

ORIGINAL ARTICLE

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Postoperative complications in total intravenous anesthesia with propofol compare with sevoflurane anesthesia: A retrospective study

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Abstract

The aim of us is to define the incidence of postoperative complications two anesthesia procedures. During the period between 01.01.2016 and 01.01.2017, totally 583 patients were included in the study, who had oral-maxillofacial surgeries. Anesthesia types were determined as propofol-based total intravenous anesthesia (TIVA) and sevoflurane-inhalation anesthesia (SA). Surgical types were divided into two groups, major and minor. Postoperative complications and recovery period were determined as tachycardia, bradycardia, hypertension, hypotension, recovery time, additional analgesia, nausea-vomiting.

While TIVA was used 241 patients, SA was used 342 patients. Incidences of patients, having had major surgeries under TIVA, for additional analgesic, nausea-vomiting, and recovery period on average were found as 12.7%; 13.5%; 13min respectively. As for the patients having had minor surgeries under TIVA, the same values were 10.2%; 6.5%; 12min respectively. Incidences of patients, having had major surgeries under SA, for additional analgesic, nausea-vomiting, recovery period on average were found as 11.3%; 34.2%; 7min respectively. Patients having had minor surgeries under TIVA performed the same values as 9.8%; 19.5%; 5min respectively.

It was observed that SA caused more nausea-vomiting than TIVA; however, it had a shorter recovery period. We have been in the opinion of that SA absolutely must be done with nausea-vomiting premedication and that it could be preferred owing to the shorter recovery.

Keywords: Sevoflurane Anesthesia, Total intravenous anesthesia (TIVA), maxillofacial surgery, Ppostoperative complications, recovery period

Introduction

TIVA and inhalation/volatile anesthesia are the primary general anesthesia procedures used in all surgical applications. 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. The depth of the anesthesia could be controlled in modern anesthetic devices by monitoring the respiration and volatile anesthetics and/or minimal anesthetic concentration (MAC). Sevoflurane is one of the volatile-gas anesthetics. TIVA, on the other hand, is a widely used method today accepted as an alternative to SA 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 [1]. 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 devies could also be given at the infusion rates calculated automatically according to personalized data previously entered to the system [2].

These two general anesthesia procedures are used in oral and maxillofacial surgeries for the realization of patient comfort and/or invasive surgery applications [3-5]. Many prevalence researches have been conducted related with the frequency of post-operative complications for both methods [6-8].

During the recovery period, vital finding changes encountered in the follow-up, postoperative pain and postoperative nausea-vomiting are among the postoperative complications frequently encountered. In addition, 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. A short recovery period is a must in ideal anesthesia management. The modified Aldrete scoring system is generally used to define the patients' readiness while they are sent to service from the recovery room [9,10]. In this system, activity, respiration, circulation, consciousness and oxygen saturation parameters are evaluated. Postoperative complication frequency in the patients, their recovery periods and their states to be able to go to their service departments could display differences depending on surgery and anesthesia procedures.

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The aim of this study was to determine the postoperative complication incidences of these two anesthesia procedures decided according to the state of the patient and the surgery type and length and to compare recovery data and periods.

Material and Methods

This study was approved by the Research Ethics Committee of Faculty of Medicine. Informed written consent was obtained from all patients, according to the ethical guidelines of the 2008 Declaration of Helsinki. Totally ASA I-II, 18-60 ages, 583 patients who had had oral and maxillofacial operations for 30 minutes and over with TIVA and SA methods between 1st Oct, 2016 and 1st Oct, 2017. The ones who had insufficient data in their files and who were conscious/superficial sedation patients were excluded from the study. The patients were allocated to two groups as TIVA and SA. The TIVA group was named "Group TIVA", and the volatile anesthesia group was named "Group SA".

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 SA were given 1-2% volume sevoflurane in 50% O₂ and 50% N₂O during maintenance of anesthesia, while the patients in group TIVA were applied 4-10 mg kg⁻¹ h⁻¹ propofol and 0.05-0.1 µg kg⁻¹ fentanyl IV infusion with 50% O₂ and 50% air. While being woken up, each patient was given 0.3 mg kg⁻¹ tenoxicam for analgesia and 0.2 mg kg⁻¹ methoclopyramide 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 monitorization 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. While surgery assisted rapid maxiller expansion (SARME), extraoral region autogen graft operations, open reduction of mandibula-maxilla fracture, temporomandibular joint surgery, central face region fracture, cyst enucleation, orthognotic surgery, jaw resection- tumor surgery and alveolus operations were determined as major surgery group; filling-endodontic procedures, tooth extraction, embedded tooth extraction and implant surgery were decided as 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 30 mmHg lower than the postoperative value, then it was qualified as hypotension, if 30 mmHg higher, then hypertension. The other postoperative complications, too, were defined as additional analgesia needs observed during the one-hour-postoperative period and as nausea-vomiting. The recovery period, among the other evaluated parameters, were identified as the period passing until the Modified Aldrete Score (Table. 1) reached 9 and the patients whose values were 9 or over were taken to services.

In the analyses of the data, SPSS ("Statistical Package for Social

Sciences") 10.0 for Windows statistical package program was used. Whether the distributions of the variables studied complied with normal distributions or not was investigated with Levene Homogeneity Test for Variants. While the study data were being evaluated, in the comparison of the quantitative data between groups besides the descriptive statistical methods (average, standard deviation), t-test was used in independent groups for continuous variants complying with normal distribution and Mann Whitney U test was used for the variants not displaying a normal distribution. The comparison of the distribution of the rates between groups was done with Chi-Square Test. For i-group comparisons, Freidman Test was preferred. Results were evaluated in the 95% confidence range, and significance at p<0.05 level.

Table 1. Modified Aldrete Scoring

Consciousness	Fully awake	2
	Arousable on calling	1
	Not responding	0
Activity	Moves all extremities	2
	Moves two extremities	1
	Unable to move extremities	0
Respiration	Breathes deeply, coughs freely	2
	Dyspneic, shallow or limited breathing	1
	Apneic	0
Circulation	20 mm Hg > preanesthetic level	2
	20 - 50 mm Hg > preanesthetic level	1
	50 mm Hg > preanesthetic level	0
Oxygen saturation	SpO ₂ > 92% on room air	2
	Supplemental O ₂ required to maintain SpO ₂ > 90%	1
	SpO ₂ < 90% O ₂ supplementation	0

Aldrete JA. J Clin Anesth 1995

Results

The demographic characteristics of the patients included in the study and their average operation periods were given in Table 2.

Table 2. Demographic Characteristics of the Patients and Operation Periods

	Group SA (n=342)	Group TIVA (n=241)	P Value
Age (year)	18.62±14.93	23.74±15.72	p>0.05
Weight (kg)	41.53±28.32	47.26±29.93	p>0.05
Gender (M/F)	184/158	119/122	p>0.05
Operation Period (min)	74±14	76±13	p>0.05

Major and minor surgery rates were found as 21.1% and 78.9% respectively for 241 patients who were applied TIVA, while the same rates were 15.4% and 84.6% respectively for 342 patients for whom SA was used.

The risk factor for complications (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 TIVA and Group SA with regard to major and minor surgeries (Table 3).

For the patients who had major surgeries under TIVA, the additional analgesia and nausea-vomiting incidences were found as 12.7% and 13.5% respectively and the recovery period was 13 minutes. For the patients who had minor surgeries under TIVA the same incidences were 10.2% and 6.5% and the recovery period was 12 minutes.

On the other hand, for the patients who had major surgeries under SA, the additional analgesia and nausea-vomiting incidences were found as 11.3% and 34.2% respectively and the recovery period was 7 minutes. For the patients who had minor surgeries under SA the same incidences were 9.8% and 19.5% and the recovery period was 5 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 (Table 3).

Nausea-vomiting incidence was found statistically significant and high for the patients who had both major and minor surgeries in Group SA ($p<0.05$) (Table 3).

The recovery period was found statistically significant and long in Group TIVA when compared to Group SA particularly for the patients who had major surgeries ($p<0.05$) (Table 3).

Table 3. Postoperative Complication Numbers and Recovery Periods of Group TIVA and Group SA

		Group TIVA		Group SA		P value
		Major surgery	Minor surgery	Major surgery	Minor surgery	
Complications belonging to Vital Functions (n)	hypertension	7	5	9	8	$p>0.05$
	hypotension	8	6	5	6	$p>0.05$
	tachycardia	9	9	6	8	$p>0.05$
	bradycardia	5	6	7	7	$p>0.05$
	low saturation	14	13	18	15	$p>0.05$
Additional Analgesia Need (%)		% 12.7	% 10.2	% 11.3	% 9.8	$p>0.05$
Nausea-Vomiting (%)		% 13.5	% 6.5	% 34.2	% 19.5	$p<0.05^*$
Recovery Period (min)		13	12	7	5	$p<0.05^*$

*There was difference between Group TIVA and Group SA with regard to both major and minor surgeries

Discussion

Different anesthesia approaches depending on various factors are applied to patients who are to be given surgical intervention under general anesthesia. These factors influencing the anesthesia approach could be the patient's clinic, 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 [11]. The cardiovascular stability of TIVA has been reported to be better than inhalation anesthesia, to be sympathtanakaic to surgical stimuli and to diminish hormonal and metabolic changes [12]. 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 SA method that we made with sevoflurane and N₂O.

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 nitrogen protoxide. This decrease has been explained with the fall in the systemic vascular resistance [13]. 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 [14]. 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 patient [15]. In this study, no significant difference between Group TIVA and Group SA 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 sempatholytic effect of propofol and it doesn't disrupt the propofol baroreflex sensitivity [16]. Reid [17], Tandonnet [18] and Bostek [19] 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. [20] 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 [21]. In a study in which Aydın et al. compared hemodynamic effects of Group TIVA and Group SA the average puls rate was found significantly higher in Group TIVA [22].

In this study, tachycardia and bradycardia risks were quite low in both groups and no difference was observed between the propofol used Group TIVA and the sevoflurane used Group SA.

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 [23]. 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 [24]. In this study, no definite reduction was observed for SpO₂ during the recovery period and all hemodynamic parameters progressed within physiological limits.

Many studies did not find any significant difference between these two anesthesia methods with regard to additional analgesia need and postoperative pain scores [6,7]. Watson et al. extensively evaluated the postoperative complications and recovery parameters between the sevoflurane used Group SA and the propofol used Group TIVA and indicated that there was no difference related with extubation period, eye opening time, coughing, keeping breath, uneasiness, trembling, postoperative pain and nausea-vomiting [20]. Similarly, Ian et al. did not find any difference between the two methods for additional opioid usage [7]. Our findings displayed parallelism with these studies. However, while no difference was found between the methods for additional analgesia need, an evident difference was determined between the methods with regard to postoperative nausea-vomiting incidence. 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 [6,25]. Tang et al. proposed TIVA for daily surgeries with regard to patient satisfaction owing to low nausea-vomiting rate [8,26,27]. In addition, in their postoperative nausea-vomiting study conducted specifically in oral and maxillofacial surgeries, the low nausea-vomiting incidence of the propofol used TIVA needed less anti-emetic and provided sufficient patient satisfaction [4]. Similarly, the postoperative nausea-vomiting incidence in propofol used TIVA was found low in our study. We determined the 60 minutes postoperative period as the observation time in the evaluation of additional analgesia and nausea-vomiting in our study. The observation periods in similar studies were generally composed of a few hours short term observations in postanesthesia maintenance units or in services [6,8,26,27]. 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 [28]. 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 on 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 [29,30]. Vuyk et al. [31] evaluated the interaction of all synthetic opioids when they were used

with propofol with regard to sufficient anesthesia and recovery. Fentanyl, alfentanil and sufentanil are expected to extend the recovery. As for remifentanyl, when the infusion is ended, the effect disappears very fast [32]. 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 TIVA. 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 postanesthesia unit [7,24,26]. Bharti et al. proposed inhaler anesthetic usage since it provided cardiovascular stability without extending the recovery period [24]. Fleischmann et al. reported that although the effect starting times of TIVA and SA were similar, SA provided a faster recovery with respect to recovery period [26]. Furthermore, there are also some other publications indicating that the inhaler anesthetics are faster with regard to effect starting time [28].

This clinical study had some limitations. The most important limitation of this study is 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. Remifentanyl has shorter effect period than fentanyl. Therefore, the use of remifentanyl can provide easier recovery than fentanyl. Likewise, the use of nitrous oxide in inhalational procedure causes more nausea and vomiting. The use of air instead of nitrous oxide may be provide to only discuss effect of sevoflurane on postoperative nausea and vomiting.

Conclusion

No difference was observed between the two anesthesia methods with regard to complications belonging to vital findings and they were accepted as reliable. The recovery period was found significantly long in Group TIVA particularly for the patients who had undergone a major surgery. According to those findings, SA method could be said to have led to more nausea-vomiting than TIVA, but to have provided a faster recovery. I am of the opinion that inhaler anesthetics usage in long-termed operations absolutely requires nausea-vomiting premedication and they could be preferred since they have a shorter recovery period than intravenous anesthetics.

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Competing interests

The authors declare that they have no competing interest.

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