"EFFICACY OF KETAMINE CO-INDUCTION WITH PROPOFOL FOR LMA INSERTION IN CHILDREN"

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CHENNAI – 600 003.

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CERTIFICATE

This is to certify that the dissertation entitled, **"EFFICACY OF KETAMINE CO-INDUCTION WITH PROPOFOL FOR LMA INSERTION IN CHILDREN"** submitted by Dr.Omprakash.S, in partial fulfilment for the award of the degree of Doctor of Medicine in Anaesthesiology by the Tamilnadu Dr. M.G.R. Medical University, Chennai is a bonafide record of the work done by him in the Department of Anaesthesiology, Madras Medical College, during the year 2006 – 2009.

DR. T.P.KALANITI, M.D.,
DEAN,
MADRAS MEDICAL COLLEGE &
GOVT. GENERAL HOSPITAL,
CHENNAI – 600 003.

PROF. DR. KAMALINI SRIDHARAN,
M.D., D.A.,
PROFESSOR & H.O.D,
DEPT OF ANAESTHESIOLOGY,
MADRAS MEDICAL COLLEGE,
CHENNAI – 600 003.

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CONTENTS

INTRODUCTION

Propofol is commonly used as induction agent for insertion of LMA in children [3, 4]. When used as a sole anesthetic agent children require a larger dose of propofol for insertion of LMA than adults [5, 6]. This large dose needed for induction may be associated with hemodynamic and respiratory effects like hypotension, bradycardia, apnea or hypoventilation [7, 8, 9].

Combination of ketamine and propofol is additive and allows the use of a lower dose of propofol as well as reduces the incidence of hypotension and respiratory depression induced by propofol [10-12]. This practice of administering a small dose of a sedative or other anaesthetic agent to reduce the total dose of induction agent is known as Co-induction and has been used with success in adult but with variable effect on recovery [1, 2, 11, 13-15].

The combination of ketamine and propofol in sedative doses has been studied in children under going cardiac catheterization UGIE and MRI [17, 18]. These studies were able

to show the advantage of combining propofol with the low doses of ketamine in terms of preservation of hemodynamic parameters without prolonging recovery.

The present study was therefore aimed at studying the effect of co-administration of ketamine with the propofol on LMA insertion characteristics, hemodynamic changes and recovery in children undergoing day care surgery.

AIM AND OBJECTIVES

The primary aim of this study was to ascertain if a combination of propofol and ketamine prevents hypotension when compared to propofol alone, and to see if the combination improves LM insertion and recovery characteristics.

The main objectives are:

1) Laryngeal mask insertion characteristics

2) Hemodynamic changes

3) Duration of recovery in children

REVIEW OF LITERATURE

Co-induction of anaesthesia, the rationale [1]

Combination therapy with two or more different drugs, with the intention of reaching the same therapeutic goal, was heavily criticized for a long time. However, it is accepted today, especially when advantages over monotherapy can be shown. For the induction of anaesthesia or for long-term sedation in the intensive care unit, combination therapy may offer an improved effect profile, a more balanced ratio of desired versus adverse effects, an improved time-course of effect, simpler treatment requirements or lower costs. Midazolam and propofol have been investigated as potential partners for those two indications.

Animal experiments and clinical pharmacology studies have shown that midazolam and propofol have synergy with other centrally active drugs. It could be expected that the relationship between desired effects and adverse effects could be improved by skilful use of the synergism between midazolam and propofol. Co-induction of anaesthesia and co-administration in long-term sedation can offer improvements in therapeutic situations compared with monotherapy. These improvements are in terms of a more suitable effect profile, a more favorable ratio of desirable effects to side-effects, optimization of the time-course of effects and reduced costs.

Co-induction of anaesthesia: day-case surgery. [2]

Planned co-induction of anaesthesia is practiced by anesthetists exploiting drug interactions, particularly synergism, principally between midazolam, fentanyl, sufentanil and alfentanil, and propofol. It can produce an improvement in all phases of anaesthesia, including induction, maintenance and recovery. There are

advantages in combining midazolam with propofol, thereby reducing the risk of awareness and also the dose of propofol and hence its side-effects and cost. Propofol is the principal intravenous induction agent for day-case anaesthesia. A major advantage is that by reducing the dose of propofol there is less chance of the severe bradycardia that is sometimes associated with the combined use of propofol and opioids, although this can be prevented by vagolytic agents. However, the use of opioids increases the incidence of post-operative nausea and vomiting. Another important drug is ketamine, the effects of which are often additive with other drugs. The combination of ketamine and midazolam is an important technique, particularly in the management of critically ill patients. The alpha 2-agonists, e.g. clonidine and dexmedetomidine, may also have a role in this context in the future. This paper presents the current approach to the co-induction of anaesthesia, particularly in relation to the reduced risk of awareness when using midazolam, and the

health economics in relation to the potential reduction in the dose and hence cost of propofol.

S.Goel et al.2008 [10]

In there study they compared the efficacy of ketamine and midazolam co-induction with propofol and propofol alone for LMA insertion among 60 ASAI/II children undergoing day care procedure. They divided the sample in to 3 groups; P group -- propofol alone, PK group – ketamine with propofol and PM group – midazolam with ketamine. The parameters they compared are hemodynamic changes, LMA insertion characteristics and the duration of recovery.

In their study they found that ,in propofol alone group(P), systolic blood pressure (SBP) showed a significantly greater decrease compared to group Propofol –Ketamine (PK) and group Propofol-Midazolam.(PM)($P < 0.005$). Only 5% of patients in groups PK and PM showed >20%, fall in SBP compared to 89% in group P ($P < 0.005$).

More children in groups PK and PM had acceptable conditions for LM insertion compared to group P ($P < 0.05$).

The time to achieve Steward Score of 6 was longer in groups PK and PM compared to group P ($P < 0.005$).

They concluded that, in children, the combination of propofol with ketamine or midazolam produced stable hemodynamic and improved LM insertion conditions but with delayed recovery.

Srivastava, Sharma , Kumar , Saxena et al 2006 [11]

It was a double blind prospective randomized study comparing the efficacy of small dose of propofol, ketamine and midazolam co-induction with propofol. The study was conducted among 68 patients (ASA I and II) aged 20-40 years, undergoing elective general, orthopaedic, or gynaecological surgery.

In there study all patients were divided into 4 groups based on the co-induction agent as: (ketamine) group KP,

(midazolam) group MP, (propofol) group PP or, (normal saline 3 ml) group SP - control. Induction of anaesthesia was done by titrated dose of propofol preceded by 2 ml of lignocaine and they compared the hemodynamic effects and total propofol requirement.

They found that the dose of propofol required to induce anaesthesia was significantly lower in group KP (1.2 mgkg-1), MP (1.4 mgkg-1), and PP (1.6 mg kg-1) compared to control group (2.7 mg kg-1).

Fall in mean arterial pressure (MAP) from the baseline following induction was observed in all the groups being maximal (21%) in control group and minimal (4%) in group KP. Relative bradycardia was seen in all patients, but least in KP group. The group MP and PP had 13% and 11% falls in MAP respectively.

They concluded that all co-induction agents reduce the requirement of propofol compared to placebo and haemodynamic effects were dose dependent. In their study Ketamine appeared to be a suitable and safe alternative to midazolam co-induction. Propofol auto-co-induction does not offer any advantage over midazolam regarding cardiovascular stability.

Hui TW, Short TG, Hong W et al 1995 [12].

In their study they utilized propofol and ketamine as induction agent in 180 female patients to know the additive interactions between them. Quantal dose-response curves were determined in 180 female patients to whom the drugs were administered individually and in combination into three groups. They observed the incidences of apnea, arterial pressure, and heart rate changes during the first 5 min and were recorded.

They found that the addition of ketamine did not significantly alter the ED50 for apnea of propofol. There was a significant difference in the arterial pressures among the three groups ($P < 0.001$). Using the combination, the cardiostimulant effects of ketamine balanced the cardiodepressant effects of propofol. There was no change in arterial pressure or heart rate after the noxious stimulus.

Guit JB, Koning HM, Coster ML et al [16].

It was a prospective study in 18 patients who underwent noncardiac surgery. In their study they utilized ketamine as an analgesic during total intravenous anaesthesia with propofol. The study compared the combination of propofol and fentanyl with that of propofol/ketamine.

They concluded that the propofol/ketamine combination resulted in haemodynamically stable anaesthesia without the need for additional analgesics. They found Propofol to be effective in eliminating side effects of a subanaesthetic dose of ketamine in humans, as the postoperative behaviour was normal in all patients and none of the patients reported dreaming during or after the operation. They recommended the propofol/ketamine combination for total intravenous

anaesthesia for surgery when stable haemodynamic parameters were required.

Goh PK, Chiu CL, Wang CY et al [15].

This was a prospective, double-blind, randomized, placebo-controlled clinical trial on 90 adult patients .In their study they investigated the effect the of ketamine co- induction with propofol improves. Hemodynamic profile and laryngeal mask airway (LMA) insertion conditions were observed. Ninety adult patients were randomly allocated in to three groups ;ketamine group , receiving ketamine 0.5 mg x kg(-1) (n = 30), fentanyl group (fentanyl 1 microg x kg(-1) (n = 30)) and group receiving normal saline (n = 30), before induction of anaesthesia with propofol 2.5 mg x kg(-1). Insertion of the LMA was performed 60s after injection of propofol.

In that study arterial blood pressure and heart rate were measured before induction (baseline), immediately after induction, immediately before LMA insertion, immediately after LMA insertion and every minute for three minutes after LMA insertion. Following LMA insertion, the following six subjective endpoints were graded by a blinded

anaesthestist using ordinal scales graded 1 to 3: mouth opening, gagging, swallowing, movement, laryngospasm and ease of insertion.

They observed that the Systolic blood pressure was significantly higher following ketamine than either fentanyl (P = 0.010) or saline (P = 0.0001). The overall insertion conditions were similar in the ketamine [median 7.0, interquartile range (6.0-8.0)] and fentanyl groups [median 7.0, interquartile range (6.0-8.0)]. Both appeared significantly better than the saline group [median 8.0, interquartile range (6.75-9.25); P = 0.024].

The incidence of prolonged apnoea (> 120s) was higher in the fentanyl group [23.1% (7/30)] compared with the ketamine [6.3% (2/30)] and saline groups [3.3% (1/30)].

They concluded that the addition of ketamine 0.5 mg / kg improves haemodynamics when compared to fentanyl 1 microg / kg, with less prolonged apnoea, and is associated with better LMA insertion conditions than placebo (saline).

Akin A, Esmaoglu A, Guler G et al [17].

This was a prospective, randomized, double blinded comparison of propofol-ketamine with propofol-fentanyl for sedation in patients undergoing elective UGIE. Ninety children of ASA I–II, aged 1 to 16-year-old were included in the study. The study compared the clinical efficacy and safety of propofol-ketamine with propofol-fentanyl in pediatric patients undergoing diagnostic upper gastrointestinal endoscopy (UGIE).

Patients were randomly assigned to receive either propofol-ketamine (PK; n = 46) or propofol-fentanyl (PF; n = 44). PK group received 1 mg·kg−1 ketamine + 1.2 mg·kg−1 propofol, and PF group received 1 μg·kg−1 fentanyl + 1.2 mg·kg−1 propofol for sedation induction. Additional propofol (0.5–1 mg·kg−1) was administered when a patient showed discomfort in either group.

Heart rate (HR), systolic arterial pressure, peripheral oxygen saturation, respiratory rate (RR) and Ramsey sedation scores of all patients were recorded perioperatively.

They concluded that Propofol/ Ketamine and Propofol/ Fentanyl combinations provided effective sedation in pediatric patients undergoing

UGIE, but the PK combination resulted in stable hemodynamics and deeper sedation though more side effects.

Tomatir E, Atalay H, Gurses E et al [18].

They investigated the effects of low dose ketamine before induction on propofol anesthesia for Forty-three children aged 9 days to 7 years undergoing magnetic resonance imaging (MRI).

The children were randomly assigned into 2 groups to receive intravenously either a 2.5 mg·kg−1 bolus of propofol followed by an infusion of 100 μg·kg−1·min−1 or a 1.5 mg·kg−1 bolus of propofol immediately after a 0.5 mg·kg−1 bolus of ketamine followed by an infusion of 75 μg·kg−1·min−1. If a child moved during the imaging sequence, a 0.5–1 mg·kg−1 bolus of propofol was given.

Systolic and diastolic blood pressures, heart rate, peripheral oxygen saturation and respiratory rates were the parameters monitored. Apnea, the requirement for airway opening maneuvers, secretions, nausea, vomiting and movement during the imaging sequence were noted. Recovery times were also recorded.

They found that the systolic blood pressure and heart rate decreased significantly in the propofol group, while blood pressure did not change and heart rate decreased less in the propofol-ketamine group. Apnea associated with desaturation was observed in three patients of the propofol group. The two groups were similar with respect to requirements for airway opening maneuvers, secretions, nausea-vomiting, and movements during the imaging sequence and recovery time.

They concluded that intravenous administration of low dose ketamine before induction and maintenance with propofol preserves hemodynamic stability without changing the duration and the quality of recovery compared with propofol alone.

Furuya A, Matsukawa T, Ozaki M et al [19].

They investigated efficacy of ketamine before induction with propofol produces in Twenty-two patients assigned to one of two groups to receive either propofol with ketamine (n = 11) or propofol alone (n = 11, control).

In their study anaesthesia was induced with 2 mg kg−1 propofol and 0.5 mg kg−1 ketamine or 2 mg kg−1 propofol alone. Ketamine was administered 1 min prior to induction with propofol. Immediately after

induction with propofol, vecuronium (0.15 mg kg−1) was administered. Four minutes after administration of vecuronium, tracheal intubation was performed. Anaesthesia was maintained using sevoflurane (0.5%) in 66% nitrous oxide until 3 min after intubation. Systolic, diastolic and mean arterial pressure and heart rate were recorded on arrival, directly before induction with propofol, prior to tracheal intubation, immediately after intubation and at 3 min after intubation.

They found that the administration of ketamine before induction with propofol preserved haemodynamic stability compared with induction with propofol alone.

PROPOFOL

Pharmacokinetic characteristics:

- pharmacokinetic data consistent with a three-compartment model
- High lipid solubility (loss of consciousness with one circulation time)

- Clearance greater in young children but recovery of consciousness following single dose is similar in all ages (depends on redistribution only)
- High hepatic extraction (cytochrome P450-CYP2C9 activity greater in children aged 3-10 y than in adults.
- Volume of distribution is very large (twice that in adults)
- Elimination half time: age-dependent but no clinical implication after a single dose.
- Decreasing dosage regimen needed to ensure stable drug concentration in central compartment during infusion of propofol.

Pharmacodynamic characteristics:

- Main effect: hypnotic

- Mode of action: not fully understood; affects GABA (A) receptor function.
- ED50 varies with age but less than with thiopental.
- Transient reduction in mean arterial blood pressure (more marked with thiopental) due to direct relaxant effect on systemic vascular smooth muscle.
- Little effect on normal pulmonary vasculature but decreases increased vascular tone.
- Less depression of myocardial contractility than with thiopental.
- Prolongs QT interval; may cause bradycardia , junctonal arythmia, (despite atropine)
- Hemodynamic response to tracheal intubation, pharyngeal and laryngeal reflexes better suppressed than with thiopentone.
- Respiratory depression and incidence of apnea greater than with thiopental.

- Spontaneous excitatory movements are common during induction and recovery.
- Dose dependent CNS depression; reduces cerebral oxygen consumption.
- Reduces intracranial pressure by reducing cerebral blood flow.
- Anti-emetic.
- No effect on adrenal steroidogenesis or T- lymphocyte function.
- Recovery of consciousness and psychomotor skill faster than with thiopental.

Clinical use

- Suitable solution : 1% isotonic emulsion; chemically but not bacteriologically stable –do not store > 6 h at room temperature; add 1 ml lidocaine 1 % to 20 ml of propofol to reduce pain on injection.

- Contraindications: hypersensitivity to propofol, allergy to soybean oil or eggs.

- IV induction dose (give slowly):

  - 1 to 4 y, 3- 4 mg/kg;

  - > 4 y, 2.5 – 3.5 mg / kg;

  - Sleep state obtained in 30-40 sec;

  - Duration of action - 5 to 10 min

- Continuous infusion:

- Initial maintenance phase (first 30 to 45 min), 18-20mg/kg/h;

- Second maintenance phase – 9 to 11 mg/kg/h.

Adverse effects

- Cardiovascular: hypotension, arythmias.

- Respiratory: respiratory depression, apnea, larygospam, bronchospasm, hiccups.

- Neurological: headache, confusion, atypical seizures – like movements, opisthotonus.
- Other: pain on injection abdominal pain, fever.

KETAMINE

Pharmacokinetics characteristics:

- Pharmacokintic data consistent with two compartment model
- Only moderate lipid solubility (loss of consciousness takes > 1 min)
- Clearance slightly increased in young children ; Duration of anaesthesia is similar in all ages
- Relatively high hepatic extraction : extensive liver metabolism (reduced in neonates)
- Volume of distribution : no significant age – related variation
- Elimination half time : age-dependent but no clinical implication after a single dose

Pharmacodynamic characteristics

- Main effects: relatively poor hypnotic; produces intense analgesia, amnesic.

- Mode of action: NMDA receptor antagonist; interact with other CNS receptors.
- Spontaneous involuntary movements not uncommon ; poor muscle relaxation.
- Decrease EEG amplitude and frequency , although polymorphic delta activity may be increased intermittently (but no epileptic seizures) .
- No increase in CBF or ICP in patients with reduced intracranial compression (adults)
- Decrease contractility but MAP usually maintained due to sympathomimetic action
- Perceptual illusions, vivid dreams, and other emergence reactions less common than in adults, but can be reduced by concomitant administration of midazolam.
- Higher incidence of postoperative emesis (give regular ondansetron)

- Potent bronchodilatory effects (can be used to treat status asthmaticus)
- Hypersialorrhoea (always give antisialagouges)
- FRC and minute volume usually maintained , although CO2 response slightly reduced
- Greater retention of protective pharyngeal and laryngeal reflexes than other agents
- Recovery from anaesthesia is difficult to evaluate due to psychodysleptic effects

Clinical use

- Solution : 2.5% (pH 10.5) ; dilute for neonates ; chemically and bacteriologically stable for more than 24 h at room temperature
- Contraindications : acute porphyria , arterial hypertension , allergy to ketamine (unusual) , myocardial dysfunction , psychiatric / addictive disorders

- Induction dose : IV (slow injection) , 2.5-4 mg/kg ; IM , 10 mg/kg ; rectal (not usual) , 8-10 mg/kg ; oral (not usual) , 3-6 mg/kg
- Maintenance dose , half the initial dose every 7-10 min ; continuous infusion , 30-45 mcg / kg / min for first 20 min then halve the rate.
- Single IV dose : sleep state obtained in < 60 sec ; duration of action , 5-12 min
- Single IM dose : sleep state obtained in 3-5 min; duration of action 15-30 min
- Single rectal dose : sleep state obtained in 4 -7 min ; duration of action , 15 – 40 min
- Single oral dose : sleep state obtained in 20 min ; duration of action , 120 min

LMA AND THE PEDIATRIC PATIENT

The infant larynx is very delicate, and avoiding the potential trauma of endotracheal intubation appears attractive if the patient's condition and surgical procedure permits use of the LMA. It provides a reliable airway, permits positive pressure ventilation, facilitates an unimpaired operative field, and prevents aspiration of oropharyngeal secretions or blood. Many procedures that are unique to the children and that require the administration of anaesthesia, such as diagnostic or quick peripheral procedures, lend themselves quite well to use of the LMA as opposed to the face mask or endotracheal intubation.

Specific LMA uses in pediatric population:

Radiation therapy

Computed tomographic scanning

Magnetic resonance imaging

Burn reconstruction

Out patient dental anaesthesia

Extracorporeal shock wave lithotripsy

Adenotonsillectomy

Newborn resuscitation

Diagnostic flexible bronchoscopy

Intraoperative bronchoscopy during thoracotomy

Difficult airway

- Airway rescue
- Arthrogryposis
- Burn contractures
- Cervical spine anomaly
- Cri du chat syndrome

- Diagnostic laryngobronchoscopy
- Downsyndrome
- Edwards syndrome
- Freeman –Sheldon syndrome
- Goldenhar's syndrome
- Hurler syndrome
- Kenny – Caffey syndrome
- Mucopolysaccharidoses
- Neck contracture
- Obstructed hydrocephalus
- Pierre robin syndrome
- Schwartz – Jampel syndrome
- Tongue tumor
- Tracheostomy
- Treacher Collins syndrome

The advantages of the LMA over the face mask include:

1) Freeing the anesthesiologist's hands to perform other procedures (e.g., insertion of intravenous catheters, performing regional nerve blocks),

2) Improved oxygenation and ventilation,

3) Improved ventilation in children with acquired and congenital airway abnormalities,

4) Protection from aspiration of nasal and oral secretions,

5) Ensured airway patency when the patient head is inaccessible(e.g., during MRI or RT),

6) Less manipulation of the head and neck and

7) Decreased contamination of the operating room environment with inhaled anesthetics.

The advantages of LMA over Endotracheal tube include:

1) Elimination of the need for muscle relaxant for airway insertion, which decreases the drug exposure and reduces the cost,

2) Less trauma to the airway,

3) Lesser hemodynamic response to insertion and removal,

4) Stable intraocular pressure dynamics,

5) Better patient toleration of the airway during lighter levels of anaesthesia , there by providing a more secure airway during the emergence from anaesthesia,

6) Reusability.

LMA size and types:

Size availability of different types of LMA:

LMA size	LMA-classic	LMA-flexible	LMA – unique	LMA-fastrach

1	+			
1.5	+			
2	+	+		
2.5	+	+		
3	+	+	+	+
4	+	+	+	+
5	+	+	+	+

Description of LMA sizes:

Mask size (mm ID)	Patient weight (kg)	ID (mm)	Cuff volume (ml)	Max ETT
1	<5	5.25	<4	3.5 uc
1.5	5-10	6.1	<7	4.0 uc
2	10-20	7.0	<10	4.5 uc
2.5	20-30	8.4	<14	5.0 uc
3	30-50	10	<20	6.0c
4	50-70	10	<30	6.0c
5	>70	11.5	<40	7.0c

A fibreoptic bronchoscope can pass through an ET with an internal diameter ID at least 1mm larger than the outside diameter of the bronchoscope.

c – Cuffed; uc – uncuffed

Induction techniques:

Unique to the pediatric population is the higher incidence of induction with inhaled anaesthetics. An adequate depth of anaesthesia and suppression of pharyngeal reflexes is necessary before insertion of LMA. The most frequently used inhaled anaesthetics for induction in children are sevoflurane and halothane both of which are satisfactory for LMA when the depth of anaesthesia is adequate .Isoflurane is less suitable for induction than sevoflurane or halothane ;however isoflurane is a good choice for maintenance of anaesthesia with the use of LMA . Desflurane produces a high incidence of breath holding and coughing and is a poor choice for the induction of anaesthesia in either children or adults.

When compared with thiopental, propofol produces greater depression of pharyngeal and laryngeal reflex activity [20] thus resulting in more suitable condition of LMA insertion. Propofol 3.5 mg/kg mixed with lidocaine 0.5 mg/kg provides good condition for LMA insertion in 95% of

unpremedicated children[6]. Intravenous propofol 4 mg/kg with lidocaine 1mg/kg alone or followed by the inhalation of 4% to 5% halothane also provides adequate condition for insertion of LMA [21].There are also reports of ketamine being used in combination with halothane- enriched air to facilitate LMA placement in children [22].

Neuromuscular blocking agents can be administered before LMA insertion, but they are seldom required, eliminating the need for muscle relaxants to facilitate endotracheal intubation avoids the risks associated with these drugs in children.

The LMA can also be inserted in awake children after adequate topical anaesthesia to the pharynx. This method has been reported in children with known difficult airways.

Insertion techniques:

The most efficient insertion technique is the standard technique described by Brain. [22]. The mechanism of insertion parallels the action of swallowing a bolus of food ,

with index finger imitating the action of the tongue .The following basic steps are recommended for insertion of the LMA in pediatric patients .

1) Deflate the cuff and lubricate the upper surface of the tip of the LMA ;

2) Establish an adequate depth of anaesthesia with the loss of pharyngeal reflex ;

3) Flatten the tip of the LMA against the anterior part of the hard palate immediately posterior to the upper incisors. position the index finger at the junction of the shaft and the mask ;

4) Advance the LMA in one continuous motion while applying the pressure along the palatopharyngeal curve with the index finger. the initial force vector should be directed cranially , not posteriorly ;

5) Press the LMA along the soft palate as the cuff passes along the posterior pharyngeal wall until the LMA tip is seated in the hypopharynx ;

6) Inflate the cuff with the minimum volume of air required to achieve an effective seal. Do not exceed the maximum recommended volume.

7) Attach the breathing circuit , and confirm the ability to deliver the positive pressure ventilation ;

8) Place a soft gauze roll as bite block next to the shaft of the LMA;

9) Tape the LMA in place ; and

10) Auscultate the neck, checking for upper airway obstruction and confirming the cuff seal.

The other approaches are Diagonal approach, upside – down approach and laryngoscope approach [23-25].

Correct positioning of LMA can be assessed by observing synchronous movements of the chest, abdomen, and respiratory system. Breath sounds should be equal upon auscultation .In addition, pulse oximetry, capnography, and airway pressure monitoring will confirm the adequacy of ventilation. If the child is not ventilating well spontaneously, then gentle assisted ventilation, keeping the peak inflation pressures below 20cm H_2O, can be performed. Problems that may be encountered during insertion of the LMA in children include coughing, laryngospasm, hypoxemia, breath holding, vomiting, partial obstruction and excessive salivation .When an inadequate airway is detected after LMA insertion, the device should be removed and reinserted correctly.

Maintenance and Monitoring:

Sevoflurane, isoflurane and halothane and total intravenous anaesthesia with propofol have all been used successfully with the LMA for general anaesthesia in children

[26,27].Toddlers and older children generally do well with spontaneous ventilation, although mild hypercapnia may develop [26,27].

End – tidal carbondioxide measurements from an LMA in a pediatric patient weighing more than 6 kg are as accurate and reliable as those obtained when an endotracheal tube is used.

Removal of LMA:

The timing for the removal of the LMA at the conclusion of anaesthesia in pediatric patients remains controversial. Some anaesthesiologist recommends leaving the LMA in place until it is expelled spontaneously by the awake child [28]. Others however, suggest that there are fewer complications if the LMA is removed under anaesthesia [29-31].Finally, there are studies suggesting that there is no difference in the incidence of complication between either of these methods. The reported incidence of complications following removal of the LMA is 10% to 13% and includes

coughing, laryngospasm, retching, vomiting, breath holding, stridor, desaturation and excessive salivation .[28-30, 32]

Whether to remove the LMA with cuff inflated or deflated is also controversial. Deflation of the cuff before removal may permit aspiration of oropharyngeal secretions that have pooled above the cuff. Allowing the awake child to spontaneously expel the LMA with cuff inflated reduces the risks of aspiration or oropharyngeal secretions. The incidence of sore throat following minor pediatric surgery appears to be unaffected by the choice of an LMA or endotracheal tube. If other than physicians, LMA removal in children should be performed only by trained personnel.

Other specifications which require mention here are:

LMA can be used as a conduit for endotracheal intubations, Neonatal resuscitation, for ENT procedures, conduit for fibre optic bronchoscopy.

MATERIALS AND METHODS

This study was conducted in Department of Anaesthesia, Institute of Child Health, an attached institution of Madras Medical College, Chennai between June 2008 and August 2008 on forty patients, posted for day care surgery. This study was done after institutional approval and written informed consent was obtained from the parents of each child included in the study.

A prospective, randomized, controlled study - Conducted on 40 ASA I and II children of either sex, age 1-8 years undergoing general or urogenital surgery lasting 45 to 60 min were randomly allocated in to two groups – group P (saline and propofol) and group PK (ketamine co-induction with propofol)

Inclusion criteria:

1) children belonging to ASA I and II

2) children between ages 1 and 8

3) child undergoing general and urogenital surgery lasting for 45 to 60 mins.

Exclusion criteria:

1) full stomach

2) allergic to egg

3) hyper reactive airway disease

4) difficult airway

5) obese

6) features of raised intracranial pressure

7) parent refusal and

8) sepsis

MATERIALS:

2 LMA classic of 2 size and one LMA classic 1.5 size of Laryngeal mask co.Ltd. (LMCL), Inj.propofol , Inj.ketamine

METHODS:

After getting parental informed consent and ethical committee clearance, all patients underwent pre-operative assessment, investigations and evaluation. Children were fasted 6 h for solids and 4 h for fluids. Children were premedicated with inj.atropine 20µg /kg im 30 min prior to the induction of anaesthesia. I.V access was obtained in dorsum of the hand with 22 G cannula.Co-loading done at rate of 15 ml/kg/hr with ringers lactate.

In operating room, baseline recording of heart rate (HR) and blood pressure (NIBP) and oxygen saturation (SPO_2) was obtained. Patients elected by randomization by sealed envelope. Pre-dosing with the test drug was performed 2 min prior to the administration of the induction dose of propofol in all the groups. Equal volumes of Drug A (normal saline) and Drug B (ketamine 0.5 mg/kg) were given as test drugs in

groups P and PK respectively. In group P 5 ml of saline is taken as test drug and in PK group calculated ketamine dose was diluted to 5 ml volume .After giving the test drug intravenously child was preoxygenated 100% oxygen for 2 min. Both the groups were induced with i.v. propofol bolus of 2.5 mg /kg mixed with lignocaine 0.5mg/kg over 5 s. The syringe containing propofol was covered with white paper to mask the dose given.

An experienced anaesthesiologist who was also masked to the dose of propofol as well as co-induction agent inserted LMA 30 s after giving the propofol bolus. The insertion of LMA was categorized by the anaesthesiologist who inserted it as:

Excellent - if the jaw was relaxed, there was no coughing, gagging, swallowing, no limb movements or laryngospasm;

Satisfactory - if the jaw was relaxed, there was no coughing, gagging, swallowing or laryngospasm and little limb movements;

Unsatisfactory - if there was coughing or gagging or swallowing or laryngeal spasm. In unsatisfactory cases additional boluses of 0.5mg/kg Propofol was given and further titrated to facilitate insertion of LMA.

Caudal block of 1ml/kg of 0.25% bupivacaine was administered for analgesia in all groups. Patient did not receive any narcotics intraoperatively. The failure of caudal block was assessed by hemodynamic response (increase in HR and SBP by 20 % of baseline to surgical incision). The children with failed caudal block were excluded and intraoperative analgesia in these children was supplemented with I.V. narcotics. Anaesthesia maintained with Nitrous oxide (50%) + oxygen (50%) with Propofol infusion at rate of 10mg /kg /hr delivered through syringe infusion pump. The maintenance of propofol was modified based on hemodynamic changes intraoperatively; the infusion was

increased or decreased by 50 µg / kg / min with increase or decrease of systolic blood pressure by 20 % from the baseline respectively.

The children were monitored intraoperatively for HR, NIBP, ECG, SpO2 and ETCO2. The Heart and blood pressure was recorded immediately after propofol bolus, then every minute till 2 min after LMA insertion and then every 5 min during the course of the surgery.

The children were also monitored for hypoxemia, respiratory depression, laryngospasm and increased secretions. Propofol infusion was stopped 5 min before the expected end of surgery. The total propofol dose used for induction was also recorded. LM was removed in the deep plane of anesthesia. Recovery was assessed using Steward's Postanaesthetic Recovery Score measured every 5 min (20). The time to recovery was defined as time from stopping propofol infusion to a score of 6 on Steward's Postanaesthetic Recovery Scale.

Steward's Postanaesthesia Recovery Scale:

Parameter	Finding	Points
Consciousness	Awake	2
	Arousable and responding to stimuli	1
	not responding to stimuli	0
Airway	coughing on command or crying	2
	maintaining good airway and breathing easily	1
	airway requires maintenance	0
Movement	moving limbs purposefully	2
	non-purposeful movements	1
	not moving	0

(STEWART' S POST OPERATIVE RECOVERY SCORING; MINIMUM SCORE –O, MAXIMUM-6)

OBSERVATION AND RESULTS

40 ASA I /II children divided in to two groups P and PK were enrolled into the study. None of the children enrolled in the study was excluded. Two groups were similar for age, weight, duration of procedure and types of surgical procedures performed. Table 1a & 1b.

Table 1a: Demographic profile

Variable	P	PK
Gender M:F	19:1	18 :2
Age (yrs)	3.1 (1.6)	3.9 (1.9)
Weight (kg)	11.8 (2.7)	12.5 (2.8)

Duration of surgery (min)	41 (4.7)	38.5 (5.4)

All data are mean and (SD)

Table 1b: Types of surgical procedures between 2 groups

Procedure	**P**	**PK**
Herniotomy	8	5
Circumcision	8	10
Orchidopexy	-	3
Urethroplasty	2	-
Hydrocele	2	2

All these procedures were done electively under day care list. Procedures in both the groups were similar.

Hemodynamic changes:

In this study there is no significant difference in mean baseline MAP between P and PK group and the MAP (after bolus) decreased significantly at most of the time of observation after propofol bolus in both the groups P and PK. 20 % of the patient (4/20) had MAP fall (MAP 2) > 20 % than the **base line MAP** (MAP 2) in PK group compared to 45% (9/20) in P group .The % decrease in MAP between the **base line MAP** (MAP 1) and **After bolus MAP** (MAP 2) were statistically analysed between two groups P and PK .This was

not statistically significant between two groups P and PK. (Table -2).

Table-2: Hemodynamic changes

Mean arterial pressure Base line mean (SD)	89.5 (13)	90.35 (9.9)
After induction mean (SD)	72 (11)	79 (9.5)
% fall from base line mean (SD)	19.45 (10.7)	14.4 (9. 96)#
Pulse rate /min Base line mean (SD)	120.3 (7)	125.7 (10.4)
After induction mean (SD)	118.75 (8.7)	118.8 (7.7)#

- (p value > 0.05)

Heart rate decreased all the times of observation when compared to baseline in the propofol group .In PK group fall in the heart rate was not significant. Difference in the HR between 2 groups at all time intervals was not significant.

Insertion characteristics:

In this study both excellent and satisfactory condition of LMA insertion as acceptable and analysed accordingly. In the PK group only 3 patient had acceptable condition and in P group none .All the patient in P group and most of patient (17) in PK group received additional boluses of propofol for attaining optimal insertion condition (Table -3).

Table -3 Frequency distribution of grades of LMA insertion

Groups	Excellent	Satisfactory	Unsatisfactory
P	-	-	20 (100%)
PK	-	3 (15 %)	17 (85%)

The total propofol bolus required for LMA insertion between 2 groups were analysed statistically:

The mean induction dose required in P group was 55mg (4.7mg /kg) with SD of 10.4 mg which is comparable with PK group requiring 39 mg +/- 9.2 (3.1mg/kg) TABLE – 4 which is statistically significant

($p < 0.005$).

Table 4: Total induction dose of propofol and co-induction agent

Parameter	P	PK
Median dose of co-induction agent (mg)	____	6.5
Total dose of propofol Mean (SD) Median	55.25 (10.4) 55	39(9.2)* 37.5
Induction dose (mg/kg)	4.73 (0.51)	3.17 (0.36) *

* - (p value < 0.005)

Recovery characteristics:

The mean time to achieve Steward Score of 6 was significantly different in 2 groups. The time to achieve Steward Score of 6 was longer in PK group (58.5 min) compared to P group (44.5 min) {p value < 0.05) (Table -5).

Table 5: Time taken to attain Steward's recovery score of 6

Parameter	P	PK
Duration of recovery (min)	44.5 (14. 7)	58.5 (25) **

** - (p value < 0.05)

There were no episodes of hypoxemia, respiratory depression, increased secretion, laryngospasm and hallucination in any of children during this period.

DISCUSSION

Children require a large dose of propofol compared to adults because of a larger volume of distribution and higher cardiac output [33]. the combination of propofol-ketamine is additive and has been shown to reduce dose of propofol required for LMA insertion in adults [12,16].Therefore we decided to use 2.5 mg/kg of propofol for inducing in group were ketamine is used. Studies of unpremedicated children suggest that although there are age related differences in induction dose (ED 50) of propofol, these are not pronounced as those for thiopentone. Children between 6-12 yrs of age have ED50 dose requirements of propofol similar to these for adults, and for the purpose of standardizing the dose, propofol dose is kept 2.5mg/kg in propofol alone group.

The peak effect of ketamine occurs at 1 min [34] we therefore administered these drugs 2 min prior to the administration of induction dose of propofol.

Tomatir et al [18] utilized a combination of ketamine (0.5mg/kg) and propofol 1.5mg/kg followed by 75 µg/kg for sedation in children undergoing MRI study. They found the i.v administration of low dose ketamine with propofol preserves hemodynamic stability .Similarly Akin et al [17] investigated that effect of propofol-ketamine combination on hemodynamics, recovery and sedation level in children undergoing cardiac cathterisation. They found this combination to decrease propofol dose and maintain MAP better without prolonging recovery time.

S.Goel et al [10] used a combination of ketamine 0.5mg/kg and propofol 2.5mg/kg followed by propofol infusion of 150µg/kg for LMA insertion in children undergoing day care procedures. They found that i.v. administration of low dose ketamine with propofol preserves hemodynamic stability and improves the LMA insertion characteristics.

In this study the combination of propofol and ketamine was studied in children undergoing urogenital and general surgery procedures under day care. The children in all group

of our study showed a similar fall in HR .This has been postulated to be due to loss of resting vagal tone, which is higher in children. Similar findings have been reported by Tomatir et al [18] and S.Goel et al [10]

In this study a clinically significant fall in MAP (> 20% fall) was seen in 20 % of patient in group PK compared to 45% in group P.A high dose of propofol produces a greater decrease in blood pressure possibly because of decrease in after load . It can also be due to decrease in cardiac output secondary to a reduced preload as a result of vasodilatation of capacitance vessels [35]. Comparably stable hemodynamics in the ketamine group may be due to the compensation of the sympatholytic effect of propofol with the sympathomimetic action of ketamine [15, 19] and ,the lesser amount of propofol used in that group.

In this study none of the patient in the P group (0/20) had acceptable condition for LMA insertion compared to the group receiving propofol-ketamine (3/20). All the patient in the propofol group received additional boluses of propofol

for LMA insertion compared to 85% patient requiring an additional bolus in PK group. S.Goel et al [10] found the overall LMA insertion conditions to be better in ketamine- propofol than in propofol group in children.

The improved LMA insertion condition in 3 cases in group receiving ketamine as co-induction agent in this study may be related to deeper level of anaesthesia. Ketamine by itself does not have any role in improving mouth opening or suppressing airway reflex.

S.Goel et al [10] found in their study that recovery was significantly prolonged in groups PK compared to propofol group P .In this study similar to the above study recovery was delayed in PK group (58.75 min) compared to P group (44.5min) .this finding was significant as seen by other authors [10].In this study, prolonged recovery may probably be due to greater depth of anesthesia using ketamine.

During the study side effects like increased secretions, laryngospasm and hallucinations with ketamine were not

observed. Recent studies have shown that the combination of ketamine and propofol prevents psychomimetic side effects of ketamine, in addition to prevention of cardiorespiratory depression and providing analgesia [17].

SUMMARY

Objectives:

Use of ketamine lowers the induction dose of propofol (co- induction) producing hemodynamic stability.

Background:

Large doses of propofol needed for induction and laryngeal mask (LMA) insertion in children may be associated with hemodynamic and respiratory effects .Co-induction has the advantage of reducing dose and therefore maintaining hemodynamic stability.

Methods/Materials: A prospective ,randomized ,double-blind ,controlled study was conducted in 40 ASA I/II children ,age 1-8years.Normal saline, Ketamine 0.5 mg/kg were administered in P (propofol) and PK (propofol-ketamine) group respectively, 2min prior to administration of the induction dose of propofol. Propofol 2.5 mg/kg given as induction in groups (P and PK), LMA inserted 30s later and insertion conditions assessed. Heart rate and Blood pressure were recorded immediately after propofol bolus, then every min till 2 min after LMA insertion. Recovery was assessed using Steward's score.

Results: 20% of the patient in PK group had MAP fall > 20 % compared to 45 % in P group .This difference was not statistically significant and thus ketamine propofol co-induction for LMA insertion produce no better hemodynamic stability compared to propofol alone .

ketamine co induction with propofol produced comparably better condition for LMA insertion(3/ 20) than propofol alone (0/20) and significantly reduced the total induction dose of propofol {39 +/- 9.2 ,(3.1 mg/kg) } compared to propofol alone { 55.2 +/- 10.4 ,(4.7 mg/kg)} for LMA insertion [$p < 0.005$]. , but this is at the expense of recovery time with PK group (58.7+/- 25) taking significantly longer recovery time compared to P group (44.5 min +/- 14.7) {$p < 0.05$}.

CONCLUSION

The result of this study showed that the co-induction with ketamine prior to propofol induction for LMA insertion in children decreases the total dose of propofol used for induction, however this advantage is at the expense of prolonging the recovery time. Ketamine co-induction with propofol showed no better significant hemodynamic stability compared to propofol group.

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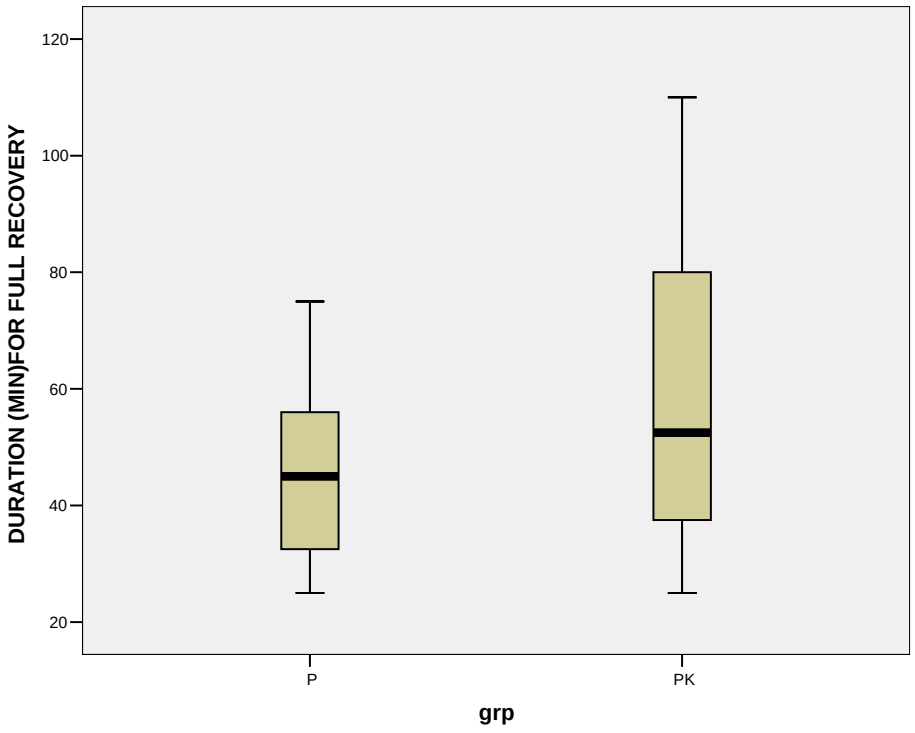
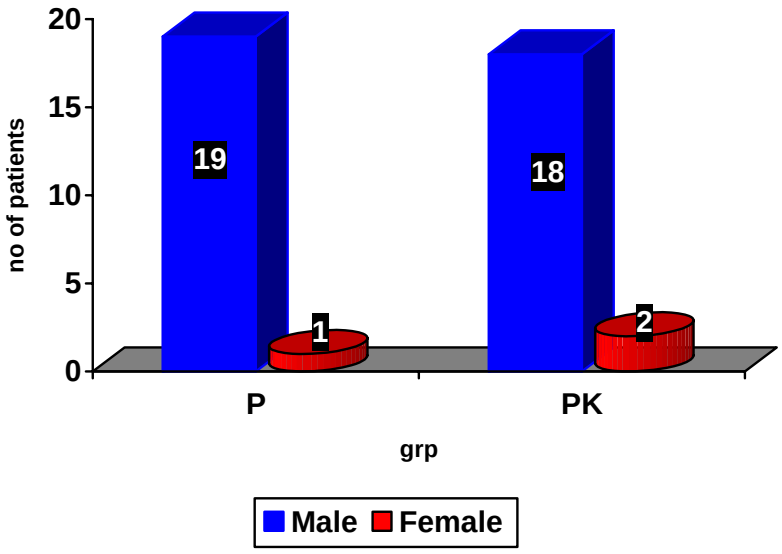
COMPARISON OF RECOVERY CHARACTERISTICS

BETWWEN TWO GROUPS



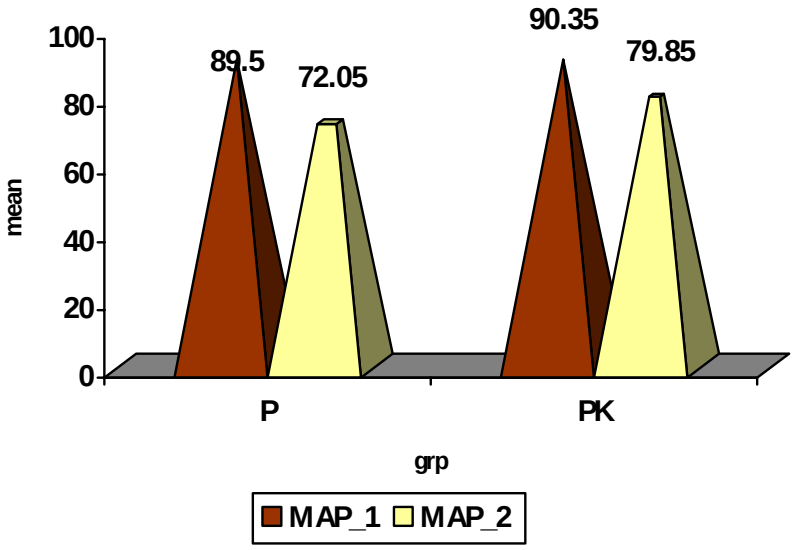
DEMOGRAPHIC PROFILE :

WITH SEX RATIO AMONG THE GROUP:

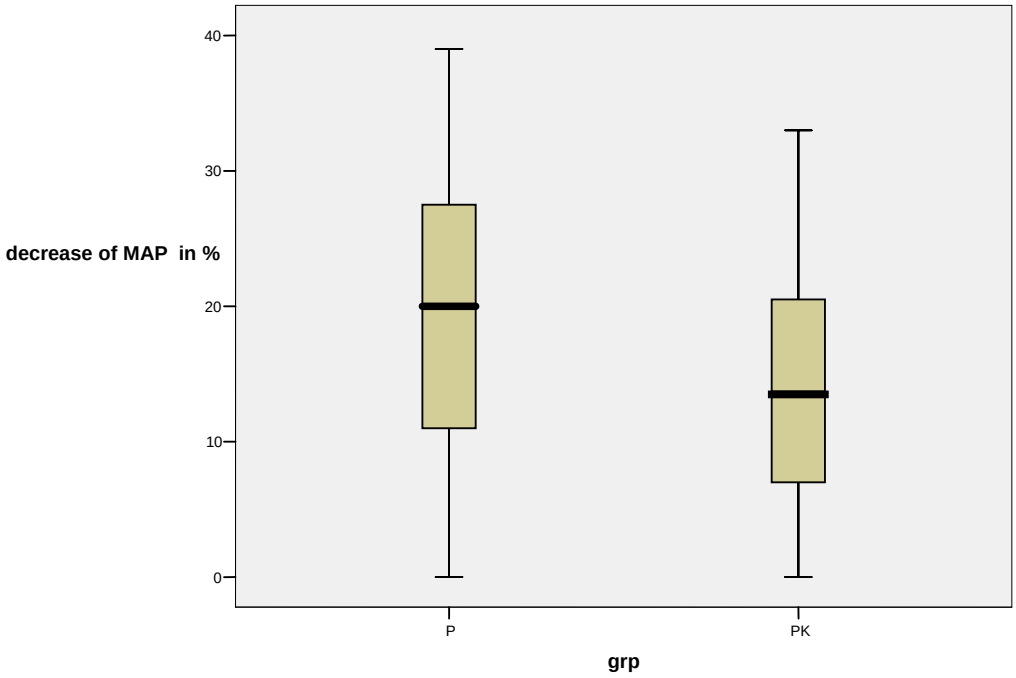


COMPARISION OF HEMODYNAMIC PARAMETERS :

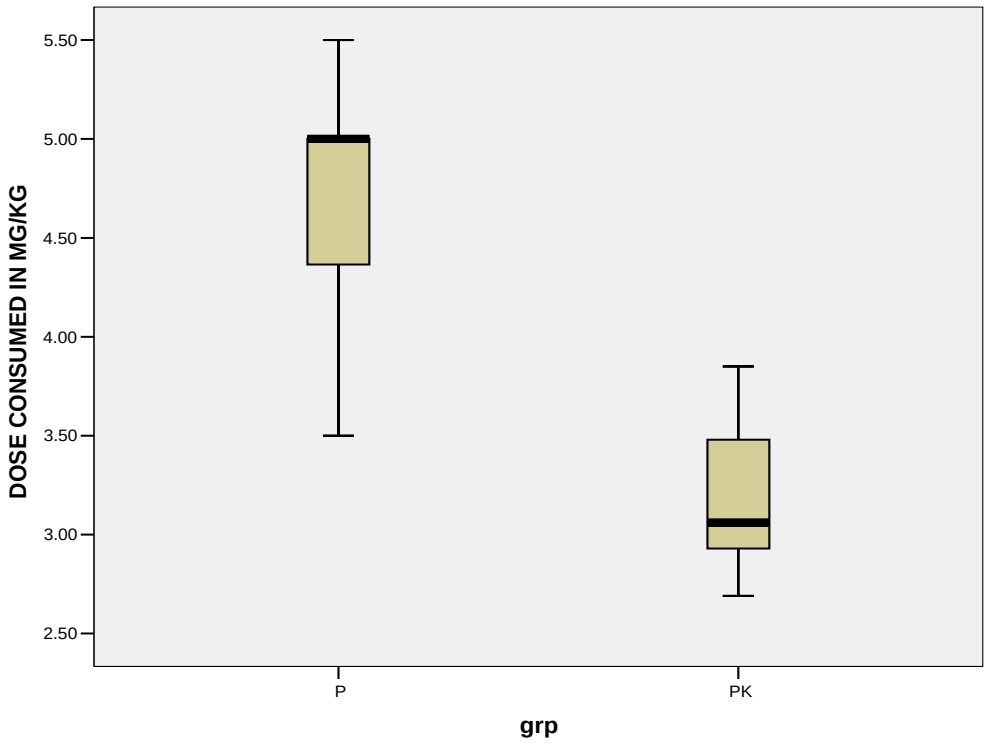
baseline and after bolus MAP comparison between the Groups:



COMPARISON OF PERCENTAGE FALL BETWEEN MAP1 AND MAP2 IN BOTH THE GROUPS



COMPARISON OF PROPOFOL CONSUMPTION BETWEEN GROUPS


DOSE CONSUMED IN MG/KG
5.50
5.00
4.50
4.00
3.50
3.00
2.50
P
PK
grp

PROFORMA

Name :

Age :

Sex :

ASA :

MPC :

IP no: :

Informed written Consent :

Diagnosis :

Surgery :

Weight :

Comorbid Conditions :

Investigations

Hb/pcv: BT CT BL.Sugar: Bl.Urea :

Sr.Creatine:

……i.v. cannula in dorsum of upper limb

Premedications:

Inj. atropine 20mcg/kg----------i.m

HR	NIBP	SP02

Baseline Monitoring;

predosing with test drug 2 min before induction

P	Propofol	NORMAL SALINE
PK	Ketamine co-induction	INJ. KETAMINE 0 .5mg/kg i.v.

---

induced with Inj. propofol 2.5 mg/kg bolus

P	PK

LMA INSERTED AFTER 30 SECS --Insertion characteristics

Jaw relaxation	Coughing	Gagging	Swallowing	Limb movements	laryngospasm

EXCELLENT SATISFACTORY
UNSATISFACTORY

(Nil above parameter) (Little limb movement) (Above parameters)

ADDITIONAL BOLUS OF INJ. PROPOFOL…….. Titrated to satisfactory

SUPPLEMENTED WITH CAUDAL EPIDURAL OF 1ml/kg of 0.25% bupivacaine

---------- ml

Maintained with nitrous oxide (50%) and oxygen (50%) and Propofol infusion 10 mg /kg /hr

Intraoperative Hemodynamics

Time	HR	NIBP	Sa02	RR	Etco2	Manipulation in Propofol infusion
After bolus						
1 Min						
2 Min						
5 Min						
10 Min						
15 Min						
20 Min						
25 Min						
30 Min						
35Min						
40 Min						
45 Min						
50 Min						
55 Min						
60 Min						
65 Min						
70 Min						

Fluids	
Volume (ml)	

Postoperative Hemodynamics

Time	HR	BP	Sa02	RR
0 Min				
5 Min				
10 Min				
15 MIN				
20 min				
25 min				
30 min				
35 min				
40 min				
45 min				

Perioperative Complications

	Intraoperative	Post Operative	Treatment Given
LARYNGOSPASM			
BRADYCARDIA			
HYPOTENSION			
TACHYCARDIA			
DESATURATION			
SECRETIONS			

Parameter	**Finding**	Points
consciousness	Awake	2
	arousable and responding to stimuli	1
	not responding to stimuli	0

airway	coughing on command or crying	2
	maintaining good airway and breathing easily	1
	airway requires maintenance	0
movement	moving limbs purposefully	2
	non-purposeful movements	1
	not moving	0

STEWART' S POST OPERATIVE RECOVERY SCORING MINIMUM SCORE –O MAX-6

TIME (MIN)	5 MIN	10 MIN	15 MIN	20 MIN	25 MIN	30 MIN	35 MIN	40 MIN	45 MIN	50 MIN	55 MIN	60 MIN	65 MIN	70 MIN
POST-OPERATIVE SCORE/ 6														

name	Age(yr)	Sex	ASA	MPC	Diagnosis	Surgery	Weight(kg)	Co morbid Con ditions	IP NO	Hb/PCV	BT	CT	inj .atropine 20 mcg/kg i.m	Baseline heart rate	B.P	MAP	SPO2	group	inj .ketamine .5 mg/kg i.v	propofol	inse rtion charact eristics	additional bolus	LMA SIZE	total induc.dose	DOSE CONSUMED IN MG/KG	0.25% bupivacaine 1ml/kg caudal	maint. O2:N2o5 0%
GOWTHAM	5	M	I	I	UDT	ORHIDOPEXY	13	nil	77482	11	3 20	4 05	0.3	124	128/81	96	100	PK	7.5	35	UNSATIA	10	2	45	3.46	13	INF.PRO
SANTOSH	3	M	II	I	PHIMOSIS	CIRCUMCISION	10	nil	2259/08	11	3 25	5 40	0.2	136	118/62	81	100	pk	5	25	US	5	1.5	30	3	10	INF.PRO
VASANTH	8	M	I	I	PHIMOSIS	CIRCUMCISION	15	NIL	3456/08	12	4 10	5 40	0.3	124	124/76	92	100	PK	7.5	40	US	10	2	50	3.33	15	PROPOF
ABISHEK	4	M	II	I	RIH	HERNIOTOMY	14	NIL	2670/08	10	2 30	4 50	0.3	112	114/72	86	100	PK	7	35	US	10	2	45	3.21	14	INF.PRO
MADHUMITHA	5	F	II	I	B/LIH	HERNIOTOMY	15	NIL	50258	9.8	2 30	4 32	0.3	120	110/76	87	100	PK	7.5	40	US	5	2	45	3	15	INF.PRO
SHANMUGAM	3	M	II	I	UDT	ORCHIDOPEXY	10	NIL	615106	11	3 20	4 32	0.2	126	116/72	86	100	PK	5	25	US	10	1.5	35	3.5	10	INF.PRO
JEGAN	4	M	II	I	LIH	HERNIOTOMY	13	NIL	575/08	9.8	2 50	4 15	0.3	120	140/61	87	100	PK	6.5	35	***SATIs***	NIL		2	35	2.69	13	INF.PRO
SHWETA	4	F	II	I	RIH	HERNIOTOMY	14	NIL	234/08	9.8	3 12	5 02	0.3	124	120/80	93	100	PK	7	35	US	5	2	40	2.86	14	INF.PRO
KAMELESH	2	M	II	I	PHIMOSIS	CIRCUMCISION	11	nil	2257/08	9.2	2 20	5 40	0.3	140	114/63	80	100	PK	5.5	30	***SATIS***	NIL		2	30	2.72	11	INF.PRO
VENKATESAN	2	M	II	I	PHIMOSIS R VAGINAL	CIRCUMCISION PV SAC	10	NIL	904/08	10	2 20	4 50	0.2	136	121/76	91	100	PK	5	25	US	5	1.5	30	3	10	INF.PRO
SANTOSH NANDHA	3	M	II	I	HYDROCELE R VAGINAL	LIGATION PV SAC	10	nil	890/08	9.6	1 50	4 10	0.2	154	108/69	82	100	PK	5	25	US	10	1.5	35	3.5	10	INF.PRO
KUMAR	2	M	II	I	HYDROCELE	LIGATION	10	nil	1106/08	10	1 55	4 30	0.2	116	85/55	65	100	PK	5	25	US	5	1.5	30	3	10	INF.PRO
KALI	8	m	I	I	PHIMOSIS	CIRCUMCISON	16	nil	613615	11	3 30	5 05	0.3	116	123/84	97	100	PK	8	40	US	10	2	50	3.12	16	INF.PRO
SURESH RAJ	2	M	II	I	PHIMOSIS	CIRCUMCISION	8	nil	1736/08	9.6	2 30	5 32	0.2	118	111/74	86	100	PK	4	20	US	10	1.5	30	3.75	8	INF.PRO
DHANUSH	3	M	II	I	PHIMOSIS	CIRCUMCISION	11	nil	921/08	10	2 30	4 50	0.2	114	110/80	90	100	PK	5	30	***SATIs***	NIL		1.5	30	2.72	11	INF.PRO
BALAJI	8	M	I	I	PHIMOSIS	CIRCUMCISION	20	nil	789/08	10	2 50	5 20	0.4	118	133/87	104	100	PK	10	50	US	5	2	55	2.75	20	INF.PRO
DINESH	3	M	II	I	UDT	ORCHIDOPEXY	13	nil	675/08	11	2 45	4 50	0.3	124	128/81	96	100	PK	7.5	35	US	10	2	45	3.46	13	INF.PRO
VARADHA	4	M	I	I	RIH	HERNIOTOMY	15	nil	1250/08	10	2 30	4 30	0.3	124	124/79	94	100	PK	7.5	40	US	15	2	55	3.67	15	INF.PRO
MONISH	3	M	II	I	PHIMOSIS	CIRCUMCISION	13	nil	1245/08	10.6	3 35	5 00	0.3	136	138/94	109	100	PK	6.5	35	US	15	2	50	3.85	13	INF.PRO
MANOJ KUMAR	2	M	II	I	PHIMOSIS	CIRCUMCISION	10	nil	1024/08	10	3 10	6 00	0.2	132	128/94	105	100	PK	5	25	US	5	1.5	30	3	10	INF.PRO
SIVA	4	M	II	I	RIH	HERNIOTOMY	10	NIL	2107/08	9	3 40	5 40	0.2	118	110/74	86	100	P	0	25	US	10	1.5	35	3.5	10	INF PRO
PRAVEEN	3	M	II	I	HYPOSPADIAS	URETHROPLASTY	13	NIL	2234/07	11	4 00	5 00	0.3	126	100/70	80	100	P	0	30	US	25	2	55	4.23	13	INF PRO
AJAY	3	M	II	I	RIH	HERNIOTOMY	13	NIL	1223/08	11	2 00	5 00	0.3	122	92/45	61	100	P	0	30	US	25	2	55	4.23	13	INF PRO
ASWANTH	4	M	II	I	LIH	HERNIOTOMY	13	NIL	2618/08	10	2 55	4 56	0.3	132	98/72	80	100	P	0	30	US	35	2	65	5	13	INF PRO
TAMILARASU	2	M	II	I	HYPOSPADIAS	CHORDAE CORRECTION	10	NIL	222/08	9.8	2 00	4 50	0.2	112	135/95	107	100	P	0	25	US	25	1.5	50	5	10	INF PRO
MANIKANDAN	8	M	II	I	HYDROCELE	PVSAC LIGATION	20	NIL	2009/08	11	3 11	5 20	0.4	112	144/75	88	100	P	0	50	US	30	2	80	4	20	INF PRO
ESTHER	5	F	I	I	RIH	HERNIOTOMY	15	NIL	1826/08	10	3 10	4 30	0.3	112	132/87	102	100	P	0	40	US	30	2	70	4.66	15	INF PRO
SUMANTH	3	M	I	I	PHIMOSIS	CIRCUMCISION	12	NIL	905/08	9.7	2 10	4 20	0.3	112	138/95	109	100	P	0	30	US	30	2	60	5	12	INF PRO
N	2	M	II	I	PHIMOSIS	CIRCUMCISION	12	NIL	899/08	11	3 20	5 55	0.3	116	100/60	71	100	P	0	30	US	30	2	60	5	12	INF PRO
NIRMAL	6	M	I	I	PHIMOSIS	CIRCUMCISION	16	NIL	2024/08	9	3 15	5 10	0.3	112	11O/80	90	100	P	0	40	US	25	2	65	4.1	16	INF PRO
AKASH	2	M	II	I	PHIMOSIS	CIRCUMCISION	10	NIL	4543/07	12	2 55	4 30	0.2	124	100/70	80	100	P	0	25	US	20	1.5	45	4.5	10	INF PRO
SANJAY	3	M	I	I	PHIMOSIS	CIRCUMCISION	10	NIL	1122/08	9.8	2 20	4 30	0.2	122	127/84	98	100	P	0	25	US	30	1.5	55	5.5	10	INF PRO
VISHWA	2	M	II	I	PHIMOSIS	CIRCUMCISION	10	NIL	1324/08	10	2 30	4 30	0.2	132	116/80	92	100	P	0	25	US	30	1.5	55	5.5	10	INF PRO
RUTHRAN	2	M	II	I	LIH	HERNIOTOMY	10	NIL	2210/08	10	3 45	5 00	0.2	122	122/71	88	100	P	0	25	US	25	1.5	50	5	10	INF PRO
YUGENDREN	2	M	II	I	LIH	HERNIOTOMY	8	NIL	2212/08	9	2 50	4 10	0.2	124	107/82	90	100	P	0	25	US	15	1.5	40	5	10	INF PRO
RAJESH	2	M	II	I	LIH	HERNIOTOMY	10	NIL	2329/08	11.4	3 30	5 20	0.2	130	126/108	114	100	P	0	25	US	25	1.5	50	5	10	INF PRO
SATISH	2	M	II	I	PHIMOSIS	CIRCUMCISION	10	NIL	495/08	9	1 55	3 40	0.2	112	131/88	102	100	P	0	25	US	25	1.5	50	5	10	INF PRO
VIGNESH	2	M	II	I	RIH	HERNIOTOMY	10	NIL	1353/08	11.2	3 00	5 00	0.2	124	92/71	78	100	P	0	25	US	25	1.5	50	5	10	INF PRO
HARISH	2	M	II	I	PHIMOSIS	CIRCUMCISION	11	NIL	513/08	10	3 00	4 55	0.2	112	102/71	80	100	P	0	25	US	25	2	50	4.9	11	INF PRO
SIVAPRAKASM	3	M	I	I	CONGENITAL HYDROCELE	PVSAC LIGATION	13	NIL	371/08	11	3 52	4 32	0.3	130	148/67	94	100	P	0	35	US	30	2	65	5	13	INF PRO

after bolus - HR	B.P	MAP	% decrease	duration of surgery	IVF/hr	reco score end of surgery	FULL RECOVERY	intra op[events	post op events	intaop hr	1min	2	5	10	15	20	25	30	35	40	45	50	BP	1	2	5	10	15	20	25	30	35	40	45	50
112	101/64	76	31%	40	180	1 out of 6	30	nil	nil	111	112	112	104	112	110	111	112	110	112	114			104/64	78/60	96/61	98/61	98/60	100/60	102/64	104/66	104/60	102/70	98/70		
124	97/52	67	18%	35	150	1	75	nil	nil	124	122	123	124	122	122	122	123	123	124				97/52	97/56	101/70	102/68	100/67	102/67	101/70	102/68	100/67	102/67			
128	96/66	77	17%	40	200	1	100	nil	nil	126	122	120	122	120	116	118	118	119	119	118			96/77	96/61	98/61	98/60	100/60	102/64	104/66	104/60	102/70	98/70	112/78		
112	114/70	84	2%	45	200	1	110	nil	nil	112	121	122	130	116	112	116	114	112	113	114	115		114/70	110/72	110/68	112/70	107/70	107/70	116/73	118/76	112/76	113/70	112/76	112/70	
112	108/67	78	11%	40	225	1	30	nil	nil	112	110	108	109	110	109	110	102	110	106	107			97/52	97/56	101/70	102/68	100/67	102/67	101/70	102/68	100/67	102/67			
126	109/71	82	4%	50	150	1	35	nil	nil	123	122	120	123	114	116	112	113	114	115	116	112	110	96/77	96/61	98/61	98/60	100/60	102/64	104/66	104/60	102/70	98/70	112/78	108/72	114/68
113	116/77	95	0%	40	195	1	80	nil	nil	113	112	114	120	121	102	104	122	111	111	112			116/77	114/70	114/72	100/65	98/64	94/60	98/58	97/57	94/70	95/74	100/60		
112	112/68	82	12%	40	210	1	85	nil	nil	112	112	111	116	118	117	116	113	114	109	110			112/68	114/70	116/86	112/70	107/70	107/70	116/73	118/76	112/76	113/70	112/76		
119	97/47	69	14%	30	165	1	40	nil	nil	119	115	113	112	110	112	114	112	114					97/47	95/58	96/52	93/54	85/60	88/62	89/54	90/60	88/64				
125	101/69	79	13%	30	150	1	80	nil	nil	125	125	124	126	123	124	122	123	123					101/69	96/61	98/61	98/60	100/60	102/64	104/66	104/60	102/70				
136	115/89	97	0%	45	150	1	40	nil	nil	136	134	132	133	134	135	125	126	124	128	122	128		115/89	112/70	101/61	102/64	103/60	104/60	102/63	110/70	108/68	106/66	108/64	102/70	
116	100/56	71	22%	40	150	1	85	nil	nil	116	114	118	112	115	116	118	119	120	112	116			125/72	100/56	100/60	102/64	103/60	104/60	102/63	110/70	108/68	106/66	108/64		
120	105/61	78	20%	35	240	1	50	nil	nil	120	112	112	116	110	117	118	100	92	102				123/84	105/67	90/58	93/54	85/60	88/62	89/54	90/60	88/64	100/70			
114	101/70	80	7%	30	120	1	70	nil	nil	114	114	118	112	113	117	116	118	114					101/70	101/62	100/70	98/68	96/74	96/78	94/80	97/57	94/70				
107	107/70	82	9%	35	165	1	45	nil	nil	107	112	110	112	113	111	110	109	108	112				107/72	108/72	101/61	102/64	103/60	104/60	102/63	110/70	108/68	106/66			
118	124/79	97	7%	40	300	1	50	nil	nil	118	116	117	115	116	118	116	117	114	116	114			124/79	110/70	101/72	112/68	111/71	116/70	115/67	112/66	114/72	106/74	115/76		
112	104/64	76	21%	45	195	1	30	nil	nil	112	112	111	113	114	112	111	110	109	106	104	112		106/64	112/70	101/61	102/64	103/60	104/60	102/63	110/70	108/68	106/66	108/64	102/70	
114	84/55	65	31%	40	225	1	60	nil	nil	114	116	112	116	117	118	116	114	115	114	112			88/48	95/58	96/52	93/54	85/60	88/62	89/54	90/60	88/64	94/62	96/62		
126	126/76	92	16%	35	195	1	55	nil	nil	126	124	122	126	125	126	114	117	118	120				126/76	125/72	100/56	100/60	102/64	103/60	104/60	102/63	110/70	108/68			
130	98/57	70	33%	35	150	1	25	nil	nil	130	129	123	124	122	121	122	129	126	121				96/77	96/61	98/61	98/60	100/60	102/64	104/66	104/60	102/70	98/70			
116	100/61	74	14%	45	150	1	35	nil	nil	116	114	112	112	111	120	122	114	111	112	112	113		100/61	98/64	98/61	98/60	100/60	102/64	104/66	104/60	102/70	98/70	98/72	99/64	
126	90/67	50	37%	50	195	1	40	nil	nil	126	122	132	130	126	122	112	124	115	112	113	116	116	90/67	99/62	100/60	88/54	80/48	90/60	85/60	88/62	89/54	90/60	88/64	85/60	88/62
128	90/32	51	17%	40	195	1	25	nil	nil	137	128	122	124	123	116	112	114	116	116	118			78/26	92/45	95/58	96/52	93/54	85/60	88/62	89/54	90/60	88/64	92/64		
112	78/44	55	31%	45	195	1	30	nil	nil	112	114	112	116	118	116	118	112	117	116	118	118	116	78/45	78/50	84/52	95/58	96/52	93/54	85/60	88/62	89/54	90/60	88/64	92/64	
110	86/55	65	39%	40	150	1	25	nil	nil	110	112	115	106	108	109	110	112	107	108	107			86/55	96/66	101/64	78/62	80/52	92/62	93/54	85/60	88/62	89/54	90/60		
112	106/64	78	22%	50	300	1	25	nil	nil	112	114	113	114	116	108	110	112	108	106	105	108	106	106/64	107/58	101/61	102/64	103/60	104/60	102/63	110/70	108/68	106/66	108/64	102/70	106//72
124	113/75	80	22%	40	225	1	45	nil	nil	124	122	126	120	118	117	119	116	114	118	112			113/75	112/68	114/70	116/86	112/70	107/70	107/70	116/73	118/76	112/76	113/70		
116	118/76	90	18%	35	180	1	45	nil	nil	116	118	114	116	112	110	110	111	109	108				118/76	117/75	118/70	111/71	116/70	115/67	112/66	114/72	106/74	115/76			
116	105/57	73	0%	40	180	1	45	nil	nil	116	112	113	110	111	112	110	109	110	108	109			105/57	111/61	101/62	101/61	102/64	103/60	104/60	102/63	110/70	108/68	108/64		
118	90/60	70	23%	35	240	1	60	nil	nil	118	116	112	110	118	114	112	110	111	112				90/60	92/60	100/65	98/64	94/60	98/58	97/57	94/70	95/74	100/60			
116	98/63	74	7%	35	150	1	30	nil	nil	116	118	122	120	122	124	126	122	126	124				98/63	89/53	90/54	92/53	90/54	92/56	92/66	94/63	98/65	96/68			
116	107/65	79	20%	35	150	1	60	nil	nil	116	118	112	114	118	120	124	122	123	126				107/65	107/72	108/72	101/61	102/64	103/60	104/60	102/63	110/70	106/74			
127	116/74	86	9%	40	150	1	60	nil	nil	127	126	128	126	125	126	128	124	128	127	125			116/74	112/70	116/86	112/70	107/70	107/70	116/73	118/76	112/76	113/70	112/76		
116	101/60	74	6%	45	150	1	48	nil	nil	116	118	117	112	114	115	114	117	116	114	113	112		101/60	98/58	95/58	96/52	93/54	85/60	88/62	89/54	90/60	88/64	92/64	90/76	
112	93/55	68	25%	40	120	1	75	nil	nil	112	116	118	120	112	112	116	112	123	120	118			94/65	96/65	97/66	98/64	94/60	98/58	97/57	94/70	95/74	100/60	95/65		
130	128/74	92	20%	45	150	1	40	nil	nil	128	130	132	128	124	122	124	118	117	116	18	119		128/74	121/73	118/70	117/57	118/58	111/54	116/56	111/71	116/70	115/67	112/66	114/72	
110	98/59	72	30%	40	150	1	70	nil	nil	110	112	113	114	112	111	111	112	113	114	112			98/59	99/60	92/60	100/65	98/64	94/60	98/58	97/57	94/70	95/74	100/60		
132	89/66	68	13%	40	150	1	35	nil	nil	132	128	126	124	123	124	112	116	118	118	120			89/66	88/70	98/59	99/60	92/60	100/65	98/64	94/60	98/58	97/57	94/70		
102	78/48	67	30%	35	165	1	45	nil	nil	102	108	109	111	110	114	112	112	116	110				78/48	88/50	86/56	89/66	88/70	98/59	99/60	92/60	100/65	98/64			
136	116/75	89	6%	48	195	1	52	nil	nil	132	136	132	133	134	136	132	132	134	135	132	134	132	116/75	118/58	118/68	117/57	118/58	111/54	116/56	111/71	116/70	115/67	112/66	114/72	106/74

ETCO2	1	2	5	10	15	20	25	30	35	40	45	50	spo2	1	2	5	10	15	20	25	30	35	40	45	50	POST OP HR	5	10	15	20	s	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	BP	5	10	15
	43	42	38	43	42	40	41	43	41	43	45			100	100	100	100	100	100	100	100	100	100	100				111	112	112	104	112	110																		116/74	115/89	112/70	101/61
	36	38	36	42	36	42	43	42	38	43				100	100	100	100	100	100	100	100	100	100					126	122	120	122	120	116	118	118	119	119	118	116	113	114	115							118/70	125/72	100/56	100/60
	38	42	42	41	42	41	36	38	36	42				100	100	100	100	100	100	100	100	100	100	100				126	122	120	122	120	116	118	118	119	119	118	116	112	116	114	112	113	114	115	116		101/70	101/62	100/70	98/68
	34	41	41	40	41	40	38	42	42	41	42	41		100	100	100	100	100	100	100	100	100	100	100	100			111	112	112	104	112	110	111	112	110	112	114	114	116	114	118	112	115	116	118	119	120	112	106/64	107/58	101/61	102/64
	36	43	42	40	42	40	34	41	41	40				100	100	100	100	100	100	100	100	100	100					112	121	122	130	116	112																	113/75	112/68	114/70	116/86
	37	41	43	41	43	41	36	43	42	40	42	40	42	100	100	100	100	100	100	100	100	100	100	100	100	100		120	123	114	116	112	113	114																118/76	117/75	118/70	111/71
	38	40	42	42	42	42	37	41	43	41	43			100	100	100	100	100	100	100	100	100	100	100				111	112	112	104	112	110	111	112	110	112	114	111	112	110	112	114							105/57	111/61	101/62	101/61
	39	40	41	43	41	43	38	40	42	42	42			100	100	100	100	100	100	100	100	100	100	100				112	121	122	130	116	112	116	114	112	113	114	115	114	116	114	118	112						105/57	111/61	101/62	101/61
	42	40	40	45	40	45	39	40	41					100	100	100	100	100	100	100	100	100	100					112	111	112	112	104	112	110	111															90/60	92/60	100/65	98/64
	40	39	41	41	41	41	42	40	40					100	100	100	100	100	100	100	100	100	100					120	123	114	116	112	113	114	115	116	112	110	110	109	108	112	110							98/63	89/53	90/54	92/53
	39	38	40	42	40	45	40	39	41	41	41	41		100	100	100	100	100	100	100	100	100	100	100	100			120	123	114	116	112	113	114	115															107/65	107/72	108/72	101/61
	38	36	40	42	40	42	39	38	40	43	40			100	100	100	100	100	100	100	100	100	100	100				114	116	114	118	112	115	116	118	119	120	112	116	112	111	110	110	111						116/74	112/70	116/86	112/70
	39	38	40	45	40	45	38	36	40	42				100	100	100	100	100	100	100	100	100	100					125	125	124	126	123	124	122	123	123	120													101/70	101/62	100/70	98/68
	38	39	42	40	42	40	39	38	40					100	100	100	100	100	100	100	100	100	100					116	114	118	112	115	116	118	119	120	112	116	114	113	112									106/64	107/58	101/61	102/64
	41	40	41	40	41	40	38	39	42	40				100	100	100	100	100	100	100	100	100	100	100				112	111	112	112	104	112	110	111	112														113/75	112/68	114/70	116/86
	41	42	42	41	42	41	41	40	41	40	41			100	100	100	100	100	100	100	100	100	100	100				116	114	118	112	115	116	118	119	120	112													118/76	117/75	118/70	111/71
	42	41	40	43	40	43	41	42	42	41	42	41		100	100	100	100	100	100	100	100	100	100	100	100			112	111	112	112	104	112																	90/60	92/60	100/65	98/64
	40	43	40	42	40	42	42	41	40	43	40			100	100	100	100	100	100	100	100	100	100	100				120	123	114	116	112	113	114	115	116	112	110	109											98/63	89/53	90/54	92/53
	32	42	39	44	39	44	40	43	40	42				100	100	100	100	100	100	100	100	100	100					116	114	118	112	115	116	118	119	120	112	116												97/52	97/56	101/70	102/68
	38	42	42	42	42	42	32	42	39	44				100	100	100	100	100	100	100	100	100	100					120	123	114	116	112																		96/77	96/61	98/61	98/60
	35	41	40	42	40	42	39	41	41	41	41	41		100	100	100	100	100	100	100	100	100	100	100	100			114	112	112	111	120	122	114																104/64	78/60	96/61	98/61
	40	39	43	40	43	40	35	41	40	42	40	42	41	100	100	100	100	100	100	100	100	100	100	100	100	100		112	116	118	120	112	112	116	112															97/52	97/56	101/70	102/68
	39	39	42	41	42	41	38	39	43	40	43			100	100	100	100	100	100	100	100	100	100	100				112	116	118	120	112																		96/77	96/61	98/61	98/60
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	37	40	41	41	41	41	39	39	39	40	39	40		100	100	100	100	100	100	100	100	100	100	100	100			116	114	112	112	111	120	122	114	111	112													101/70	101/62	100/70	98/68
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	41	41	41	42	41	42	37	40	41	41	41	41	42	100	100	100	100	100	100	100	100	100	100	100	100	100		126	128	126	125	126	128	124	128	127	125													116/77	114/70	114/72	100/65

20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	SPO2	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110
102/64	103/60	104/60																	100	100	100	100	100	100	100																	
102/64	103/60	104/60	102/63	110/70	108/68	106/66	108/64	116/70	115/67	112/66	114/72								100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100							
96/74	96/78	94/80	97/57	94/70	103/60	104/60	102/63	110/70	108/68	106/66	108/64	102/70	106//72	108/64	102/70	106//72			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
103/60	104/60	102/63	110/70	108/68	106/66	108/64	106/64	107/58	101/61	102/64	103/60	104/60	102/63	110/70	108/68	106/66	108/64	102/70	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	1001	100	100	100	100	100	100
112/70	107/70	107/70																	100	100	100	100	100	100	100																	
116/70	115/67	112/66	114/72																100	100	100	100	100	100	100	100																
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94/60	98/58	97/57	94/70																100	100	100	100	100	100	100	100	100															
90/54	92/56	92/66	94/63	98/65	96/68	94/70	103/60	104/60	102/63	110/70	108/68	106/66							100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100							
102/64	103/60	104/60	102/63	110/70															100	100	100	100	100	100	100	100	100															
107/70	107/70	116/73	118/76	112/76	113/70	112/76	108/68	106/66	108/64	116/70	115/67	112/66	114/72						100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100							
96/74	96/78	94/80	97/57	94/70	103/60	104/60													100	100	100	100	100	100	100	100	100	100	100	100												
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112/70	107/70	107/70	116/73	118/76	112/76														100	100	100	100	100	100	100	100	100	100														
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94/60	98/58	97/57																	100	100	100	100	100	100	100																	
90/54	92/56	92/66	94/63	98/65	96/68	98/64	94/60	98/58											100	100	100	100	100	100	100	100	100	100	100	100	100	100										
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100/60	102/64																		100	100	100	100	100	100																		
98/60	100/60	102/64	104/66																100	100	100	100	100	100	100	100																
100/67	102/67	101/70	102/68	100/67															100	100	100	100	100	100	100	100	100															
100/60	102/64																		100	100	100	100	100	100																		
100/67	102/67	101/70																	100	100	100	100	100	100	100																	
100/60	102/64																		100	100	100	100	100	100																		
98/64	94/60																		100	100	100	100	100	100																		
107/70	107/70	116/73	118/76	112/76	113/70														100	100	100	100	100	100	100	100	100	100														
100/67	102/67	101/70	102/68	100/67	102/67														100	100	100	100	100	100	100	100	100	100														
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103/60	104/60	102/63																	100	100	100	100	100	100	100																	
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96/74	96/78	94/80	97/57	94/70	102/70	102/67													100	100	100	100	100	100	100	100	100	100														
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98/64	94/60	98/58	97/57	94/70	95/74	100/60													100	100	100	100	100	100	100	100	100	100	100													