ORIGINAL RESEARCH PAPER

Health Science

A COMPARISON OF SEVOFLURANE AND PROPOFOL INDUCTION CHARACTERISTIC FOR THE INSERTION OF LARYNGEAL MASK AIRWAY IN PAEDIATRIC DAY CASE ANAESTHESIA IN ABUJA, NIGERIA.

KEY WORDS:

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ABSTRACT

Background: Recently, there has been a tendency towards performing surgeries on children on a day-stay basis. Day-case surgery has gained popularity because it results in reduction in healthcare cost, psychological and emotional impacts on children. Day--case surgery reduces behavioural problems as well as gives rise to less disruption to family life. In addition, susceptibility to nosocomial infections is less.

The laryngeal mask airway is a supraglottic airway device. Its development is believed to represents the greatest advancement in airway management since the advent of endotracheal intubation. It has several advantages for day-case anaesthesia in children.

The intravenous induction agent of choice for LMA insertion is propofol. Administration of intravenous agents such as propofol would require intravenous access, which children abhor. Inhalational induction is the more desirable method in paediatrics patients, since it does not require intravenous access before its administration. This is where halothane has held sway for several decades. However, halothane causes bradycardia, hypotension and arrhythmias. The desire to manufacture an inhalational agent which would match the induction properties of halothane, but without these drawbacks, led to the discovery of sevoflurane. The study, therefore, was aimed at comparing the induction characteristics of sevoflurane and propofol for the insertion of LMA in paediatric day case patients.

Methodology: This was a prospective randomised study which was undertaken over a six-month period at the National Hospital, Abuja, a 200-bed tertiary hospital in the capital of Nigeria. The approval of the National Hospital Research and Ethics Committee was sought and obtained. A total of sixty-six (66) patients aged 3-12 years with ASA physical status I or II, scheduled for elective day-case surgery lasting less than 60 minutes were recruited. Patients were randomised into one of the two groups, S (sevoflurane) and P (propofol). All patients were premedicated with 0.01mg/kg atropine and analgesia was provided by administration of intravenous 2μg/kg fentanyl. Patients in group S received incremental inhalational induction with up to 6% sevoflurane, while group P underwent induction of anaesthesia with intravenous 3mg/kgpropofol. Loss of eyelash reflex was solely used to determine loss of consciousness with inhalational sevoflurane induction while loss of verbal contact was solely used for intravenous propofol induction. Maintenance of anaesthesia was provided with1-2% isoflurane in 100% oxygen, while patients were allowed to breathe spontaneously.

Result: Time from the onset of induction to loss of verbal contact in the propofol group ranged from15s to 56s with a mean of 21± 0.08s, while that of loss of eye lash reflex in the sevoflurane group ranged from 55s to 2mins 9s with a mean of 1min 35s ±25s. A statistically significant difference was observed between the time from the commencement of induction to loss of verbal contact for group P, and the time from the beginning of induction to loss of eyelash reflex for group S. The time from initiation of induction to loss of verbal contact was less than the time from initiation of induction to loss of eye lash reflex. A comparison of the two means gave a $p = 0.01$.

A statistically significant difference was observed in the average time it took from the initiation of induction to successful insertion of the LMA between the propofol and the sevoflurane groups with mean values of 1min 54s ±1min 12s and 4mins 23s ±87 respectively ($p<0.05$). In this study, the HR and MAP were higher in the sevoflurane group than the propofol group demonstrating better haemodynamic stability with sevoflurane. While no significant difference was observed in the incidence of cough between the two groups, apnoea was found to be a substantial side effect of propofol induction, and head movement was associated more with sevoflurane induction.

Conclusion: This study demonstrated that both loss of consciousness and LMA insertion time were faster with intravenous propofol than inhalational sevoflurane. Also, Inhalational sevoflurane showed better haemodynamic stability ($p =0.03$), as apnoea was more associated with IV propofol induction compared to the inhalational sevoflurane ($p=0.003$).

INTRODUCTION

In recent years, there has been a change in trend towards day-stay surgeries in children[1]Children make excellent candidates for day-case surgery as they are usually healthy, free of systemic diseases and typically require straightforward, minor or intermediate surgical procedures. More than 60% of paediatric surgeries in the United States of America (USA) are performed on ambulatory basis. In the

United Kingdom (UK), an estimated 50% of all elective surgeries on children are performed as day case according to Royal College of Surgeons of England and the National Health Services Executives.[1]Many centres have been undertaking paediatric day case surgeries in Nigeria.[2,3,4]

Several reasons are responsible for the shift away from inpatient to outpatient surgery. These include reduction in healthcare cost, reduction of psychological and emotional impact, reduced behavioural problems as well as less disruption to family life of a child. Prevention of nosocomial infections is an added advantage.[1]

The laryngeal mask airway (LMA) is a supraglottic airway device invented by Dr Archie Brain, a UK Anaesthetist, in 1980 and was put to clinical use in 1986.[5]Its development represents the greatest advancement in airway management since the advent of intubation.[6, 7]It has transformed airway management in recent years and has numerous advantages for day case anaesthesia in children. Its role in the management of the "can't intubate, can't ventilate" situation is unique.[8]In experienced hands; tracheal intubation can be avoided for nearly all the usual day case procedures by the use of the LMA. This is to avoid the use of muscle relaxants and problems associated therewith, for example extubation stridor.[1]The LMA is a simple, easy-to-use and safe device for airway control in children.[9]

Propofol is a phenol derivative with the formula 2, 6-diisopropylphenol. It was developed as an anaesthesia induction agent in 1980 the same year the LMA was invented. Like the LMA, it too became commercially available in 1986. The preferred intravenous agent of induction for LMA insertion is propofol.[10] It is relatively smooth and can profoundly obtund upper airway reflexes facilitating early insertion of LMA. One drawback is that it causes pain on injection which can be minimized by the addition of 0.2mg/kg lidocaine to the propofol.[1,11]However, the main problems with intravenous induction include the need to use IV cannulas but children have a natural aversion for needles. Insertion of cannula is painful and IV access can be difficult.[1]Furthermore, propofol produces significant cardio-pulmonary depression such as hypotension and apnoea.[7,12]

Thus, inhalational induction of anaesthesia becomes a preferable technique in the paediatric age group as it avoids the need for intravenous access for its administration.[13, 14] For the past six decades, halothane with its sweet smell and non-irritant effects on the airway became the cornerstone of paediatric inhalational induction and it is readily available and cheap. Nevertheless, its propensity to cause bradycardia, hypotension and arrhythmias has led to the continued research to manufacture an inhalational agent which would match the induction properties of halothane, with minimal cardiac and hepatic side effects, and requiring lesser time for induction and emergence.[13, 14] This led to the introduction of sevoflurane.

Sevoflurane is 1, 1, 1, 3, 3, 3-hexafluoroisopropyl fluoromethyl ether. It is a volatile inhalational agent first synthesized in 1968 and introduced into clinical practice in 1995. It has a low blood/gas solubility of 0.69 which allows for a rapid induction of general anaesthesia and an early emergence. Just like halothane, it has a pleasant smell and it is non-irritant to the airway, which makes it an attractive alternative to halothane for induction of anaesthesia in children. An area where sevoflurane is expected to find increasing use is that of LMA insertion which is becoming more frequent in paediatric ambulatory surgery as this avoids some of the hazards of tracheal intubation.[1,13,15]

This study was aimed at comparing the induction characteristics of sevoflurane and propofol for LMA insertion in paediatric day case patients.

METHODOLOGY

STUDY DESIGN

This was a prospective randomized study.

SETTING: The study population was drawn from children 3-12 years old undergoing elective day-case surgical procedures lasting not more than 60 minutes. This study was carried out over a six-month period at the National Hospital, Abuja. It is a 200-bed tertiary hospital in the capital city of Nigeria.

ETHICAL CONSIDERATIONS: The approval of the National Hospital Research and Ethics Committee was sought and obtained before the commencement of the study. All patients and parents/guardians that were recruited were approached during pre-operative anaesthetic review and an informed consent from the parents or guardian of the children were sought and obtained. All those found eligible for the study were given detailed information about the study. All those that declined or withdrew from the study received the standard care due to them for the stated procedure.

SAMPLE SIZE CALCULATION

The sample size was determined using the formula for comparing two proportions by Jekel et al,[25]viz: Sample size is $2N = 4(2\alpha+2\beta)2 \times P(1-P)/(Pc-Pi)2$

2N = Total Sample size

2α = a constant conditional value that corresponds to the significant level of 5% = 1.960

2β = a constant, the value of the standard normal value not exceeded with probability ;

It corresponds to the power of 80% = 0.80

P = Pc + Pi; Pc = event control group; Pi = event rate on the intervention group.

Pc = 0.8, Pi = 0.45

P = (0.8 + 0.45) /2 = 0.625

1-P = 1-0.625 = 0.375

Pc – Pi = 0.8 – 0.45 = 0.35

$2N = 4(1.96+0.80)2 \times 0.625(0.375)/ (0.35)2$

$2N = 4(7.84) \times 0.2344/0.1225$

$2N = 31.36 \times 0.2344/0.1225$

$2N = 7.351/0.1225$

2N = 60.00

N = 60/2

N = 30.

Attrition = 10%

Total sample size = 60+6=66

Following from the above, a total of 66 patients were recruited into the study, with 33 patients in each of the two groups.

ELIGIBILITY

INCLUSION CRITERIA

Patients aged 3-12 years with ASA physical status I or II, who underwent elective day-case surgery lasting not more than 60 minutes.

EXCLUSION CRITERIA.

Patients with ASA physical status III and above, those who refused to consent and those with known allergies to the study agents.

PROCEDURE AND INTERVENTION

Sixty six eligible patients whose parents/guardians consented were recruited into the study in the reception room in the theatre complex where preoperative anaesthetic

review was also carried out on each of the patient. History was obtained from either the parents of the patients who were not old enough, or directly from the older ones assisted by their parents. History taken included last meal, fever, cough and catarrh. Equally, history was taken with respect to such diseases as asthma, diabetes mellitus and sickle cell disease as well as history of previous surgery/anaesthesia and drug allergy. Patients were physically examined starting with general examination. Patients' BP were taken using appropriate size of cuff. Also, patients' pulse rate were taken and recorded along with chest and abdominal examinations. Their weights were also taken and recorded, their investigations reviewed and their ASA status ascertained.

Patients were randomised into one of the two groups. The numbers S1 to S33 and P1 to P33 were written on pieces of paper and each put in an opaque envelope and sealed. These 66 envelopes were thoroughly mixed up and kept in a bag in the theatre reception room. Each of parents picked one of the envelopes at random from within the bag. The envelope picked was taken into the theatre by an independent anaesthetist not involved in the study.

Before a patient was taken to the theatre, a routine check (''cockpit drill'') was carried out to ascertain the availability of oxygen, sevoflurane and isoflurane amidst other things. An appropriate size of LMA was selected, the cuff tested for leakage and lubricated after complete deflation. Propofol, atropine and fentanyl were withdrawn and labelled.

Each child had fasted for at least four hours to solid food, two hours to semi solid food and allowed oral intake of clear fluid up to one hour before surgery. All the children had 20 or 22 gauge cannula inserted intravenously on arrival in theatre. An intravenous fluid was set up using 4.3% dextrose in 0.18% saline. The fluid was administered via a burette and the quantity that was given was calculated based on each patient's weight, using 4mls/kg/hr for the first 10kg, 2mls/kg/hr for the next 10kg and subsequently 1ml/kg/hr for the balance of the weight. The deficit was arrived at by multiplying the maintenance values by the number of hours the patient had fasted. This was added to the maintenance fluid. Half of the total was given in the first one hour and the balance given over the following two hours.

On arrival in theatre, patient was placed supine on the operating table and non-invasive blood pressure cuff, a pulse oximeter probe, electrocardiogram (ECG) electrodes as well as precordial stethoscope were attached to the patient and baseline vital signs obtained. A capnograph was made ready and attached to the breathing system. Patient was premedicated with 0.01mg/kg atropine. Analgesia was provided by intravenous administration of 2μg/kg fentanyl. At this point, the envelope was opened in order to ascertain the induction agents that was to be used. Patient was pre-oxygenated with 100% oxygen for three minutes using the Jackson-Ree's modification of the Ayre's T-piece (Mapleson F) for patients weighing less than 25kg. However, the Bain's circuit was used for those weighing 25kg and above.

Throughout the period of the intervention in each of the patients, two assistants were usually available to help. These assistants were fellow residents who had been in training for up to two years. The first assistant was in charge of timing while the second took care of record keeping. Both assistants worked under the directive of the investigating anaesthetist.

Patients in group P were then given intravenous 3mg/kg propofol with the addition of 0.2mg/kg lidocaine in the same syringe to prevent pain on injection. A timer was activated immediately propofol was given. The time to loss of verbal contact was noted. Once there was loss of verbal contact and the eyeballs centralized and jaw relaxed, the investigating anaesthetist inserted the LMA. The time from loss of verbal contact to successful insertion of LMA was also noted.

Any hypotension noticed was treated with infusion of 0.9% saline at rate of 20mls per kilogramme body weight (ml/kg). This intervention was sufficient for all the incidence of hypotension observed, thereby requiring no further interventions. All cases of apnoea noticed were treated by mask ventilation. Those who could not have LMA successfully inserted were intubated using appropriate endotracheal tube size, facilitated with intravenous 1.5mg/kg suxamethonium and were excluded from the study. Adequate equipment and preparation were put in place to institute cardiopulmonary resuscitation should cardiovascular collapse occur.

Group S received incremental concentration of sevoflurane up to 6% in 100% oxygen using the DatexOhmeda 7 anaesthetic machine. Concentration of the volatile agent was increased by 1% every 3 breaths. Again, a timer was activated at the commencement of sevoflurane induction until there was loss of eye lash reflex. The time to the loss of eye lash reflex was noted. At this time the patient was manually ventilated. As soon as the eye balls were centralised and the jaw relaxed the LMA was inserted.

The process of LMA insertion involved extending the patient's neck. The patient's mouth was opened while the anaesthetist inserted the LMA with the radio-opaque line facing the anaesthetist, the mask facing the patient as the LMA was gently pushed into the throat behind the tongue. [28]From the commencement of induction with either of the agents, until successful insertion of LMA, patient was observed for complications such as apnoea, cough and head movement by the investigating anaesthetists who also passed such information to the second assistant for recording. When the LMA could no longer be pushed further down, the cuff was inflated and connected to Mapleson F circuit or the Bain's circuit as may be indicated by the child's weight earlier recorded. Correct position was ascertained by observing chest movement while inflating the reservoir bag and by auscultation for breath sounds as well. The LMA was then secured using tape and the vapouriser changed to that of isoflurane. .Maintenance of anaesthesia was provided with 1-2% isoflurane in 100% oxygen.

Patient was allowed to breathe spontaneously. The capnograph was then connected. Mean arterial blood pressure (MAP), heart rate and arterial oxygen saturation were recorded at zero, 1 minute, 3 minute and 5 minutes post insertion. As soon as LMA insertion was confirmed to be successful, the capnograph was connected and maintenance agents turned on, patient was handed over to the surgeon for surgery to begin. Thereafter, monitoring of the patient (SPO_2, HR, MAP and $EtCO_2$) continued at 5minutes interval throughout the duration of surgery.

At the end of surgery, isoflurane was cut off and 100% oxygen administered for 5mins. The cuff of the LMA was deflated and removed when the patient was fully awake. Patient was thereafter, transferred to the post anaesthetic care unit (PACU).

All the patients were seen at the PACU to ensure that adequate monitoring and oxygenation continued. A patient was discharged home only if he/she was fully awake, able to walk, drink, void urine with adequate pain control, not bleeding, with stable vital signs and did not have post-operative nausea and vomiting. Patients were accompanied by responsible adults who were to ensure compliance with instructions given.

At the end of the each intervention process, the envelope

chosen was destroyed. The study was concluded when the last envelope was picked, procedure undertaken according to the content and the envelope destroyed.

MEASUREMENT OUTCOMES

Primary Outcomes:

1. Time interval between commencement of induction and loss of eye lash reflex and loss of verbal contact for sevoflurane and propofol groups respectively.
2. Time interval between commencement of induction and successful insertion of LMA with the two agents, propofol and sevoflurane

Secondary Outcomes

1. Associated adverse events such as cough, head movement, apnoea, and jaw tightening during induction and LMA insertion using either sevoflurane or propofol.
2. Haemodynamic changes (HR, NIBP {MAP}, SpO_2, $EtCO_2$) that occurred during induction and LMA insertion using either IV propofol or inhalational sevoflurane.

DATA COLLECTION

Data collection was done by the investigating anaesthetist. The data collected included age, sex, weight, ASA classification, the indications for surgery, the type of surgery patient underwent, induction agent used, time from induction to loss of verbal contact and eye lash reflex to propofol or sevoflurane respectively, time from loss of verbal contact and eye lash reflex to insertion of LMA, time from beginning of induction to successful insertion of LMA as well as vital signs at baseline, 0, 1, 3, and 5 minutes post insertion. Thereafter, monitoring was continued at an interval of 5 minutes until the end of surgery. Adverse conditions at insertion such as number of attempts of LMA insertion, apnoea (absence of breathing), coughing, jaw tightening (difficult mouth-opening) and head movement were also recorded whenever they occurred. Also records of failure of LMA insertion and need for tracheal intubation was taken. LMA insertion was deemed to have failed if 3 attempts at insertion were not successful.

DATA ANALYSIS

Statistical analysis was carried out using the Statistical Package for Social Sciences (SPSS) version 18 for Windows®. Demographic, haemodynamic and other variables are presented in tables and figures, expressed as means and counts as appropriate. Chi-square test was used for non-parametric data to determine the difference between the two groups. Student t- test was used for parametric data. A p-value of less than 0.05 is considered to be significant.

RESULTS

A total of sixty-six patients, 33 in the propofol group (group P) and 33 in the sevoflurane group (group S) completed the study.

The age of patients in the propofol group ranged from 3 to 12 years with a mean of 6.63±3.11 years (table I). Similarly, the age of those in the sevoflurane group was between 3 and 12 years with a mean of 6.51 ±2.46 years (table I). Table I also shows a statistically non-significant difference between the mean age of the patients from the propofol and that of the sevoflurane group ($p>0.05$). Out of the sample population of 33 in the propofol group, 24 (72.7%) were male while 9(27.3%) were females. Of the 33 in the sevoflurane group, 27 (78.8%) were males while 6(21.2%) were females (Table I). Weight of children in the propofol group was between 11.00kg and 44.00kg with a mean of 25.59 ±10.81kg. Children in the sevoflurane group weighed between 13.50kg and 40.00kg with a mean of 25.75±8.34kg. Table I again shows a statistically non-significant difference between the mean weight of the patients from the propofol and the sevoflurane group ($p>0.05$). Table I as well shows no difference in the ASA classification of the respondents.

In the propofol group, duration of surgery ranged between 8 mins 42s and 56 mins 0s with a mean of 32 mins 24s ±10mins 24s. In the sevoflurane group, however, duration of surgery was between 14mins 0s and 57mins 15s with a mean of 31mins 18s ±10mins 27s (table 1). There was no significant difference in the duration of surgery between the propofol and the sevoflurane group ($p>0.05$) (table I).

Time from the onset of induction to loss of verbal contact in the propofol group ranged from15s to 56s with a mean of 21 ± 0.08s, while loss of eye lash reflex in the sevoflurane group were from 55s to 2mins 9s with a mean of 1min 35s ±25s (table II). There is a statistically significant difference between the average time for the loss in eye lash reflex (for sevoflurane) and loss of verbal contact (for propofol) [$p<0.001$].

The time it took from the initiation of induction to successful insertion of LMA in the propofol group ranged from 43s to 6mins 35s with a mean of 1min 54s ±1min 12s. But for the sevoflurane group, successful insertion time was between 3mins 22s and 6mmin 31s with a mean of 4mins 23±87sec (table II). A statistically significant different was observed in the mean time it takes from the initiation of induction to successful insertion of the LMA between the propofol and the sevoflurane groups respectively ($p=0.05$)

In the propofol group, the most common indications for surgery were hernias 12 (making up 18.18% of the study population), hydrocele 5 (7.57%), undescended testis 3 (4.54%) and intact prepuce 1(0.03%), while others totaled 13 (19.69%). In the sevoflurane group on the other hand, the most common indications included hernias 13 (19.69%), hydrocele 4 (6.06%) and 3 each for undescended testis and intact prepuce (4.54%), while others were 12 (18.18%), (table III). In both groups a minimum of 1 attempt and a maximum of 2 attempts at LMA insertion were made with a mean of 1.06 ±0.24 and 1.12 ±0.33 ($p = 0.392$) for the propofol and the sevoflurane group respectively.

The baseline heart rate (HR) for the propofol group ranged between 71 beats/min and 139 beats/min with a mean heart rate of 112±16.60 beats/min, while that of the sevoflurane group was from 70 beats/min to 130 beats/min with a mean heart rate of104 ±13.56 beats/min. At the base line there was a significant difference between the mean heart rate of the propofol and the sevoflurane group ($p<0.05$) (figure 1). Baseline mean arterial pressure (MAP) for the propofol group was from 61mmHg to 102mmHg with a mean of 76.96±11.11mmHg, while MAP for the sevoflurane group ranged between 60 and 119mmHg with a mean of 81.63 ±12.07mmHg. A non-significant difference ($p>0.05$) was observed between the mean arterial pressure (MAP) of the propofol and the sevoflurane group (figure 1).

Also, the baseline peripheral arterial oxygen saturation (SpO_2) for the propofol group was between 99% and 100%, with a mean of 99.69±0.47% just as that of the sevoflurane group ranged from 98% to 100% with a mean of 99.45 ±0.67% (figure 1). Figure 1 also shows a non-significant difference in the mean baseline peripheral oxygen saturation between the propofol and the sevoflurane group.

Figure 2 shows that at 1 minute, the mean heart rate of the propofol group was slightly higher than that of the sevoflurane group though not significant ($p>0.05$) . But from the 3rd, 5^{th}, 10^{th}, 15^{th}, 20^{th}, 25^{th} and 30^{th} minutes the mean heart rate of the sevoflurane group became more than that of the propofol group, although not statistically significant.

Figure 3 shows that the mean arterial pressure (MAP) for the sevoflurane group was more than that of the propofol group

for all the minutes observed (1min, 3mins, 5mins, 10,mins, 15mins, 20mins, 25mins, 30mins), even though the MAP was more in the sevoflurane group in the first minute compared to the other observed minutes. A statistically significant difference was observed between the mean arterial pressure of the sevoflurane and the propofol group across all the observe times.

Figure 4 shows that the mean peripheral arterial oxygen saturation (SPO_2) for the sevoflurane group was significantly higher ($p<0.05$) than that of the propofol group at the first minute. After this, there was no significant difference in the mean peripheral arterial oxygen saturation between the propofol and the sevoflurane groups throughout the rest of the intervention period.

Figure 5 shows that at the 5th, 15th, 20th, 25th, 30th minutes, the mean $EtCO_2$ of the propofol group was slightly higher than that of those in the sevoflurane group, but the difference was not statistically significant. The case was different at the 10th minute, because the mean $EtCO_2$for the sevoflurane group was slightly higher than that of the propofol group. Again, the difference was not statistically significant.

Table IV shows that 3(9.1%) and 2(6.1%) respectively of the study participants from the sevoflurane and the propofol had cough. A statistically non-significant difference was observed between the study groups with regards to the incidence of cough ($p=0.00$) Also from the same table IV, it was discovered that 7(21.2%) and 5(15.2%) of the patients from the sevoflurane and the propofol had the head movement respectively. A statistically significant difference was found between the research group with regards to the incidence of head movement ($p<0.01$)

While, 8 (24.2%) of the study participants in the propofol group had apnoea, apnoea was not seen in the respondents in the sevoflurane group 0(0%). Table IV thus shows a significant difference between the study groups with regards to the incidence of apnoea ($p=0$). Even though Jaw tightening was not observed in any of the groups, a patient in each of the groups had failed LMA insertion, necessitating endotracheal intubation and were accordingly excluded from the study.

Table I: Comparison Of The Demographic And Clinical Parameters Of The Patients In The Two Study Groups.

Demographic and Clinical Parameters	Sevoflurane	Propofol	p value
Age range in yrs (mean±SD)	3.0-12.00 (6.52±2.46)	3.00-12.00 (6.64±3.11)	0.861
Sex Distribution Male Female	27 6	24 9	0.566
Weight range in kg(mean±SD)	13.50-40.50 (25.72±8.36)	11.00-44.00 (25.59±10.81)	0.954
ASA Range(mean±SD)	1.00–2.00 (1.09±0.29)	1.00-2.00 (1.15±0.36)	0.458
Range of duration of Surgery in minutes(mean±SD)	14.00-57.25 (31.30±10.45)	8.70-56.00 (32.40±10.40)	0.676

Table II: Comparison Of Induction And Successful Lma Insertion Time Between The Two Study Groups

Induction & LMA Insertion Time	Sevoflurane	Propofol	p-value
Mean induction time in minutes(±SD)	1.58±0.42	0.35±0.13	0.03
Mean successful LMA insertion time in minutes(±SD)	4.38±1.45	1.90±1.20	<0.001

Table III: Common Indications For Surgery

Indications	Sevoflurane	Propofol	p value
Hernias	13	12	0.329
Hydrocele	4	5	
Undescended testes	3	3	
Intact Prepuce	3	1	
Others	10	12	

Table IV: Frequency Of Types Of Complications In The Two Groups.

Complication		Sevoflurane N(%)	Propofol N(%)	p value
Cough	Yes	3(9.1)	2(6.1)	0.642
	No	30(90.9)	31(93.9)	
Head Movement	Yes	7(21.2)	5(15.2)	0.000
	No	26(78.8)	28(84.8)	
Apnoea	Yes	0(0.0)	8(24.2)	0.003
	No	33(100.0)	25(75.8)	

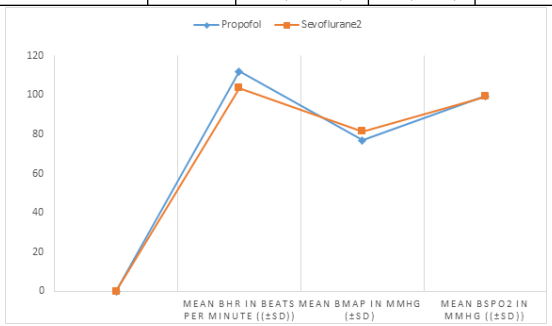

Figure 1 : Comparison Of The Baseline Haemodynamic Values (HR, BP, SPO_2) Observed With Either Of The Induction Agents Before Induction.

BHR – Baseline Heart Rate
BMAP – Baseline Mean Arterial Pressure
$BSPO_2$ – Baseline Peripheral Oxygen Saturation

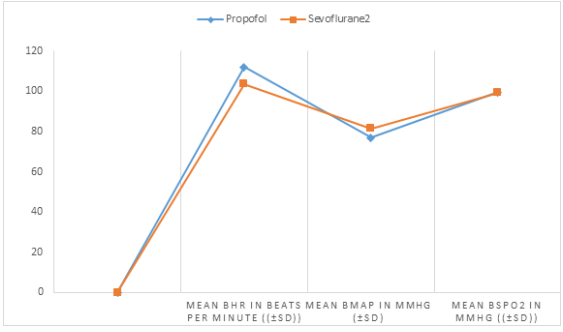

Figure 2: The Heart Rate Obtained During The Perioperative Period, Plotted Against Time In Minutes In The Two Groups.

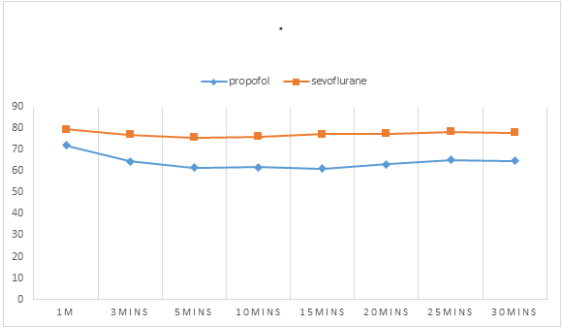

Figure 3: The Mean Arterial Pressure (map) Obtained During The Perioperative Period, Plotted Against Time In Minutes In The Two Groups

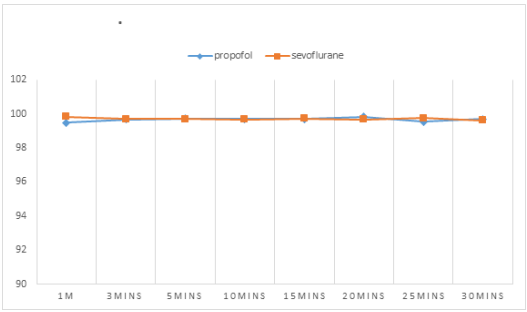

Figure 4: The Peripheral Arterial Oxygen Saturation Obtained During The Perioperative Period, Plotted Against Time In Minutes In The Two Groups

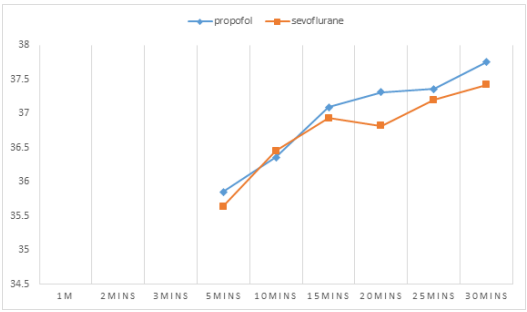

Figure 5: The $Etco_2$ Obtained During The Perioperative Period, Plotted Against Time In Minutes In The Two Groups.

DISCUSSION

A comparison of the mean age and weight between the 2 groups did not show any statistically significant difference. There was a preponderance of male patients in both groups probably due to the indications for the surgeries which occur mainly in male children. The ASA classification of patients between the 2 groups was also not statistically significant. Therefore the 2 groups were comparable demographically.

It should be noted that from these results of demographic data, that the two groups compare very well in age distribution, sex and weight. Therefore, whatever differences that may be seen to have occurred with other variables in this study would not have arisen on the basis of demographic differences.

The indications for surgery between the 2 groups were also comparable. These indications for surgery could be explained based on the fact that they are common childhood diseases some of which are congenital and have been allowed to remain up to this age bracket by the parents who failed to seek medical attention earlier. Surgical procedures undertaken for these pathologies are not only minimally invasive, they are also of short duration and thus suitable for day case surgery. It is also common knowledge that the two most common indications, hernias (particularly the inguinal/inguinoscrotal types) and hydrocoele are diseases of the male child. Also, only male children have problems of undescended testis and intact prepuce. This explains why the study population is dominated by the male gender as observed earlier in the sex distribution.

A comparison of the means of the duration of surgery of the two groups gave a p=0.05. This shows that there is no significant difference between the two groups with regards to the duration of surgery. This can be explained from the inclusion criterion which stipulates that duration of surgery would not exceed sixty minutes and this was adhered to in the recruitment process.

A comparison of the mean time obtained from the commencement of induction to loss eyelash reflex and beginning of induction to loss of verbal contact in the sevoflurane and propofol groups respectively, demonstrated a statistically significant difference (p=0.000). Time to loss of verbal contact, indicating hypnosis using propofol intravenous induction is far shorter than the time to loss of eyelash reflex which, on the other hand, is indicative of hypnosis using sevoflurane inhalational induction as shown in the result. This observed difference in the time interval for these two variables can best be explained from the fact that propofol is a fast acting intravenous induction agent which induces hypnosis in one-arm-brain circulation time, which is 10 to 20 seconds. On the other hand, inhalational induction usually takes a longer time to achieve. This is more so in this particular study where the inhalational induction with sevoflurane was conducted using incremental concentration of sevoflurane. It follows, therefore, that to achieve hypnosis (loss of eye lash reflex) with inhalational sevoflurane would take a longer time as shown in the result.

This result agrees with the results in the previous studies conducted by Gantara et al, [16] and Ghatje et al, [17] that demonstrated that induction time with propofol is shorter than that of sevoflurane. In related studies in adults, Divatia et al, [18]Siddik et al, [19] and Ahmeduddin et al,[20] also showed faster induction with propofol. This has arisen probably due to the relatively high dose of propofol (3mg/kg) used for induction by the authors. However, in the similar study conducted by Savita et al, [21] the result showed that induction was equally fast in both sevoflurane group (45.93 ± 5.58 seconds) and propofol group (45.2 ± 6.07 seconds), difference of which was observed not be statistically significant. (The authors did not state the p-value.) This was equally in agreement with that of Koh et al,[22] which also observed fast induction in both groups. This could have arisen as a result of use of tidal volume ventilation technique. In their own study, Saravanan et al, [23] demonstrated that the time to induction was less in the sevoflurane group compared to the propofol group (Group S- 39.1s vs Group P- 41.1s; p= 0.09), which also correlates with similar study that also compared propofol and sevoflurane in children conducted by Kalpana et al. [24] In the studies cited where the times of induction for the two groups were similar or for sevoflurane induction was shorter, the concentration of sevoflurane was high between, 6 and 7 %.

In this study, a statistical difference was observed in the mean time interval from the beginning of induction to successful insertion of LMA between the two groups. LMA insertion time for propofol was shorter than that of sevoflurane with a p= 0.05.This difference emanates from the fact that not only does propofol induces hypnosis very fast as shown in the short time interval required for loss of verbal contact as demonstrated above, it also profoundly obtunds airway reflexes, thus marking insertion easier and faster. Also, as explained earlier, it took a longer time to achieve loss of eye lash reflex using sevoflurane and even more time to achieve the other conditions required for LMA insertion such as centralization of the pupil and jaw relaxation. Incremental inhalational induction as was used in this study, would no doubt add to the time required for optimal condition for the insertion of the LMA

This result agrees with the study by Saravanan et al, [23] in which the time to LMA insertion was shorter with propofol (Group P- 59.3sec vs Group S-117.9sec; p= 0.0001). This is also in agreement with the studies by Divatia et al, [18], Siddik et al, [19] and Ti et al, [14] who obtained similar results. The observed similarity could be attributed to identical dosage of 3mg/kg propofol use for induction by these authors. A similar study conducted by Savita et al, [21] also agrees with this finding showing the time of insertion to be higher in sevoflurane group (106.7 ± 17.64 sec.) than the propofol group (77.23 ± 22.73 sec.). This could be attributed to the difficult jaw

opening associated with sevoflurane initially. The result of this study is comparable to other studies in which significantly longer time of LMA insertion in sevoflurane group were observed compared to the propofol group. [14,17,25,27,28] However, this study contrasts sharply with Koppula et al, [28] Gil et al, [37] and Kalpana et al. [24] Whereas Koppulana et al, [29] reported similar time in both groups, the latter two set of authors achieved faster induction time with sevoflurane than with propofol. In these studies in which time of LMA insertion with sevoflurane turn out to be shorter than LMA insertion time for IV propofol, high concentration of sevoflurane were utilized giving rise to faster induction time.

Comparing the number of attempts at LMA insertion in both groups, a minimum of 1 attempt and a maximum of 2 attempts were made with a mean of 1.06 ±0.24 and 1.12 ±0.33 for the propofol and the sevoflurane groups respectively which was not statistically significant. The average number of attempts for insertion in the study carried out by Savita et al, [21] were 1.10 for sevoflurane group and 1.14 for propofol group and the result is in consonance with the result obtained in this study. The result is also comparable to a study which also recorded similar average number of attempts. [16] This was not, however, in agreement with other studies which recorded fewer attempts with propofol compared to sevoflurane. [14,16,17,30,31] This can be explained from the fact that propofol significantly obtunds airway reflexes, thereby facilitating ease of LMA insertion.

Analysis of haemodynamic parameters was done from the beginning of induction to 30 minutes for the purpose of uniformity since durations of surgery were not the same. End tidal carbon dioxide recordings were started usually 5 minutes into anaesthesia when the LMA had been connected to the capnograph.

With regards to the HR obtained in the course of anaesthesia and surgery, no significant difference was observed, even though HR for the sevoflurane group was generally higher. This is best explained by the fact that the cardiovascular depressant effect of intravenous propofol is more than that of inhalational sevoflurane.

The comparison of the differences in the MAP between these two groups lends credence to the fact that IV propofol has a more cardiovascular depressant effect than inhalational sevoflurane. In this study, the MAP was significantly higher in the sevoflurane group than the propofol group. This observed reduction in the MAP with propofol was thus not unexpected.
Concerning the SpO_2, the result showed that there was no significant difference in the peripheral arterial oxygen saturation between the propofol group and the sevoflurane group. Oxygen saturation for the two groups were optimal throughout the study time for the two groups indicating adequate oxygenation. This was ensured so as to avoid hypoxaemia in this vulnerable paediatric group.

Saravanan et al, [23] in their study found no significant difference between both groups in hemodynamic stability and this corresponds with the result obtained by Kalpana et al, [24] and Ahmedudddin et al. [20] The observation of no difference in the haemodynamic changes arose probably because of the use of the relatively low dosage of 2mg/kg of propofol for induction in the propofol group. Mori et al, [32] also found a non-significant reduction in blood pressure when sevoflurane was used as induction agent. Gil et al, [33] also did not find any differences in blood pressure and oxygen saturation among patients in the study comparing sevoflurane and propofol for induction and maintenance of anaesthesia using LMA in paediatric patients. But they also observed a higher heart rate with sevoflurane in paediatric patients. This result again was in consonance with the findings in this study where higher values of HR were observed with sevoflurane group than the propofol group even though it was not statistically significant. Kalpana et al, [24] however, observed more fall in MAP 2 min after induction using propofol.

The findings with regards to the HR also correlates with the result got by Savita et al, [21] which showed that the heart rate was slightly higher in sevoflurane group at all-time intervals without any statistically significant difference. They also observed that the propofol group had a greater degree of fall in systolic and diastolic BP after induction. The difference was found to be statistically significant at only 2 min post LMA insertion in systolic BP. This finding equally agrees with the finding in this study where there was a statistically significant low MAP in the propofol group compared to the sevoflurane group. The finding also agrees with that found by Koh et al, [22] in which they observed a statistically significant difference only in the 4th and 5th minutes post induction. One other study carried out by Priya et al, [31] also found a significant difference only in the 3rd minute after induction. Some other studies found no significant difference. [17, 26, 33] The non-significant difference in arterial oxygen saturation was in agreement with other studies. [14,17,32]

With regards to the $EtCO_2$, even though slight variations occurred between the two groups, there was no significant difference between the two groups overall. This goes to show that there was adequate respiration throughout the intra-operative period. This was even more so given the fact that the patients were allowed to breathe spontaneously.

Certain complications were observed in the course of the study. Incidents of cough were not much different between the sevoflurane than the propofol groups. On the other hand, head movement was seen more with the sevoflurane group than the propofol. The difference is statistically significant with a p=0.000. This could have arisen because patients undergoing inhalational induction may pass through the stage of excitement resulting in movement of parts of the body. Again, while 8 (24.2%) of the study participants in the propofol group had apnoea, none (0%) had it in the sevoflurane group. The difference was equally significant with a p=0.003. This was as a result of the fact that propofol has a profound respiratory depressant effect, giving rise to apnoea. In their study, Joo et al, [34] observed that, the incidence of transient apnoea during induction occurred more frequently in the propofol group as compared to the sevoflurane group and this was in agreement with the findings in this study. This also correlates with result obtained in the study carried out by Kati et al. [28] Jaw tightening was not seen in any of the groups. However, one patient each had failed intubation necessitating tracheal intubation, and was accordingly excluded from the study.

Saravanan et al, [23] in their study found that in both groups, no incident of coughing, gagging, regurgitation, vomiting, laryngospasm or desaturation was noticed during induction or LMA insertion. Their result does not tally with results of this study. The addition of N_2O to the fresh gas flow could possibly account for this difference.

This study was carried out on paediatric patients who underwent day case surgery with LMA for airway management. Induction was either by IV propofol or inhalational sevoflurane. Inhalational induction which avoids pain of intravenous cannulation is preferable in children. Sevoflurane with its pleasant smell, low airway irritability and good haemodynamic stability was expected to become more useful in this regard.

CONCLUSION

In conclusion, both inhalational sevoflurane and IV propofol are suitable induction agents for LMA insertion in children.

Nevertheless, both loss of verbal response and LMA insertion time when using IV propofol for induction were shorter than the loss of eyelash reflex and LMA insertion time when using inhalational sevoflurane for induction. Sevoflurane possess superior haemodynamic stability compared to propofol. By way of complication, there was no significant difference in the incidence of cough between the two groups. However, apnoea was discovered to be a significant side effect of IV propofol induction while head movement was more associated with inhalational sevoflurane induction.

RECOMMENDATIONS

Establishing venous access in children should be carried out only after adequate depth of anaesthesia has been achieved with an inhalational agent in paediatrics.

Whenever propofol induction is to be conducted, one should be on the watch out for apnoea having been established as a major complication at induction.

LIMITATION OF STUDY

Intravenous access that was obtained in all the children gave rise to agitation in some, which could have affected inhalational induction with inhalational sevoflurane, resulting in longer induction time.

CONFLICT OF INTEREST

None

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