was 0.49 %.
The average plastic surgeon might expect 1 case of either deep vein thrombosis or pulmonary embolism for every 200 facelifts performed.
A major survey done by De Jongh and Grazer[14], showed that general anaesthesia was used in 44 % of facelift patients overall, but in 84 % of patients who developed thromboembolism – suggesting an increased relative risk for facelifts performed under general anaesthesia.

Warner [43] showed that general anaesthesia was an independent risk factor because of the immobility that reduced muscle tone and reduced venous return from the legs and the pelvic areas. He showed that after the first hour of general anaesthesia, there appears to be a linear relationship between the procedure time and the incidence of postoperative deep vein thrombi.

Iverson [22], who led an American Task Force on the issue, concluded that because of the risks involved for deep vein thrombosis during certain plastic and reconstructive procedures "when possible, procedures longer than three or four hours should be performed under local anaesthesia combined with intravenous sedation."

Anticipated- reputed: Respiration may be depressed during rapid intravenous injection – apnoea, and laryngospasm have occurred.
Actual: Two patients had apnoea after the bolus dose of ketamine. The apnoea was managed with airway support as the saturation levels dropped.

At no stage was there the need to intubate any of the patients in this research project. Laryngospasm was not seen.

Anticipated- reputed: Diplopia and nystagmus.
Actual: 4of the patients had nystagmus after the bolus dose of ketamine. There was no nystagmus or diplopia during the recovery phase.

Anticipated- reputed: Nausea and vomiting.

Actual: During the pre-sedation evaluation all patients were asked if they had previously experienced postoperative nausea and vomiting. Marcus [27] showed in his study that such an event should be consider red as a predictor of future episodes of postoperative nausea and vomiting.
Fifteen of the patients in the research project vomited after previous operations under general anaesthesia. Of this group, four patients felt nauseas while in the recovery room. One of the four patients had one episode of vomiting.

Anticipated-reputed: Hypersalivation due to ketamine.
Actual: At ketamine doses of 0.25- 0.3mg/kg, one patient developed hypersalivation after the bolus dose. This was not troublesome but it was decided to give an antisialogogue such as glycopyrrolate.

Propofol

Anticipated-reputed: Propofol can cause apnoea during induction of anaesthesia and special care should be exercised when propofol is used with other respiratory depressants such as the opioids and benzodiazepines.
Actual: Apnoea was not seen during the induction phase prior to the administration of ketamine in this research project, after propofol administration.



Anticipated-reputed: Venoirritation during intravenous infusion.
Actual: The procedure used in this research project was to place the patient's arms in a support at right angles to their bodies, while on the operating table. (See photo 1). This enables the sedation practitioner to place the intravenous catheter in a large antecubital fossa vein. Eight patients required the co-administration of lignocaine to alleviate the problem of venoirritation.

Anticipated-reputed: Propofol may cause a generalised systemic reaction, which may be anaphylactic in nature.
Actual: No systemic reactions or anaphylactic reactions requiring resuscitation were seen due to propofol at an infusion rate of 4mg/kg/hr.

Anticipated-reputed: Propofol can induce excitatory effects in about 14% of patients.
Actual: This side effect was not encountered during research project.

Anticipated-reputed: Propofol may precipitate a convulsion in an epileptic patient.
Actual: One patient was on anti-epileptic therapy. No convulsions were seen during the research project.

Anticipated-reputed: Propofol concentration for loss of consciousness decrease by 0.24ug/ml for every decade from age of 20 years.
Actual: Infusion rate of propofol was not reduced with patient age. This could be seen as a potential weakness in the research protocol. Over-sedation in the elderly patients in this research project was not seen.

Anticipated-reputed: Infusion rates for propofol should be body weight adjusted, scaling propofol use to lean body mass of the patient.
Actual: With the constant infusion rates used in this research project over-sedation was not observed in obese patients.



Alfentanil

Anticipated-reputed: Respiratory depression that may continue into the postoperative period – especially when combining propofol and alfentanil.
Actual: Episodes of apnoea were not observed during the administration of alfentanil during the operation at the doses used in this research project. The drug company warns that drugs such as the benzodiazipines, neuroleptics, barbiturates and other central nervous depressants, such as alcohol, may potentiate the respiratory depression of the opioids. The transient respiratory depression, in some cases during the study, could therefore have been caused by the co-administration of the research drugs. Due to the fact that all the drugs were used at low doses, simple airway manoeuvres solved the problems of respiratory depression. The used of naloxone was never necessary.

Anticipated-reputed: Alfentanil may induce myoclonic movements and may cause chest wall muscle rigidity.
Actual: This side effect was not seen in the research project due to the fact that:

> Alfentanil was given as a slow intravenous infusion and not in large doses.
> Midazolam may have been instrumental in preventing the occurrence of this side effect.

Anticipated-reputed: Alfentanil may cause euphoria.
Actual: Both propofol and alfentanil cause euphoria. Post operative euphoria and long acting postoperative analgesia caused by the local anaesthesia contributed to patient satisfaction. By using different drugs it is impossible to report on alfentanil and possible euphoria.

Anticipated-reputed: Alfentanil may cause allergic reactions and laryngospasm.
Actual: No such complications were encountered.

Anticipated-reputed: Alfentanil may cause bradycardia that may be marked and rapid in onset. The bradycardia may be more pronounced when alfentanil is used with other anaesthetic agents that depress the heart rate and increase vagal activity. Asystole can occur, and the manufactures advise that atropine should be administered if the heart rate is slow.
Actual: As the concentrations of alfentanil used in the research project (1mg during the duration of the procedure) were well below the recommended dose, bradycardia was not seen. Atropine was available in case of bradycardia and hypotension.

Anticipated-reputed: Alfentanil can cause nausea and vomiting.
Actual: Only 4 patients developed postoperative nausea and vomiting. It is not really possible to say which drugs, of the many given, caused this. Pavlin's [34] study highlighted propofol's ability to offset the emetic symptoms that accompanied alfentanil infusions. His study also confirmed other findings that propofol temporarily relieves the symptoms of postoperative nausea and vomiting at sub-sedative doses.

Anticipated-reputed: Alfentanil is metabolised via the cytochrome P450 3A4-enzyme system, which is affected by drugs such as erytromycin, fluconazole and certain antiretrovirals. These products can increase the risk of prolonged respiratory depression.
Actual: These products were screened for in the pre-sedation evaluation.
Patients were not receiving them.

Local anaesthetics – Lignocaine and bupivacaine.

Anticipated-reputed: Lignocain and bupivacaine are contraindicated for patients with heart block and conduction disorders, hypovolaemia and for patients with hepatic impairment.
Actual: Patients with these conditions were excluded from the research project.

Anticipated-reputed: Cimetidine and beta-blockers reduce local anaesthetic metabolism with increased risk of toxicity.
Actual: Patients on these drugs were excluded from the research project.

Anticipated-reputed: Opioid analgesics used perioperatively may have additive respiratory and cardiac depressant effects.
Actual: The results from the research project showed respiratory and cardiac stability.

Anticipated-reputed: The young and elderly have an increased risk for systemic toxicity and the manufacturer suggests that doses should be reduced accordingly.
Actual: The same doses of local anaesthesia were used for all the patients in the research project. No systemic toxicity was observed due to the fact that:

The recommended doses were not exceeded.
The local anaesthesia was combined with epinephrine and hyalase to prevent systemic absorption.
Patients were carefully monitored for toxicity.

Anticipated-reputed: Sedation may mask the warning clinical signs that are indicative of the development of toxicity. Toxic effects have

been reported with blood plasma levels of between 2 – 6 μg/ml. In plastic and reconstructive surgery done under sedation, the combination of sedative drugs with high doses of lignocaine has a high potential for toxicity. The adverse effects of lignocaine are dose related and often result from inadvertent intravascular administration.

The metabolites of lignocaine can display up to 80% of the toxic activities of the parent drug. This phenomenon is of clinical significance when doses are repeated during longer operative sessions of one hour or more, as is the case with plastic and reconstructive surgery. Central nervous system effects include dizziness, light-headedness, restlessness, agitation and euphoria. With increasing toxicity there may be drowsiness, respiratory depression and convulsions.
The cardiovascular signs of toxicity range from prolonged PR interval to complete heart block and asystole on the ECG.
The cardiovascular signs secondary to central effects are bradycardia, hypotension and cardiac arrythmias.
Occasionally lignocaine can cause the patient to present with nausea, chills and transient tinnitis.
Actual: Adequate patient monitoring, a high index of suspicion for toxicity and early treatment is part of the resuscitation management plan for local anaesthetic toxicity.
Any sedation practitioner must be aware of the possibility and clinical symptoms and signs of local anaesthetic toxicity.



Epinephrine

Anticipated-reputed: Epinephrine may produce a wide range of side effects, most of which mimic the symptoms and signs of excessive stimulation of the sympathetic nervous system. The central effects of epinephrine include:

Restlessness.
Tremor.
Irritability.
Psychotic states.

Actual: With the doses of epinephrine used in the research project these side effects were not observed, especially in the patients with heart disease, hypertension and previous cerebrovascular accidents.

Anticipated-reputed: Stimulation of the alpha-receptors produces vasoconstriction, which could result in hypertension causing cerebral haemorrhage and pulmonary oedema. A transient tachycardia after epinephrine is commonly seen.
Actual: No episodes of hypertension, severe tachycardia or bradycardia were observed. The mentioned side effects were not expected as all the patients were ASA I and II classified.

## SAFETY OF CO-ADMINISTRATION OF THE FOUR DRUGS

An extensive literature search was done to see if there were studies available, where the four drugs used in this research project, were used in other studies. None could be found.
This is the first research study on the combination of the four drugs for plastic and reconstructive surgery.



Several studies show synergism using a three-drug combination:

Avramov [3] showed that popofol produces an opioid sparing effect. There is a 30 – 50% decrease in alfentanil requirements when administered with midazolam as premedication. This opioid sparing effect further reduces opioid induced postoperative nausea and vomiting. They conclude that the combination of midazolam, propofol and alfentanil provides effective intraoperative amnesia, and excellent intraoperative sedation and analgesia.

Short et al [40] showed synergism between propofol, alfentanil and midazolam. They concluded that the combination of these three drugs should be seen as a new drug development with individual properties, rather than merely reflecting the known properties of the individual agents.
Friedberg [16,17,18] used midazolam, propofol and ketamine together and obtained satisfactory operating conditions for sedation in all patients. He showed that propofol, together with midazolam, block ketamine

induced hallucinations. It was possible to reduce propofol requirements by the addition of midazolam as premedication.
He used a combination of midazolam, propofol and ketamine on 1264 patients and concludes that this combination preserves the life protective reflexes and still gives the surgeon tranquil operating conditions.

Friedberg's work also showed that:

The sympathomimetic effect (tachycardia and hypertension) of ketamine on the cardiovascular system was blocked when given together with propofol, leading to haemodynamic stability.
A dissociative subhypnotic dose of ketamine added to a stable level of propofol hypnosis, acts as an analgesic.
The propofol/ketamine tecnique allows the patient to tolerate local anaesthetic injections, and remain oblivious to the course of the surgical procedure.
An extremely smooth level of hypnosis is provided by a carefully titrated qualitative infusion of propofol. The combination of the two drugs produces a faster onset of sedation, and improved the quality of sedation.
The co-administration of small doses of ketamine with propofol improves ventilation during sedation.
Ketamine preserves the integrity of the laryngeal and pharyngeal reflexes and is a recognised bronchodilator. Protective airway reflexes such as coughing and swallowing are preserved and may be slightly exaggerated. Its effect on central respiratory drive is minimal, and it preserves the response to carbon dioxide. The risk of aspiration with ketamine is minimal due to the preservation of the laryngeal reflexes.
The combination of propofol and ketamine significantly improved post operative analgesia.

Bradinath [6] showed that subhypnotic doses of ketamine, administered in combination with propofol for sedation, in midazolam premedicated patients, contribute to significant analgesia without haemodynamic and respiratory depression. This haemodynamic stability makes the combinations ideal for outpatient sedation and analgesia.

Mortero [32] showed synergism between the three drugs in his study. The combination of midazolam, a small dose of ketamine, and propofol, improved ventilation during sedation. Their synergistic effect produced

less pain, required less postoperative analgesic medication, and patients were more active after discharge.
Mortero also comments that subanaesthetic doses of ketamine produce a "high" postoperatively. Propofol produced a positive mood, which combines well with the anxiolytic effect of midazolam during the recovery period.
The synergism that exists between the drugs would enable one to use the lowest possible dose, with less side effects, with maximum benefit to the patient. The co-administration of the drugs in low doses could represent a "new drug", as the net effect does not reflect the properties of the individual agents.

Pavlin [34] showed synergistic properties between propofol and alfentanil:

Propofol produced an opioid sparing effect and decreased the alfentanil dose requirements by 30% – 50% - this is consistent with other studies in literature.
The synergism of propofol – induced sedation by alfentanil was related to the elevated plasma concentrations of propofol.
When the two drugs were combined there was a 50% reduction in pain recorded.



Propofol has the ability to block the emetic symptoms that accompany alfentanil infusions in 50% of the subjects. This finding is consistent with other studies that show that propofol has anti-emetic properties.

Badrinath [6] showed that:

Ketamine produced a dose dependant reduction in the incidence of patient responsiveness to the administration of local anaesthesia.
Subhypnotic doses of ketamine, administered with propofol for sedation, produced significant analgesia without cardiopulmonary compromise.
The anti-emetic properties of propofol block the tendency for postoperative nausea and vomiting seen when high doses of ketamine are given.

Propofol and ketamine in combination produce a clear-headed, energetic, "high" during the recovery period.

The co-administration of a small-dose of ketamine with propofol improves ventilation during sedation, and reduces the opioid requirements in recovery.
The patient's mood was significantly better in the recovery room.
Cognitive function returned more rapidly in the co-administration group, than those given propofol alone.
Ketamine preserved airway patency and muscle tone at doses of 1 mg / kg.

Frizelle [19] showed how ketamine produced, a dose related increase in the blood pressure when used with propofol for patients undergoing procedures under spinal anaesthesia. He provided further proof that when ketamine is used with propofol for the induction of sedation, the cardiostimulant effects of ketamine at subanaesthetic doses balances the cardiodepressant effects of propofol. This is then ideal for sedation and analgesia.

Frey [15] postulates that the ideal method for the use of propofol and ketamine in combination is in a 3:1 ratio. He showed that the combination provides cardio-respiratory stability, and prevents the ketamine induced emergence reactions. He comments that the combination provides excellent quality of sedation for patients undergoing a very painful procedure, such as a retrobulbar block.

Angelini's [2] review on sedatives and analgesic medications used in intensive care units in the United States of America shows that ketamine is used at doses of between 0.2- 0.5 mg / kg. He comments on the excellent safety profile, and rapid onset of intense analgesia and amnesia at these subanaesthetic doses that ketamine provides for the critically ill patients.
He commented that propofol (10 mg / ml) is usually administered at doses of 3-4 mg/kg/hr to sedate the critically ill. At these doses, the rapid decrease in serum drug levels enable the patients to respond to verbal command, within 10 minutes of discontinuation of the infusion.

## SUMMARY OF DOSAGE REGIMES

Ketamine, given intravenously as a bolus at 0.5 – 2 mg / kg, reaching peak concentrations and a clinical effect within 1 minute [Friedberg 16,17,18].

Ketamine given as a continuous IV infusion of 20 – 40 μg / kg / min.
Subhypnotic doses of ketamine were given at doses between 9 – 18 μg / kg / min [Badrinath 6].
The recommended ratio for Propofol : Ketamine was 10 : 1.
Propofol given as an initial intravenous bolus of between 1 and 3 mg / kg followed by a continuous infusion rate of 3 – 4 mg / kg / hr [Angelini 2].
Sub anaesthetic doses of ketamine 0.2 – 0.5 mg / kg can produce a rapid onset and offset of intense analgesia and amnesia.

The literature surveys and the results of the research, support the fourth academic aim, which is to determine whether sedations can be done safely and effectively using a combination of midazolam, propofol, alfentanil and ketamine.

## B. STRATEGIC AIMS

To assess how the standards set for office based surgical facilities impact on patient safety and cost.

From the literature survey on the evolution of the plastic and reconstructive office base surgical facility in the United States of America, it is clear that office based surgery, performed by a qualified surgeon and anaesthesiologist, is safe, provided that:

The office based surgical facility meets and adheres to the standards set out by their regulatory authorities.
Safe sedation protocols are followed.
Proper patient selection is done.

The American model shows, that plastic and reconstructive office based surgeries, further enhance patient safety as there is a decreased risk for exposure to nosocomial agents.

The aim of standards for an office based surgical facility is to maximise patient safety. These standards, as set out by the Department of Health define:

The general environment of an office based facility.
The operating room environment.
Facility sterilisation procedures.

Facility asepsis protocols.
Facility maintenance and cleaning protocols.
Minimum necessary equipment requirements.
Facility emergency power requirements.
Facility medical and hazardous waste disposal protocols.
Facility resuscitation protocols.

The strategic aim in this research project was achieved in that the plastic and reconstructive office based surgical facility in George, where the research was done, complies fully with all the standards for such a facility as set out by the Department of Health.
The design and management of this plastic and reconstructive office based surgical facility complies with the nationally recognised standard, thereby enhancing patient safety.
The cost comparison between the same surgical procedure done in a private hospital theatre and the office based surgical facility, showed a R12000 saving in the office based surgical facility.
Both the patient and the health insurance in South Africa could benefit from the cost effectiveness of the office based surgical facility.

# RECOMMENDATIONS



Intravenous sedations for patients undergoing plastic and reconstructive surgery in an office based surgical facility can be done safely and effectively provided that:

The office based surgical facility complies fully with all the standards set out by the Department of Health. [Provincial Gazette 5/28 Annexure B 38]
Correct patient and procedure selection for such a facility is done.
Safe, well-researched intravenous sedation protocols are used.
A qualified, dedicated, sedation practitioner monitors the patient throughout the procedure.
Sedation levels are assessed continuously during the procedure to prevent over sedation.
Monitors to assess heart rate and rhythm, blood pressure and oxygenation are used during the procedure and recovery period. A capnograph will have to be considered if deeper levels of sedation are used.

Age and size appropriate resuscitation equipment is available in the office based surgical facility.
Emergency drugs are available in the surgical facility.
Resuscitation protocols are in place.
The staff working with the patients in the office based surgical facility are trained in advanced life support.
The patients are monitored in the recovery area until it is safe for them to be discharged.

I would also like to recommend that all plastic and reconstructive office based surgical facilities in South Africa share information regarding:

Types and efficacy of surgical procedures performed.
Types and efficacy of sedation and anaesthesia used.
The information should be shared to enable us to learn from our peers, thereby improving safety and quality of care of patients treated in such facilities.

# CONCLUSION

In 2005, 10 million plastic and reconstructive procedures were done in the United States of America of which 45% were done in an office based setting. This statistic, together with the fact that the American Society of Dermatological Surgery encourages patients to have certain elective plastic and reconstructive procedures done under local anaesthesia to reduce the risk of thrombo-embolism, makes it all the more important to identify a form of anaesthesia that can be used safely and effectively in conjunction with local anaesthesia in the office based setting.

The sedation technique used, together with the different forms of local anaesthesia used in this research project, comes very close to the ideal for the following reasons:

During the sedation technique the patient receives a bolus dose of ketamine, which causes 15 minutes of dissociative anaestheia or deep sedation without the reduction of muscle tone. For the rest of the procedure the patient remains in a state of conscious sedation, again without the loss of muscle tone. This feature of the sedation technique reduces the very real risk of the formation of thrombo-embolism

during plastic and reconstructive surgery as seen in the literature reviews.
All the doses of local anaesthesia provided in this research project were well below the recommended doses and were always given with epinephrine or hyalase or both, thereby reducing the risk of local anaesthetic toxicity.
Literature reviews on the co-administration of propofol and ketamine and propofol and alfentanil provide evidence that the drugs can be used together safely, and that they work synergistically. This enables the use of the lowest possible doses, reducing side effects and drug complications.
Our findings in this research project are consistent with safety and efficacy studies in literature.
The combination of the sedation drugs at low concentrations in the research study caused minimal airway depression – the airway depression could be easily and safely handled in all patients.
The combination of propofol and ketamine cause hemodynamic stability.
The use of a target controlled infusion pump in the research project allows for a steady level of sedation, which is predictable and reproducible without interfering with the patient's airway.
The total intravenous sedation technique is ideal for the office based setting because none of the drugs used can cause malignant hyperthermia.
The sedation technique leads to high patient satisfaction, which stems from effective preoperative anxiolysis and amnesia, being oblivious to intraoperative events, and emerging with an energetic "high" without postoperative pain and very few side effects.
Patient satisfaction is extremely important, however their safety must never be compromised. This is demonstrated in this research study.
The sedation technique provides the surgeon with a window of opportunity to inject local anaesthesia with minimal patient discomfort. The subsequent level of sedation allows the surgeon to operate on a calm and relaxed patient. With the sedation practitioner being present throughout the procedure, the surgeon can continue operating without concerns about the safety of the patient.
The sedation technique is cost effective.

This cost effective sedation technique produced predictable and reproducible levels of sedation, a low side effect profile and a high

level of satisfaction for both the patient, surgeon, and sedation practitioner. By exploiting the synergistic properties of the different anaesthetic and local anaesthetic drugs, the technique allows for the use of the lowest possible doses, with the least possible side effects for the patient.

With careful patient selection and continuous intraoperative monitoring, the sedation technique offers a combination of a short dissociative anaesthetic phase and a conscious sedation phase. It is safe, predictable, allowing the surgeon to proceed efficiently with local anaesthesia and operate under tranquil operating conditions. The technique enables the patient to be both oblivious to painful local anaesthetic infiltration and the surgical procedure, as well as emerge quickly without pain, emesis, hangover or hallucinations. The technique itself reduces the risk for thomboembolism which continues to be a threat for plastic and reconstructive surgeons world-wide.

# CHAPTER 7.

# BIBLIOGRAPHY


1. Anello S.; Office based surgery: Advantages, disadvantages, and the nurse's role.
(Plastic Surgical Nursing VOL 22:107-111, 2002)

2. Angelini AA , Keltzer GJ , Coursins TR. ; Use of propofol and other nonbenzodiazepine sedatives in the intensive care unit.
(Critical Care Clinics VOL 212: 235-239; Oct 2001)

3. Avramov, Michail, White, Paul.; Use of alfentanil and propofol for outpatient monitored anaesthesia care: Determining the optimal dosing regimen.
(International Anaesthesia Research VOL 85:566-572, Sept 1997)

4. Baker S, Gordon P.; Midazolam in Ambulatory Surgery.
(Plastic and Reconstr. Surg VOL 82: 244 - 1998.)

5. Barnard DP.; Hazards of local anaesthetic injections. Second edition 2000: 47-60

6. Badrinath M, Avranov JR, Shadrick O, Ivankovich BD.; The use of a Ketamine – Propofol combination during monitored anaesthesia care.
(Ambulatory Anaesthesia VOL 298: 1498-1500; Dec 1999)

7. Bisaccia, Dwight, Swenson.; Liposuction "conscious sedation" monitored anaesthesia care and level of consciousness monitoring.
(Aesthetic Plastic Surgery VOL 12: 455- 460; 2005)

8. Bitar G, Mullis W, Jacobs W, Mathews D, BeaslyM, Smith K, Waterson P, Getz S, Capizzi P, Eaves F.; Safety and efficacy of office based surgery with monitored anaesthesia care / sedation in 4778 consecutive plastic surgery procedures.
(Plastic and Reconstructive Surgery VOL 111:150-158; 2003)

9. Bren-Shloma I, Abd-El-Khalim H, Ezry J, Zohar S, Trevskoy M.;Midasolam acts synergistically with fentanyl for induction of anaesthesia.

(British Journal of Anaesthesia VOL 64:45 - 1990)

10. Bruyn M, Fine NA, Lee JYY, Mustoe. TA; The clinical outcome of abdominoplasty performed under conscious sedation: Increased use of fentanyl correlated with a longer stay in outpatient unit.
(Plastic Reconstr Surg VOL 103: 1521 - 2003)

11. Byrd HS, Barton FE, Orenstein.; Safety and efficacy in an accredited outpatient plastic surgery facility: A review of 5316 consecutive cases.
(Plastic Reconstr Surg VOL 112: 1260 - 1999)

12. Coldiron B.; Safety of office based surgery.
(The Archives of Dermatology VOL 35: 356-360; 2004)

13. Davidson, Venturi, Attiger, Baker, Spear.; Prevention of venous thromboembolism in plastic surgery patients.
(Plastic Reconstructive Surg VOL107: 112-116; 2004)

14. De Jongh R, Grazer FM.; Perioperative management of cosmetic liposuction.
(Plastic Reconstr Surg VOL 107:1039 - 2001)



15. Frey L, Sukhani S, Pawlowski E, Pappas BN, Slogoff B. ;Propofol versus propofol – ketamine sedation for retrobulbar nerve block : Comparisons of sedation quality , intraocular pressure changes , and recovery profiles.
( Anaesth Analg VOL 45: 200-205;1999)

16. Friedberg BL.; Propofol – Ketamine Technique.
(Anaesthetic Plastic Surgery VOL 17: 297-300; 1993)

17. Friedberg BL.; The effect of a dissociative dose of Ketamine on the Bispectral Index during Propofol hypnosis.
(Journal of Clinical Anaesthesia VOL 11:4-7; 1999)

18. Friedberg BL.; Propofol – Ketamine Techinique :Dissociative Anaesthesia for office surgery. (A 5 year review of 1264 cases ).
(Journal of Aesthetic Plastic Surgery VOL 23:70-75 1999)

19. Frizelle HP, Duranteau G, Samii NB.; A comparison of Propofol with a Propofol – Ketamine combination for sedation during spinal anaesthesia.
(Anaes Analg VOL 84:1318-1322; 1997)

20. Hasen KV, Samartiz D, Mustoe TA.; An outcome study comparing intravenous sedation with midazolam/fentanyl vs. propofol infusion for aesthetic surgery.
(Plastic Reconstructive Journal VOL 112:1683 - 2003)

21. Iselen-Chaves IA, Flaishon R, Sebel P, PeterSA.; The effect of the interaction of propofol and alfentanil on recall, loss of consciousness, and bispectral index.
(Plastic and Reconstructive Surgery VOL 92: 1300-1310; 2000)

22. Iverson RE.; Sedation and analgesia in the ambulatory setting: Clinical guidelines.
(Plastic and Reconstructive Surgery VOL 90: 1559 - 1999)

23. Keyes JR, Singer R, Iverson R, McGuire M.; Analysis of Outpatient Surgery Safety Using Internet – based Quality Improvement and Peer Review Program.
(Plastic and Reconstructive Surgery VOL 100:1478 - 2004)

24. Kissin I, Vinnik HR, Castillo R, Bradley ER.; Alfentanil potentiates midasolam-induced unconsciousness in subanalgesic doses.
(Plastic and Reconstructive Surgery VOL115: 1723-1729; 1998)

25. Lofsky AS.; Deep vein thrombosis and pulmonary embolism in plastic surgery office procedures.
(Plastic Reconstr Journal VOL 115(2): 20- 2000)

26. Marcus JR, Julius J, Fine N, Thomas, Mustoe T.; Optimisation of Conscious sedation in plastic surgery.
(Plastic and Reconstructive Surgery VOL 68: 145 - 2001)

27. Marcus JR, Few JW, Chao J, Fine N, Mustoe T.; The prevention of emesis in plastic surgery: A randomised, prospective study.
(Plastic and Reconstructive Surgery VOL 69:2487-2493 June 2002))

28. Manigaux C, Guignard B, Fletcher D, Sessler D, Dupont X, Chauvin M.; Intraoperative small dose ketamine enhances analgesia after out patient knee arthroscopy.
(Ambulatory Anaesthesia VOL 22: 258 - 2001)

29. Mc Collum JS; Milligan KR; Dundee JW.; The anti-emetic action of propofol.
(Anaesthesia VOL 43:239-240; 1998)

30. Milne SE, Kenny GNC.;Future applications of the TCI systems.
(Anaesthesia VOL 53: 56 - 1998)

31. Morello DC, Colon GA, Fredricks S, Nelson and Singer.; Patient safety in accredited office surgical facilities.
(Plastic Reconstr Surg VOL 99:1496-1499; 1997)

32. Mortero BD, Clark K, Merrit GH, Metz AA.; The effects of small – dose Ketamine on Propofol sedations: Respiration, Postoperative Mood, Perception, Cognition and Pain.
(Ambulatory AnaesthesiaVOL 78: 1532 January 2001)

33. Niechajev, Haraldsson.;Two methods of anaesthesia for rhinoplasty in outpatient setting.
(Aesthetic Plastic Surgery VOL 221:456; 1996)

34. Pavlin DJ, Coda B, Shen D, Tschanz J, Nguyen Q, Schaffer R, Donaldson G, Jacobson RC, Chapman C.; Effect of combining propofol and alfentanil on ventilation, analgesia, sedation, and emesis in human volunteers.
(Journal of the American Society of Anaestesiology VOL 84:23-37; 1996)

35. Petersen-Felix S, Arendt-Nielsen L, Bak P, Fischer M, Zinden AM.; Psycophysical and electrophysiological response to experimental pain may be influenced by sedation: comparisonof the effects of a hypnotic (propofol) and an analgesic ( alfentanil).
(British Journal of Anaesthesia VOL 77: 165- 1996)

36. Pickard J.; Lipid emulsion to treat overdose of local anaesthesia.
(Anaesthesia VOL 61 : 107 - 2006)

37. Pitman GH, Aker JS, Trip ZD.; Tumescent liposuction. A surgeon's perspective.
(Clinics in Plastic Surgery VOL 23 633-645;1996)

38. Provincial Gazette 5/28 Annexure B Minimal physical and building service requirements.
(June 2001)

39. Scarborough DA, Herron JB, Khan A, Bisaccia E.; Experience with more than 5000 cases in which monitored anaesthesia care was used for liposuction surgery.
(Aesthetic Plastic Surgery VOL 27:474-480; 2004)

40. Short TG, Plummer JL, Chui PT.; Hypnotic and anaesthetic interactions between midasolam, propofol and alfentanil.
(British Journal of Anaesthesia VOL 69: 162 - 1992)

41. The American Association for Accreditation of Ambulatory Surgery: Standards and checklists for accreditation of ambulatory surgery facilities.



42. Tybra M.; Choices in sedation: the balanced sedation technique.
(European Journal of Anaesthesiology VOL 13: 8-12; 1996)

43. Warner, Shield, Chute.; Major morbidity and mortality within one month of ambulatory surgery and anaesthesia.
(Journal of the American Medical Association VOL 34 83- 1999)

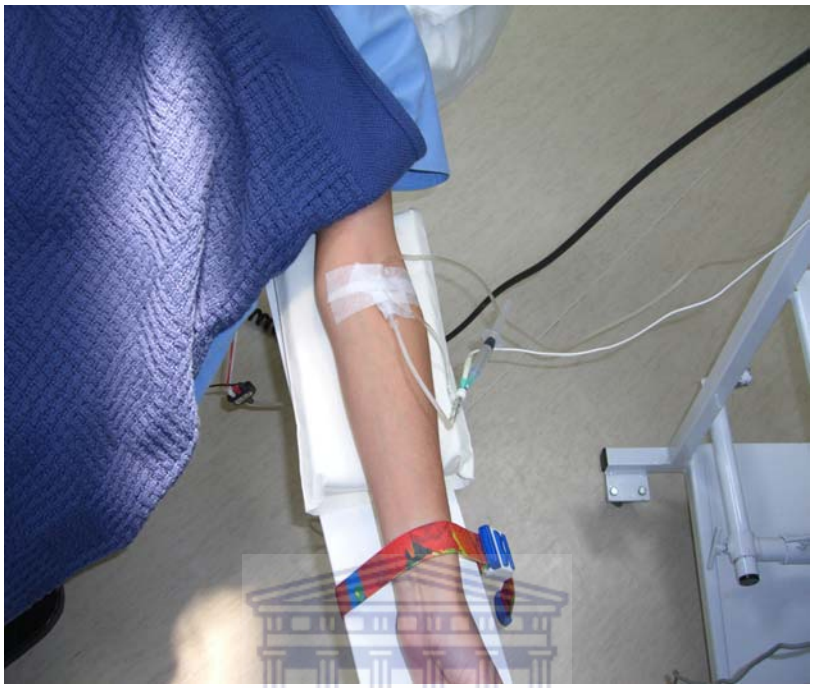
44. Vinnik HR, Bradley EL, Kissin I.; Alfentanil does not potentiate the hypnotic effect of propofol.
(Anaesthesia and Analgesia VOL 72: 308 - 1991)

45. Zol V, Kryger M, Neil G, Fine Y, Mustoe C.; The Outcome of Abdominoplastiey Performed under Conscious Sedation: Six Year Experience in 153 Consecutive Cases.
(Plastic and Reconstructive Surgery VOL 58: 412; May 2004).

46. American Medical Association; Improving office based surgery.

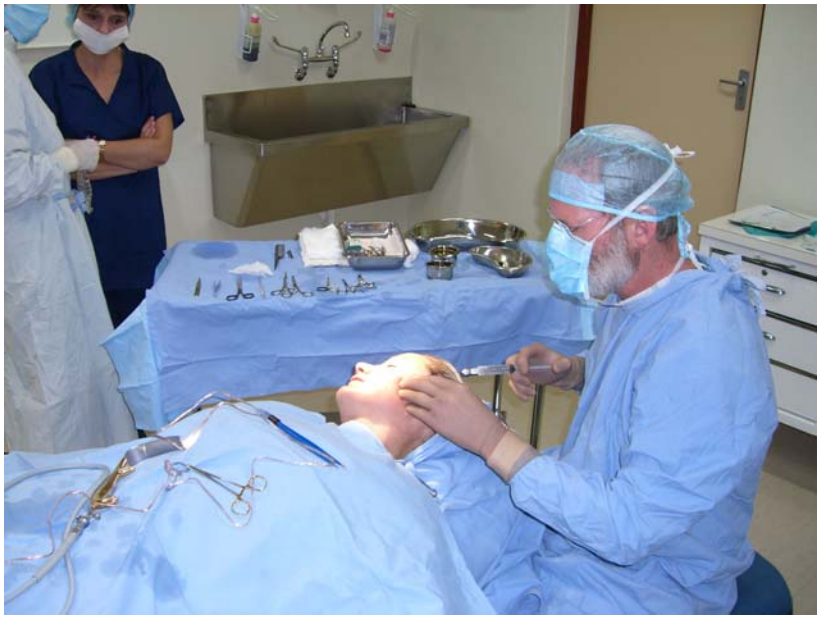
Amended Core Principles as presented to the AMA board of Trustees Jan 2003.

# APPENDIX



Picture 1.

Intravenous line established in large antecubital fossa vein to prevent venoirritation from propofol.The patient is informed that her hands are to be strapped to the arm supports. Note the 3cc syringe filled with 20 mg of ketamine to be given into the side port.



Picture 2.

A patient receiving a painful local anaesthetic injection during the dissociative phase of the sedation technique. Note that the patient is spontaneously breathing room air and is oblivious to the painful stimuli.




Picture 3

The Graseby infusion pump programmed to infuse a mixture of propofol and alfentanil at 4 mg / kg / hr at a concentration setting of 10 mg / ml.


Picture 4

The Welch Allyn monitor used. It measures oxygen saturation levels, ECG, blood pressure and respiration.



Picture 5

A patient in the recovery area being attended to by the nursing staff.

Once the patients had been transported from the operating room to the recovery area they were observed for 2 hours, postoperatively. Observations were done at 15-minute intervals. The following were assessed:

Blood pressure.
Oxygen saturation.
Heart rate.
Wound drainage.

Discharge criteria:

The patients were considered ready for discharge when:

They had stable vital signs.
Were orientated.
Had their drips removed.
Were able to pass urine.
Had no nausea or vomiting.
Had minimal wound drainage.
Had taken their postoperative analgesics.
Had been seen by the sedation practitioner and surgeon.
Had received their postoperative instruction leaflets and follow up visit dates.



Once the patient had been in the recovery area for one hour they were offered a refreshment, and the responsible person, who would transport them home, was contacted.

"*In elective plastic surgery, a satisfactory result does not equate with a happy patient and a less than satisfactory result does not automatically mean an unhappy patient. Patients having unhappy anaesthetic experiences tend not to return for secondary surgery or additional procedures. Unhappy patients are not enthusiastic proponents of plastic surgery to their family and friends.*

*The converse is equally true.*

*Patients who have had a positive anaesthesia experience are far more willing to have revisions or subsequent procedures and recommend plastic surgery to their family and friends.*

*The mild euphoria patients experience is no to be underestimated as a source of patient satisfaction with this anaesthetic technique. This phenomenon is largely unrecognised in anaesthesia literature"*
*Dr. Barry Friedberg[16]*

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~**end**~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~