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"A Comparative Study on Postoperative Complications in Using Total Intravenous Anesthesia with Propofol and Sevoflurane Inhalation Anesthesia"

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Abstract **Original Research Article**

Introduction: Propofol is a short-acting medication that results in a loss of consciousness and lack of memory for events. Sevoflurane is a sweet-smelling, nonflammable, highly fluorinated methyl isopropyl ether used as an inhalational anaesthetic for induction and maintenance of general anesthesia. We have a very few comparative data regarding these two anaesthetic agents. ***Aim of the study*:** The aim of this study was to compare the postoperative complications between 'total intravenous anesthesia with propofol' and 'sevoflurane inhalation anesthesia'. ***Methods:*** This retrospective study was conducted in Pioneer Hospital, Chattogram, Bangladesh. During the period from January 2018 to December 2018. In total 94 patients who had ENT surgeries previously were finalized as the total study population. Total patients were divided into 2 groups. In Group I there were 43 patients to whom total intravenous anesthesia with propofol (TIVA) had been used and in Group II there were 51 patients to whom sevoflurane inhalation anesthesia (SIA) had been used. Postoperative complications and recovery period were determined as tachycardia, bradycardia, hypertension, hypotension, recovery time, additional analgesia and nausea-vomiting. ***Result:*** For the patients who had surgeries under TIVA, the additional analgesia and nausea-vomiting incidences were found as 23.26% and 20.93% respectively and the recovery period was 12 minutes. On the other hand, for the patients who had surgeries under SIA, the additional analgesia and nausea-vomiting incidences were found as 19.61% and 33.33% respectively and the recovery period was 8 minutes. ***Conclusion:*** Due to retrospective nature of this study, results were depended on the records of patient's files only and it was a limitation of this study. According to the analysis of complications regarding two different procedures we found near about the similar performance. Although there was a difference between the lengths of recovery time but that doesn't a big issue to differ among the procedures. As it was a single centered study with some unavoidable limitations, to get more specific information we would like to recommend for conducting more studies in several places.

Keywords: Postoperative, Complication, Intravenous, Anesthesia, Propofol, Sevoflurane, Inhalation.

INTRODUCTION

Propofol-based total Intravenous anesthesia (TIVA) has a number of important advantages over inhalation techniques. Intravenous drugs can be used as anxiolytic and/or sedation, cause less pollution, and allow free airway access. Moreover, propofol markedly decreases the risk of postoperative nausea and vomiting and does not induce malignant hyperthermia [1]. There are also several well documented advantages with regards to free radical scavenging, as well as immune and organ function [1]. Since 2000[2], no article emphasizing on the scientific basis of the optimized clinical practice of TIVA can be found in the literature. The aim of the study was to compare the postoperative complications in using total intravenous anesthesia with propofol and sevoflurane inhalation anesthesia. The anesthesia applied with the inhalation of the volatile-gas anesthetics through the respiratory track is called as inhalation anesthesia. Loss of consciousness and analgesia are two components of the general anesthesia and in this procedure, this is provided with volatile anesthetics. Sevoflurane is one of the volatile-gas anesthetics. TIVA, on the other hand, is a widely used method today accepted as an alternative to SIA and was

identified as the anesthesia method composed of infused intravenous anesthetics. In this method, hypnosis, one of the two significant components of anesthesia, is provided by giving propofol and the analgesia by giving an opioid analgesic convenient for infusion [3]. While the drugs could be given with standard infusion pumps at ml h-1, µg kg-1 min-1 and similar settings for infusion speed in TIVA applications, target plasma or brain concentrations chosen with target-controlled infusion devise could also be given at the infusion rates calculated automatically according to personalized data previously entered to the system [4]. Now a day uses of TIVA procedure is well established in Bangladesh. Propofol is regarded currently as the most suitable anaesthetic agent for TIVA. It allows rapid changes in anaesthetic depth and a rapid clear-headed recovery [5, 6]. Many prevalence researches have been conducted related with the frequency of post-operative complications for both methods [7]. During the recovery period, vital finding changes encountered in the follow-up, postoperative pain and postoperative nausea and/or vomiting are among the postoperative complications frequently encountered. Besides these, the recovery periods including the observation period of the patients in the maintenance units after anesthesia are among the parameters evaluated primarily in studies conducted for patient satisfaction and cost. The modified Aldrete scoring system is generally used to define the patients' readiness while they are sent to service from the recovery room [8]. In this procedure, activity, respiration, circulation, consciousness and oxygen saturation parameters are evaluated. The aim the study was to compare the postoperative complications in using total intravenous anesthesia with propofol and sevoflurane inhalation anesthesia.

OBJECTIVES

General objective

- To evaluate the postoperative complications between 'total intravenous anesthesia with propofol' and 'sevoflurane inhalation anesthesia.

Specific objective

- To observe the postoperative complications between 'total intravenous anesthesia with propofol' and 'sevoflurane inhalation anesthesia.
- To find out the postoperative complications between 'total intravenous anesthesia with propofol' and 'sevoflurane inhalation anesthesia.

METHODOLOGY & MATERIALS

This was a retrospective study and was conducted in Pioneer Hospital, Chattogram, Bangladesh during the period from January 2018 to December 2018. The study was approved by the ethical committee of the respective institute before the starting of this intervention. Proper informed written consent was obtained from all the patients according to the ethical guidelines of the 2008 Declaration of Helsinki. Totally 94 patients with ASA score I-II, age around 20-50 years with ENT operations were selected as the study population. According to the exclusion criteria of the study patients with insufficient data or reports were excluded. The patients were allocated to two groups as Group I (TIVA) and Group II (SIA). In Group I there were 43 patients to whom total intravenous anesthesia with propofol (TIVA) had been used and in Group II there were 51 patients to whom sevoflurane inhalation anesthesia (SIA) had been used. All the patients were opened vascular access after being taken into the operating room and were given anesthesia induction with 1 µg kg-1 fentanyl, 2 mg kg-1 propofol and 0.8 mg kg-1 rocuronium. The patients in Group II were given 1-2% volume sevoflurane in 50% O_2 and 50% N_2O during maintenance of anesthesia, while the patients in Group I were applied 4-10 mg kg-1 h-1 propofol and 0.05-0.1 µg kg-1 fentanyl IV infusion with 50% O_2 and 50% air. At the end of surgery, each patient was given 0.4mg kg-1 ketorolac for analgesia and 0.1mg kg-1 ondansetron for nausea vomiting prophylaxis in a routine way. Each patient was taken into recovery room after extubation and pulse rate, non-invasive blood pressure (NIBP) and oxygen saturation evaluation were done. Postoperative complication and vital finding tracks of each patient were done as usual and were recorded. Surgery types were divided into two groups as major and minor surgery. Existence of hypoxia, tachycardia, bradycardia, hypertension and hypotension were determined as vital finding complications. If the oxygen saturation was under 90%, in spite of oxygen support, it was defined as hypoxia. Similarly, if the pulse rate was 20% higher than the preoperative value, then it was described as tachycardia, if 20% lower, then bradycardia; and if NIBP was 20 mmHg lower than the postoperative value, then it was qualified as hypotension, if 20 mmHg higher, then hypertension. For collecting data and analysis MS Excel and SPSS version 20 were used. Results were evaluated in the 95% confidence range, and significance at $p<0.05$ level.

RESULT

In our study, as distributed we found in Group I among total 43 participants there were 25 (58.14%) male and 18 (41.86%) were female. Besides these in Group II among total 51 participants there were 28 (54.90%) were male and 23 (45.10%) were female. Therefore, among the total 94 participants 53 (56.38%) male and 41 (43.62%) were female. So in this study male were dominating. The mean (±SD) body weight of the participants of group I was 43±18.76 Kg whereas it was 45±18.23 kg in group II. On the other hand, the mean (±SD) duration of operation was 75±12 minutes in group I and 77±37 minutes in Group II. The risk factor for complications such as, hypertension, hypotension, hypoxia, tachycardia, bradycardia related with vital functions was low for both anesthesia methods. There was not a statistically significant difference ($p>0.5$) between Group I and Group II with regard to major and minor surgeries. For the patients

who had surgeries under TIVA, the additional analgesia and nausea-vomiting incidences were found as 23.26% and 20.93% respectively and the recovery period was 12 minutes. On the other hand, for the patients who had surgeries under SIA, the additional analgesia and nausea-vomiting incidences were found as 19.61% and 33.33% respectively and the recovery period was 8 minutes. The additional analgesia need was observed to be higher in the patients who had major surgeries than in the patients who had minor surgeries. However, this difference was not statistically significant for both anesthesia procedures. Nausea-vomiting incidence was found statistically significant and high (33.33%) for the patients who had both major and minor surgeries in Group SIA ($p<0.05$). The recovery period was found statistically significant and long in Group I when compared to Group II.

Table-I: Age distribution of participants (N=94)

Group/ Gender	Male		Female		Total	
	n	%	n	%	n	%
Group I	25	58.14	18	41.86	43	45.74
Group II	28	54.90	23	45.10	51	54.26
Total	53		41		94	100.00

Table-II: Distribution of body weight and operation duration of participants (N=94)

Variables	Group I	Group II	p Value
Weight (kg)	43±18.76	45±18.23	p>0.05
Operation Period (min)	75±12	77±37	p>0.05

Table III: Distribution of complications among participants (N=94)

Complications	Group I		Group II		P value
	n	%	n	%	
Hypertension	4	9.30	4	7.84	p>0.05
Hypotension	3	6.98	3	5.88	p>0.05
Tachycardia	3	6.98	4	7.84	p>0.05
Bradycardia	2	4.65	3	5.88	p>0.05
Low saturation	5	11.63	7	13.73	p>0.05
Additional analgesia	10	23.26	10	19.61	p>0.05
Nausea-vomiting	9	20.93	17	33.33	p<0.05
Recovery period (Min.)	12	12	8	8	p<0.05

DISCUSSION

The aim of the study was to compare the postoperative complications in using total intravenous anesthesia with propofol and sevoflurane inhalation anesthesia. Different anesthesia approaches depending upon various factors are applied to patients who are to be given surgical intervention under general anesthesia. The factors influencing the anesthesia approach could be the patient's clinical, systemic examination and laboratory values and they display changes as the locality type and period of the surgery as well. That the short effective new intravenous hypnotics and analgesics whose cumulative effects are low have recently been put into practice has been rising the interest towards TIVA as an alternative to inhalation anesthesia[9]. The cardiovascular stability of TIVA has been reported to be better than inhalation anesthesia, to be sympatholytic to surgical stimuli and to diminish hormonal and metabolic changes [10]. It was compared in this study the effects of TIVA method, which we made with propofol and fentanyl infusion, on hemodynamics in the postoperative period with the effects of SIA method that we made with sevoflurane and N_2O. The most evident effect of propofol on cardiovascular system is the arterial hypotension. Researchers have already stated that, with TIVA method, systolic, diastolic and average arterial pressures could decrease 10-30% due to dose, age, infusion speed or the usage of opioid or nitrous oxide (N2O). This decrease has been explained with the fall in the systemic vascular resistance [11]. In a study they conducted, in which they compared the effects of propofol and sevoflurane, Scoot Jellish W *et al.* reported that propofol decreased arterial pressure at a 15-35% rate with regard to sevoflurane [12]. Fredman *et al*. found the average blood pressure measurement values similar in all groups in a study they conducted when they used propofol and sevoflurane on 146 daily patients [13]. In our study, no significant difference between Group I and Group II with regard to hypertension and/or hypotension presence was found. The pulse rate does not generally increase during the anesthesia application with propofol despite the fall in the arterial blood pressure. This is the sympatholytic effect of propofol and it doesn't disrupt the propofol baroreflex sensivity [14] reported in their studies in which they searched for the effects of intravenous and inhalation agents on hemodynamic response that the pulse rates were lower in Group TIVA during and post-operative periods. Particularly Watson *et al*.[15] found

the pulse rate in Group TIVA significantly low during postoperative period. Tanaka *et al*. reported the pulse rate values to be lower in sevoflurane group in a study in which they compared the effects of inhalation agents (isoflurane, sevoflurane, halothane and enflurane) on hemodynamic response [16]. In a study in which Aydın *et al.* compared hemodynamic effects of Group TIVA and Group SA the average pulse rate was found significantly higher in Group TIVA [17]. In this study, tachycardia and bradycardia risks were quite low in both groups and no difference was observed between the propofol used Group I and the sevoflurane used Group II. Adams et al. compared propofol and isoflurane in their study and found TIVA superior to inhalation agents since it was less toxic, it provided a faster induction, it reduced most the hemodynamic response occurring due to surgical stimulation and protected the cardiovascular stability better and it provided a complete and fast recovery [18]. However, in another study, Bharti *et al*. reported that sevoflurane used Group SA was more advantageous than propofol used Group TIVA with regard to its provision for cardiovascular stability without extending the recovery period [19]. In this study, no definite reduction was observed for SpO_2 during the recovery period and all hemodynamic parameters progressed within physiological limits. On the other hand in another study, Watson *et al*. extensively evaluated the postoperative complications and recovery parameters between the sevoflurane used Group SIA and the propofol used Group TIVA and indicated that there was no difference related with extubation period, eye opening time, couching, keeping breath, uneasiness, trembling, postoperative pain and nausea-vomiting [15]. In our findings displayed parallelism with these studies. The nausea- vomiting risk in Group SA was definitely higher than the risk in Group TIVA. As a result of the studies supporting this finding, inhaler anesthetics have started to be accepted among the other postoperative nausea-vomiting risk factors [20]. Dashfield *et al.* indicated that nausea-vomiting was more in sevoflurane used Group TIVA in the 30-min-observation period and that there was no difference with propofol used Group SA when the observation period was extended to 90 minutes [21]. The opinion of inhaler anesthetics leading to more nausea-vomiting than intravenous anesthetics could be due to short observation periods. Regarding this estimation, studies planning longer postoperative observation are required. The recovery from anesthesia depends upon the reducing speed of the medicine concentration after the medicine is ended. When the intravenous anesthetics are given for a long time in infusion form, this speed is different from the simple life and is expressed as "context sensitive half-life". The reduction of the concentration of the medicine is a pharmacokinetic characteristic. It should not be underestimated that the pharmacodynamics of the medicine and the interaction of it with the other medicines used together also influence the recovery [22], Vuyk *et al*. In this study, it was used low dose fentanyl infusion for sufficient anesthesia and analgesia besides propofol which is the primary medicine of TIVA procedure. It was observed the recovery period to be longer in Group I. There are various studies in harmony with our results indicating that patients whose anesthesia administration was provided with inhaler anesthetics woke up more quickly and was taken out of the post anesthesia unit [19]. Bharti *et al*. proposed inhaler anesthetic usage since it provided cardiovascular stability without extending the recovery period [19]. Fleischann *et al*. reported that although the effect starting times of TIVA and SIA were similar, SIA provided a faster recovery with respect to recovery period [23]. Furthermore, there is also some other publications indicating that the inhaler anesthetics are faster with regard to effect starting time [21]. The most important limitation of this study was its retrospective design. Due to retrospective nature of the study results depended on the records in the patients' files. Fentanyl infusion in TIVA procedure may have caused the prolongation of the recovery period.

LIMITATIONS OF THE STUDY

This was a single centered study with small sized samples. So, the findings of this study may not reflect the exact scenario of the whole country.

CONCLUSION AND RECOMMENDATIONS

The most important limitation of this study was its retrospective design. Due to retrospective nature of the study results depended on the records in the patients' files. Fentanyl infusion in TIVA procedure may have caused the prolongation of the recovery period. So to get more specific information we would like to recommend for conducting more studies in several places.

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