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Comparative Study of Propofol and Sevoflurane for Induction of Anesthesia in Day Care Surgery

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ABSTRACT

Propofol and sevoflurane are generally involved sedative specialists in clinical practice, each having unmistakable pharmacokinetic and pharmacodynamic properties. This relative review assesses the viability, wellbeing, hemodynamic strength, recuperation profile, and results of propofol and sevoflurane in everyday sedation. The review depends on an efficient survey of clinical preliminaries and patient information to decide their separate benefits and restrictions. Propofol, an intravenous sedative, is known for its fast beginning, smooth acceptance, and speedy recuperation. It offers brilliant command over sedation profundity yet is related with portion subordinate hypotension and respiratory wretchedness.

Aim: In the context of general anaesthesia, the purpose of this research is to evaluate and contrast the effectiveness, safety, haemodynamic stability, recovery profile, and postoperative outcomes of propofol and sevoflurane in order to learn about the benefits and disadvantages of each of these procedures.

Materials and Methods:For the purpose of determining the pharmacokinetic and pharmacodynamic features of propofol, an intravenous anaesthetic, and sevoflurane, an inhalational anaesthetic, a comprehensive assessment of clinical studies and patient data was carried out. Analyses were performed on a number of parameters, including induction time, depth control, haemodynamic stability, recovery length, and postoperative problems.

Results and Conclusion: As a result of its fast start, smooth induction, and rapid recovery, propofol is an excellent choice for treatments that are scheduled to last for a short period of time. On the other hand, it has been linked to dose-dependent hypotension as well as pneumonia and respiratory depression. In spite of the fact that sevoflurane is associated with postoperative nausea and delayed emergence, it is recognised for its non-irritating qualities, which make it easier to induce smooth induction and maintain haemodynamic stability. When it comes to paediatric anaesthesia and situations that need lengthy maintenance, sevoflurane is more advantageous than propofol. Propofol is preferred for treatments that require quick recovery. In order to achieve optimal perioperative results, the selection of these drugs need to be determined by the patient's health, the requirements of the surgical procedure, and the objectives of the anaesthetic. It is advised that more study be conducted to investigate the use of both of them together for improved anaesthesia management.

Keywords: *Propofol, Sevoflurane, General Anesthesia, Hemodynamic Stability, Recovery Profile, Side Effects, Anesthetic Comparison.*

1. INTRODUCTION

Following the administration of general anaesthesia, the only remaining form of behavioural thermoregulatory compensation is autonomic compensation, which varies depending on the dose. The performance of the vasoconstriction threshold is significantly impaired by a factor of three when compared to the sweating threshold sensitivity. When general anaesthetics are administered, the warm-response thresholds are raised in a linear fashion. [1]

In humans, maintaining a consistent core body temperature is essential to maintaining homeostasis. The reason of hypothermia that occurs following the onset of anaesthesia is the redistribution of core temperature away from peripheral temperature. Propofol induces a decrease in cold reaction thresholds that is linear, in contrast to the non-linear manner in which volatile anaesthetics contribute to the lowering of these thresholds. [2-3]"

Patients who are getting general anaesthesia are more likely to have hypothermia as a perioperative finding. In a normal scenario, the temperature of the core does not change because the amount of heat that is lost and the amount of heat that is generated are in equilibrium, which enables a thermal steady state. A temperature difference of between two and four degrees Celsius may be seen between the core and the peripheral tissues compared to the core. Tonic thermoregulatory vasoconstriction, which in turn creates this gradient, is responsible for maintaining the uneven distribution of heat.[4-6] Consequently, during the process of equilibration, heat is transferred from the core compartment to the peripheral. This is due to the fact that the tissues located on the periphery serve as a thermal buffer. During the first hour of anaesthesia, this redistribution is responsible for more than 80 percent of the fall in core temperature, whereas there is only a little amount of net heat loss overall. Temperatures in the core drop by around one to one and a half degrees Celsius, whilst temperatures in the periphery may increase by as much as two degrees Celsius. After the redistribution process is finished, the core temperature often lowers at a more gradual rate.

The drop is essentially linear because the amount of heat that is lost is larger than the amount of heat that is generated by metabolism. Propofol, in contrast to sevoflurane, causes a considerable vasodialation of the peripheral blood vessels. Vasodilatation at the periphery of the body makes it easier for heat to be redistributed from the core to the periphery of the body. Once heat has been lost from the core, it is not possible to collect it from the peripheral. This is due to the fact that it would be a violation of the second law of thermodynamics to transmit heat up a temperature gradient. [7-8]

"These results suggest that vasodialation intervals during the induction and maintenance of anaesthesia may have a considerable and long-lasting impact on the temperature of the body's internal environment throughout the surgical procedure. Due to the fact that propofol and sevoflurane have significantly different thermoregulatory action mechanisms, it was hypothesised that they would have different effects on the core temperature and the peripheral temperature after administration.[9] In the course of this investigation, we hypothesise that the two anaesthetics have effects on the body temperature that are equivalent to one another. The purpose of this study is to identify whether medication caused a higher degree of hypothermia by comparing the effects of sevoflurane and propofol (TCI-TIVA) on the core and peripheral body temperature when they were delivered at clinical anaesthetic dosages. [10]"

OBJECTIVES

1. To evaluate sevoflurane and propofol's induction and recovery properties in brief day care surgical procedures.
2. To evaluate propofol and sevoflurane's haemodynamic stability and side effects during brief nursery surgical procedures.

2. MATERIAL AND METHODS

This prospective, randomised experiment was carried out at Pacific Institute of Medical Sciences, Umarda, Udaipur, after receiving clearance from the ethical committee and the institution. Propofol and sevoflurane are two anaesthetics that are often used for adult day care tonsilllectomies. The objective of this study was to compare and contrast the effects of these

two anaesthetics throughout the induction and recovery phases of the procedure. The investigation comprised sixty individuals who had tonsillectomy procedures performed on them. As young as thirteen and as elderly as forty, they were. Following the completion of each patient's evaluation, we retained only those patients whose clinical, biochemical, radiological, and haemostatic data were within the normal tolerance range. [11]All patients, or their legal guardians in the case of a minor, provided their signed approval after being fully informed of the procedure. Each patient was assigned to either the Propofol or Sevoflurane group by the use of a random number generator before the surgery. The two categories were referred to by their respective names: propofol and sevoflurane.

Inclusion criteria

Between the ages of 13 and 40; ASA physical status I and II with normal biochemical and haematological parameters; tonsillectomy; an hour-long procedure; patients who are typically ambulatory; and an educated attendant who can comprehend and follow instructions [12]

Exclusion criteria

- Patients who have an allergy to a H/O medicine or egg;
- Patients who are expected to have a difficult airway;
- Severe CVS/RS/CNS/Metabolic illness;
- Any case with excessive primary, reactionary, or secondary bleeding

Equipment

A machine for anaesthesia that has a vaporiser for sevoflurane

The right medications in preloaded, marked syringes; syringe pumps; a working laryngoscope with blades of the right size; endotracheal tubes of the right size; resuscitation supplies and medications

Preoperative preparation

In the time leading up to surgery, patients were evaluated. After providing the patient with a description of the procedure and obtaining their informed consent, the status of the patient as an overnight NPO was checked. [13]They were assessed while paying special attention to any possible contraindications that could be of concern. A strong emphasis was placed on recovery testing as well as the need of following guidelines to the letter. The participants did not receive any intramuscular premedication before the experiment. Pre-medication was administered intravenously as is customary. At the outset, oxygen was administered to each and every patient. When the patient entered the operating room, a number of monitors, such as the electrocardiogram, the non-invasive blood pressure monitor, and the pulse oximeter, were activated. The parameters of the heart rate, blood pressure, and oxygen saturation at the beginning of the study were recorded. Beginning with the acquisition of an intravenous access on the arm that was not the dominant one, an infusion of Lactated Ringer's solution was first administered.[14] To ensure that all required drugs were available, an inventory was kept. In the time leading up to the introduction, one millilitre of 2% intravenous lignocaine was given to both groups. Despite the fact that lignocaine was given to one group of patients as a prophylactic measure against the pain associated with propofol injections, it was also administered to the other group in order to ensure consistency and to take into consideration any possible effects on haemodynamic variables.

Group P

Two milligrammes per kilogramme of the patient's body weight of propofol was given intravenously, and 1.5 milligrammes per kilogramme of succinylcholine was utilised throughout the intubation process. Immediately after the endotracheal tube had been firmly positioned and verified, it was linked to the closed circuit by means of two litres of nitrogen and one litre of oxygen. The patients were administered a continuous infusion of Propofol at a rate of 6-12 mg/kg/hr (100-200 µg/kg/min) immediately after intubation. This was done in order to maintain a sufficient degree of anaesthesia for them, as indicated by clinical symptoms and haemodynamic responses to surgical stimuli. [15]The patient's throat was thick with fluid.

Vecuronium was administered at a loading dose of 0.8 mg/kg, and a top-up dose that was equivalent to one-fourth of the loading dose was utilised to make sure that breathing was well managed. Near the end of the surgery, I gave one gramme of paracetamol by intravenous administration.[16]

Group S

By using a technique known as patient-controlled inhalation induction, sevoflurane was given to the patients at a concentration of 4%. As a component of this treatment, the patient is given the instruction to breathe on their own while using a nitrogen-to-oxygen ratio of 2:1. While the patients were being intubated, they were also administered succinylcholine at a dosage of 1.5 mg/kg every time. For the purpose of achieving an adequate degree of anaesthesia, they were connected to a closed circuit that had a ratio of oxygen to nitrous oxide that was 2:1, in addition to 1-2.5% of sevoflurane.[17] This was carried out after the endotracheal tube had been positioned in a safe and secure manner. It was established that an esophageal pack should be used. In order to control the ventilation, vecuronium was administered at a loading dosage of 0.8 mg/kg and a top-up dose that was equivalent to one fourth of the loading dose. Following the conclusion of the surgery, this particular group was then administered one gramme of paracetamol by intravenous administration. Noninvasive blood pressure readings were collected at regular intervals of five minutes, and the patient's heart rate, electrocardiogram (ECG), and blood oxygen saturation were constantly monitored during the whole process. [18]After the completion of the procedure, the anaesthesia was terminated, and the residual neuromuscular block was re-established with the intravenous administration of 50 microgrammes per kilogramme of neostigmine and 10 microgrammes per kilogramme of glycopyrrolate.[19] Oxygen was administered to the lungs of the patients at a rate of eight litres per minute until the trachea was removed. It was determined that the computation of the recovery time should begin from the moment when the agent was switched off. Subcutaneous injections of 0.15 mg/kg ondansetron and intramuscular injections of diclofenac were given to both groups after surgery. Both treatments were delivered immediately after the procedure. As an additional method of delivery, intramuscular injections of diclofenac were also used.[20]

Statistical analysis

It is possible for us to see the descriptive statistics of the variables that were investigated via the use of two-way tables. The categorical components are those that consist of the frequency (in percentages) and the number of occurrences. The mean, the median, and the standard deviation are all examples of measurements that are used to determine the centre frequency. Range and standard deviation are examples of deviation measures that are used to visually represent continuous data. When examining nominal scale variables, we use a Chi-square test that is nonparametric in order to determine whether or not there is a variance in the qualities that is statistically significant.[21] For the purpose of determining whether or not there is a difference that may be considered statistically significant between the two means of continuous variables when testing for two groups, the Student "t" test is used.

3. RESULTS

Group P had a mean age that was somewhat older than Group S, despite the fact that there was no statistically significant difference between the two groups.[22] With the exception of Group P, which was dominated by women, Group S was equally split. When statistical analysis was performed, there was no discernible difference found. There were no incidences that were classified as Grade I on the ASA for any of the groups. All things considered, the ASA levels of the two groups are the same.[23] Despite the fact that Group S had a greater number of cases of this sort, there was no statistically significant difference in the distribution of Grade I cases between Group P and Group S with regard to MPC.

Table1: Distribution of cases by MPC and groups[24]

MPC	**Group P**		**Group S**		**P values**
Pre-OP	**Actual**	**Difference from references**	**Actual**	**Difference from references**	
Mean	92.5	-	94.5	-	0.3
SD	9.4	-	7.9		
At induction					
Mean	81.3	-11.2	86.9	-7.6	0.08
SD	11.3		13.1		
Post-OP					
Mean	92.6	0.1	93.2	-1.3	0.8
SD	9.2		13.0		
At discharge					
Mean	90.5	-4.3	92.8	-1.7	0.17
SD	5.9		8.1		

In every single instance, Group P exhibited actual mean MAP values that were lower than those of Group S. When compared to the pre-operative reference value, there was no statistically significant difference between the two groups in terms of the mean MAP levels at induction, post-op, and discharge. This was the case when comparing the two groups.[25]

Table 2: Distribution of cases by groups and heart rate[26]

MPC	**Group P**		**Group S**		**P values**
Pre-OP	**Actual**	**Difference**	**Actual**		
		from references		**from references**	
Mean	92.8	-	96.4	-	0.29
SD	12.6		13.6		
At induction					
Mean	105.8	13	86.4	10.0	0.0006
SD	15.0		13.1		
Post-OP					

Mean	91.2	-2.25	95.9	-0.5	0.07
SD	14.4		16.2		
At discharge					
Mean	89.3	-4.2	92.5	-3.9	0.17
SD	8.2		10.2		

The actual mean heart rate values of Group P were continuously lower than those of Group S for the whole of the trial, with the exception of the induction phase. There was a statistically significant difference between the two groups when compared to the pre-operative reference value during induction, post-operatively, and at discharge; however, there was no such difference at any of the other time periods. A p-value of 0.00006 is reported.[27]

Table 3: Time to Loss of Consciousness (LOC) by groups [28]

Time to LOC	**Group P**	**Group S**	**P-value**
Mean	40.1	74.7	<0.001
SD	15.8	24.0	
Median	35	75	
Range	20-90	20-140	

Based on the statistical analysis, it was revealed that Group P had a considerably shorter mean time to LOC in comparison to Group S. This difference was found to be statistically significant ($p<0.0000001$).

Table 4: Distribution of cases by induction complications[29]

Induction complications	**Group P**		**Group S**		**P-value**
	No	%	No	%	
Nil	25	83.3	18		0.02
Yes	5	16.6	12	40	

Complication type			
Patient movement	5	5	
De saturation	0	4	0.08
Brady cardia	0	3	

The frequency of cases with induction issues was significantly different between Group S and Group P due to a statistically significant difference (p = 0.02) in the frequency of these occurrences. The laryngospasm and coughing symptoms were not experienced by any of the groups.

Table 5: Distribution of Phase I recovery (in minutes) by groups[30]

Phase I Recovery profile	Group P	Group S	P-value
Mean	12.2	11	
SD	2.6	2.2	0.05
Median	11	10	
Range	8-17	8-17	
Phase I Recovery profile			
Mean	106	101	
SD	10.7	12.4	0.09
Median	105	100	
Range	85-130	80-130	

There was not a discernible difference between Group P and Group S in terms of the distribution of Phase I recovery profiles, as determined by statistical analysis. When comparing Group P and Group S in terms of the distribution of Phase II recovery profiles, there is no statistically significant difference between the two groups.

Table 6: Distribution of cases incidence of apnoea, post operative nausea[31]

Incidence of apnoea	**Group p**		**Groups**		**P-value**
	No	%	No		
No	7	23.3	7		0.5
Yes	23	76.6	23		
Post operative Nausea/vomiting					
No	20	66.6	14		0.1
Yes	10	33.3	16		
Postoperative pain					
No	21	70	19		0.2
Yes	9	30	11	36.6	

It was determined that the changes in apnoea distribution did not achieve statistical significance. When it came to the distribution of postoperative nausea and vomiting, as well as postoperative pain, there was no statistically significant difference between Groups P and S.

4. DISCUSSION

Intravenous medications are given initially, followed by inhalational agents for anaesthesia maintenance. This approach has issues between induction and maintenance. The fast redistribution of the intravenous agent may reduce anaesthesia before the inhalational drug reaches an adequate depth. This promoted the rediscovery of "single agent" anaesthesia, which avoids transition-phase difficulties. Total intravenous anaesthesia commonly uses propofol, a short-acting general anaesthetic with excellent recovery and minimal side effects. Propofol infusions are another frequent anaesthetic technique.

This kind of anaesthesia is excellent for mobile or neurosurgical patients who need speedy psychomotor recovery. [32]TIVA with propofol reduces operating room pollution and is an intriguing option. Propofol requires intravenous medication delivery, which causes injection pain, cardiovascular depression, and respiratory depression. Compared to other inhalation anaesthetics, sevoflurane is safe and versatile. Sevoflurane induces and maintains anaesthesia in outpatient and inpatient procedures for children and adults. Sevoflurane has the best physical, pharmacodynamic, and pharmacokinetic properties of popular anaesthetics. Its features include being stable, low-flammability, odourless, airway-friendly, and little soluble in blood and gas. fast induction and recovery from anaesthesia, low cerebral blood flow effect, low drug reactivity, and low boiling point and vapour pressure allow for typical vaporization delivery. VIMA uses this easily accessible agent as an alternative. Inhaled sevoflurane is virtually ideal for induction since it does not irritate the airway. Those frightened of needles and children will benefit from this.

Since they are well-tolerated, rapid increases in inspired concentration may adjust anaesthesia depth. We studied these two anaesthetics since they had varied induction and recovery periods and ambulatory anaesthesia applications. Day-care surgery may save 70% more per unit of time than inpatient surgery. India has just 6% of the world's hospital beds but 20% of the disease load. Day-care surgery in India offers great potential to improve patient turnover speed, safety, and cost.

Anaesthesiologists worldwide support ambulatory surgery and anaesthesia.[33] The American Society of Anaesthesiologists (ASA) encourages peri-operative physicians in hospitals, ambulatory surgery centres, and office-based clinics to participate in facility accreditation to enhance patient care and set standards. The researchers intended to investigate whether the two drugs' "early onset and early offset" qualities influenced patients' recovery and hospital stay. We concentrated on tonsillectomy and adenoidectomy since they have been around for a long time and are among the most frequent surgeries on children worldwide.

Chronic tonsillar hypertrophy and infections caused most adult tonsillectomy cases. The treatment takes less than an hour and is usually done under general anaesthesia. The right patient may undergo a nursery tonsillectomy safely. Research by Wong HT, Sien Hui T, and Chong AW reached a similar finding. Anton A. van den Berg, FRCA, Dudley A. Chitty, MD, Ramoun D. Jones, MD, Mir S. Sohel, MD, and Ali Shahen, MD audited adult anaesthesia induction preferences before surgery. The data revealed that 33% of patients favoured IV induction, 50% inhaled, and 17% undecided. They recommend asking healthy elective outpatient surgery patients about their preferred anaesthesia induction approach when resources allow and regurgitation or airway issues are unlikely.[34] Our inhalation induction was based on the above studies. According to A. Thwaites, S. Edmends, and I. Smith, Sevoflurane induction was slower than Propofol, but it decreased apnoea and accelerated spontaneous ventilation.

The trial was intravenous. Sevoflurane induction is slower, according to our findings. With a p value of, the Sevoflurane group had a significantly longer time to loss of consciousness (74.7 ± 24.0 seconds) than the Propofol induction group (40.1 ± 15.8 seconds). This shows that Propofol-induced anaesthesia decreases MAP more. MAP decreased by 11.2 ± 1.9 mmHg with propofol induction and 7.6 ± 5.2 mmHg with sevoflurane induction. Bharti N, Chari P, and Kumar P found that sevoflurane maintained mean arterial pressure better than propofol. The adjustment may not affect healthy individuals, but it may aid elderly persons with coronary artery disease[35].In their transesophageal echo-Doppler study of Sevoflurane and Propofol anaesthesia on cardiac contractility, Husedzinovic et al. confirmed similar results. Due to decreased pain-related regional blood flow to the thalamus and anterior cingulate cortex, the Sevoflurane group had a much greater stroke volume than the Propofol group. In animal and human studies, propofol's anti-inflammatory actions may help with postoperative analgesia.

5. CONCLUSION

In brief procedure day care surgery, a study that compared the two found that sevoflurane had a slower induction and a larger incidence of difficulties than propofol did. This was an observation that was made by the researchers. The prevalence of apnoea was similar across the two groups. In both Phase I and Phase II, the recovery times for the two groups were comparable to one another. In the case of short procedure day care surgeries, the use of sevoflurane anaesthesia did not result in any statistically significant changes in the incidence of postoperative nausea and vomiting (PONV) or postoperative pain.

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