

A study on total intravenous anesthesia in orthognathic surgical procedures

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ABSTRACT

Aims and Objective: To assess the use of propofol for induction and maintenance of anaesthesia among patients undergoing various combinations of orthognathic surgical procedures.

Materials and Methods: Following Preoperative evaluation, patients were given Fentanyl (2 micrograms/kg) intravenously. Induction (2 mg/kg) and maintenance (10 mg/kg/hr) of anaesthesia was achieved by Propofol infusion. Blood Pressure and heart rate were maintained at >70 or 80 mm Hg and >50 respectively and were monitored continuously. Infusion was stopped approximately 30 to 40 minutes before the end of surgery. Immediate recovery recorded and was assessed. **Results:** The average duration of anaesthesia and surgery were found to be 4 hrs 28 min (SD= 1 hr. 35 min) and 4 hrs 3 min (SD=1 hr 38 min). None of the patients experienced pain on injection of induction agent. No significant change was observed in the mean heart rate and mean BP at different time intervals from baseline value to 30 minutes after the recovery. The average time taken to obey simple commands after stopping Propofol infusion was 42.60 ± 9.09 min. Time taken for spontaneous eye opening, full orientation and to count backwards was 43.45 ± 9.11, 47.85 ± 8.18 and 50.9 ± 9.14 respectively. Face-Hand test performed at 15 min after extubation was positive in all the patients. The mean Aldrete score at 15 min after extubation was 11.65 ± 0.75. The mean value of unaided sitting time for at least 2 min was after 119.00 ± 20.56 min. The average score of picture card test, time taken in "picking up matches" test, Ball bearing test, time taken to walk and to void urine were 5.80 ± 1.47, 67.95 ± 5.72, 9.80 ± 2.57, 172.75 ± 39.25 and 163.75 ± 55.96 respectively. Ninety percent of the patients were amenable for a repeat of this anaesthetic using the same regime but 10% of them did not answer anything. Seven patients (35%) had chills post-operatively. **Conclusion:** Propofol is an excellent anaesthetic for day care procedures.

Key words: Anesthesia, intravenous anesthesia, orthognathic surgery, propofol, sedation

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INTRODUCTION

Orthognathic surgical procedures have traditionally been done on in-patient setting. The reason for in-patient management varies but includes anesthetic

management, potential blood loss, and a greater length of operation. As orthognathic surgical procedures have evolved, several aspects of management of

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these patients have changed. The quality, result, and prognosis of any surgery rely to a great extent on the anesthetic technique.

“Sedation and analgesia” ranges from minimal sedation to general anesthesia, and is used to relieve anxiety and diminish pain, discomfort, and memory of the procedure. In conscious sedation, patients can make purposeful responses to auditory and tactile clues, and both vascular and ventilatory status are maintained. With deep sedation, patients respond only to painful stimuli, and airway support may be required. At the level of general anesthesia, patients are unresponsive, and airway support is necessary.^[1-3]

The degree of sedation should be titrated to achieve patient comfort and successful procedure. Patients may require different levels of sedation for the same procedure and may attain varying levels of sedation during a single procedure. In general, diagnostic and uncomplicated procedures are successfully performed using moderate (conscious) sedation. Deeper levels of sedation may be considered for longer and more complex procedures and also may be appropriate for patients difficult to sedate with those medications usually employed to achieve conscious sedation.^[4-6]

We now have a better understanding of the pharmacokinetic and pharmacodynamic behavior of many drugs, which help to determine a more accurate dosing regimen. The improvements in design of present day infusion devices make administration of intravenous (IV) drugs easy. Short-acting anesthetic agents, such as propofol, may be used to achieve deep sedation. Propofol is an FDA approved IV anesthetic agent used for the induction and maintenance of general anesthesia and for sedation in ventilated patients. It is classified as an ultrashort-acting hypnotic agent. Propofol possesses sedative, amnestic, and hypnotic properties, but minimal levels of analgesia. It is 98% plasma protein bound and is metabolized primarily in the liver. The drug is lipophilic and is prepared as an oil/water emulsion consisting of 1% propofol, 10% soybean oil, 2.25% glycerol, and 1.2% egg lecithin.

Propofol increases the likelihood of satisfactory deep sedation as well as the risk of rapid and profound decrease in the level of consciousness and cardiorespiratory function, which may culminate in general anesthesia. Propofol rapidly crosses the blood-brain barrier and causes a depression in consciousness that is thought to be related to potentiation of the gamma-aminobutyric acid activity in the brain. Typically, the time from injection to the onset of sedation is very short, i.e., 30–60 s. The plasma half-life ranges from 1.3 to 4.13 min.^[7,8] This study was carried out to assess the use of propofol for

induction and maintenance of anesthesia among patients undergoing various combinations of orthognathic surgical procedures.

METHODOLOGY

A randomized controlled trial was conducted among twenty patients at the Department of Oral and Maxillofacial Surgery, in our institute during March 1999 to March 2002. Ethical approval was obtained from Hospital Ethics Committee for performing the study. Informed consent was obtained from the study participants.

Inclusion criteria

- Patients aged 18–40 years
- ASA-I and II patients.

Exclusion criteria

- ASA category III, IV, and V
- Less than 18 or more than 40 years of age
- Pregnant or nursing mothers
- Patients with disorders of lipid metabolism
- Patients with significant hepatic or renal dysfunction
- Patients with significant ischemic heart disease.

Preoperative evaluation

Patient’s age, body weight, preoperative heart rate (HR), and blood pressure (BP) were recorded. History was obtained regarding previous anesthesia, surgery, significant medical illness, medications, and allergies to any medication. A complete physical examination was done to detect any abnormality of the heart, lungs, abdomen, central nervous system, and the airway was assessed for ease of intubation. The screening tests included hemoglobin percent, blood counts, erythrocyte sedimentation rate, urine albumin and sugar, chest X-ray (posteroanterior view), electrocardiogram (ECG), blood urea and sugar.

In addition patient’s intelligence was assessed grossly by finding out their general knowledge and familiarity with numbers. A note was made in their case-record so as to help in framing the questions to determine their orientation during recovery. The patients were also made familiar with clinical and psychomotor tests, which would be used in assigning recovery.

Premedication

All patients were premedicated with diazepam - 10 mg and ranitidine 150 mg on the previous night of surgery. On the day of surgery, they were premedicated with injection glycopyrrolate - 0.2 mg intramuscular 45 min before induction. On arrival to the operation theater, an 18-gauge cannula was used to open a vein on the dorsum of nondominant forearm and connected with an infusion of Ringer’s lactate. ECG, noninvasive BP, and

pulse oximeter were connected, and basal values were noted in the anesthesia chart.

Anesthesia and airway maintenance

Patients were given fentanyl (2 µg/kg) IV. Three minutes later, the induction dose of propofol (2 mg/kg) mixed with 1 ml of 2% Xylocard was given slowly over a period of 20–30 s, followed by vecuronium 0.1 mg/kg. A note was made of patient’s complaint of pain on injection.

The trachea was intubated using appropriate size nasal RAE endotracheal tube after 3 min of injecting vecuronium bromide. Intermittent positive pressure was maintained with 100% oxygen (O₂) in all patients.

Anesthesia was maintained with propofol infusion using infusion pump [Figure 1], adjusted at the rate of 10 mg/kg/h for the next 10 min, 8 mg/kg/h for the next 10 min, and 6 mg/kg/h for the rest of the duration of surgery. Every 1 h, half the induction dose of Fentanyl was given IV, and every half an hour 25% of an induction dose of vecuronium bromide was injected IV [Figure 2]. All patients received 8 mg of dexamethasone sodium to prevent intraoral edema.

If the patients were light as indicated by an increase in HR or BP of 25% above preinduction values or any untoward movement, anesthesia was deepened by increasing the rate of propofol infusion or by a bolus dose of 10–15 µg of fentanyl. All the patients were given crystalloids at the rate of 10 ml/kg/h. Mean BP of around 70–80 mm of Hg was maintained. If there was a fall in BP with mean <70 mm of Hg, this was treated with increasing the rate of infusion of fluids. If there was no response, it was treated with IV ephedrine 6 mg in increments. A fall in HR below 50 beats/min was treated with IV atropine 0.6 mg. Patient’s oxygen saturation (SPO₂) and ECG was monitored continuously. HR, respiratory rate, and BP were recorded during induction and intubation and every 5 min thereafter. The relevant observations

were entered in the pro forma. Blood loss during the procedure was also noted.

Infusion was stopped approximately 30–40 min before the end of surgery. Following this, if the patient showed signs of inadequate depth of anesthesia such as movements, tachycardia, and hypertension; 1 mg/kg of propofol was injected as a bolus dose.

At the end of surgery, residual neuromuscular paralysis was reversed with 50 µg/kg of neostigmine and 10 µg/kg of glycopyrrolate. When the patient becomes fully conscious, endotracheal tube was removed, 100% O₂ was given through facemask and HR, BP, and SPO₂ were recorded.

The following tests were used to assess recovery immediately after stopping propofol infusion.

- Obey commands
- Spontaneous eye opening
- Orientation
- Time taken to count backward
- Face hand test
- Modified Aldrete score at 15 min
- Time taken to score 12/12 in the modified Aldrete score
- Picture card test [Figure 3]
- Unaided sitting time
- Picking up matches [Figure 4]
- Ball bearing test [Figure 5].

The patients were then shifted to the postoperative ward. They were visited the next day and were enquired the exact time on the ability to walk, to tolerate fluids, and to void urine. They were asked for symptoms of nausea, vomiting, giddiness, and pain at the site of injection, headache, awareness of intraoperative events or any other complaint. Willingness to undergo a repeat anesthetic by the same technique was enquired.

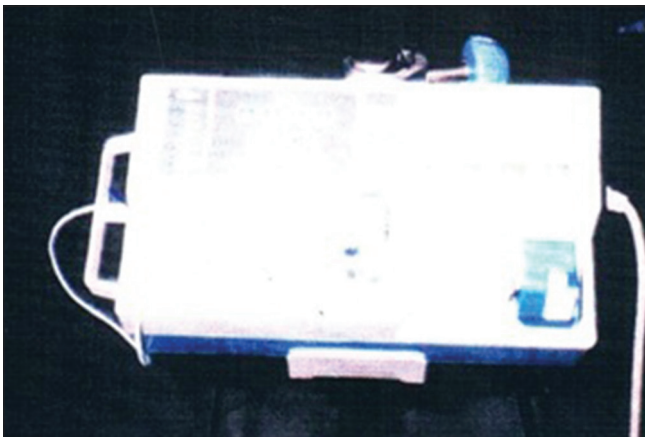


Figure 1: Infusion pump



Figure 2: Propofol vial, vecuronium, and fentanyl ampoules

Statistical analysis

The data collected in the study were tabulated and analyzed using Statistical Package for Social Sciences version 16.0 software (SPSS Inc., Chicago, IL, USA). Descriptive statistics were calculated. Friedman test was employed to evaluate the significance of differences in HR and BP at different intervals of time. Confidence interval and P value were set at 95% and ≤0.05, respectively.



Figure 3: Picture card test



Figure 4: Picking of matches test

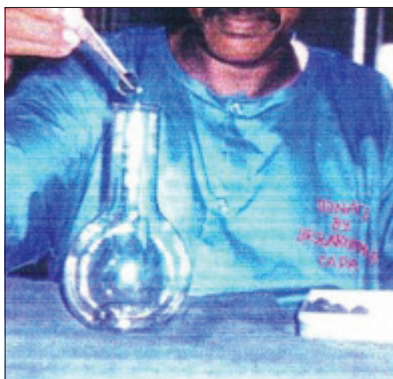


Figure 5: Ball bearing test

RESULTS

The descriptive statistics of the study population are described in Table 1. The mean age and mean weight of the 20 patients were 24.3 ± 5.8 and 51.8 ± 8.35, respectively. There were 13 males and 7 females. Table 2 describes the number of various types and combinations of orthognathic surgical procedures performed.

The average duration of anesthesia and surgery were found to be 4 h 28 min (standard deviation [SD] =1 h. 35 min) and 4 h 3 min (SD = 1 h 38 min). The average blood loss was 250.7 ± 127.4. Among all, 25% of patients required a supplement for anesthesia, as the estimated time for surgery did not coincide with the duration of anesthesia. None of the patients experienced pain on injection of an induction agent. There was no movement observed on intubation or skin incision. There was no record of arrhythmias or fall in SPO₂ in any of the patients. There were no patients requiring vasopressor or parasympatholytic agents for hemodynamic stability [Table 3].

Table 4 shows changes in mean HR and mean BP during induction, maintenance, extubation, and in the recovery period. The baseline mean HR and BP of the study population were found to be 82 ± 11.36 and 86.7 ± 7.33,

Table 1: Demographic characteristics

Particulars	Descriptive statistics
Mean age	24.30 ± 5.8
Sex (male/female)	13/7
Mean weight	51.80 ± 8.35

Table 2: Distribution of surgical procedures performed

Surgical procedures	Number of cases
Lefort-I	3
Lefort-I + upper anterior segmental	2
Lefort-I + genioplasty	1
Lefort-I + bilateral sub sigmoid	1
Lefort-I + lower subapical	1
Lefort-I + bilateral sagittal split	1
Upper anterior segmental	2
Bimax anterior segmental	3
Bilateral sagittal split	3
Genioplasty	3

Table 3: Intraoperative observations

Parameters	n (%) / mean ± SD
Pain on injection of induction	0
Movement/hiccup on intubation	0
Movement during incision	0
Need for supplement of anesthetic	5 (25)
Need for injection atropine	0
Need for vasopressor	0
Arrhythmias	0
Fall in oxygen saturation	0
Blood loss (ml)	250.7 ± 127.41
Duration of surgery (min)	243.0 ± 97.65
Duration of anesthesia (min)	267.00 ± 95.90

SD: Standard deviation

respectively. No significant change was observed in the mean HR and mean BP at different time intervals from baseline value to 30 min after the recovery.

Table 5 shows the early recovery characteristics in the operation theater. The average time taken to obey simple commands after stopping propofol infusion was 42.60 ± 9.09 min. Time taken for spontaneous eye opening, full orientation and to count backward was 43.45 ± 9.11, 47.85 ± 8.18, and 50.9 ± 9.14, respectively. Face-hand test performed at 15 min after extubation was positive in all the patients. The mean Aldrete score at 15 min after extubation was 11.65 ± 0.75 and the average time taken to reach Aldrete score of 12/12 was 15.90 ± 1.89 min.

Table 6 shows the postoperative recovery in the recovery room/postoperative ward and the values were recorded from the time of extubation. The mean value of unaided sitting time for at least 2 min was after 119.00 ± 20.56 min. The average score of picture card test, time taken in “picking up matches” test, Ball bearing test, time taken to walk and to void urine were 5.80 ± 1.47, 67.95 ± 5.72, 9.80 ± 2.57, 172.75 ± 39.25, and 163.75 ± 55.96, respectively. All the patients were able to tolerate oral fluids by 4 h, and none of the patients had nausea/vomiting. None of them were aware of intraoperative events and no one complained of pain at IV site, giddiness or a headache. Ninety percent of the patients were amenable for a repeat of this anesthetic using the same regime, but 10% of them did not answer anything. Seven patients (35%) had chills postoperatively.

DISCUSSION

Many techniques of general anesthesia and a plethora of drugs are available to provide anesthesia for orthognathic surgeries. Anesthetic management may influence the patient’s postprocedural quality of life and state of health for long years following the anesthesia.^[9] According to the Declaration of Helsinki, published by the European Society of Anesthesiology in 2010, the specialty of anesthesiology and intensive care guards the patient’s safety and their quality of life after the surgery and anesthesia.^[10]

Anesthetic technique needs to begin with a rapid and smooth induction and a prompt awakening, timed to match the end of the surgery. The maintenance phase of anesthesia must be adequate to control physiological responses and to interfere with patient’s memory, but excess depth must be avoided so as not to prolong recovery. The recovery period should be as brief as possible and be associated with minimal postanesthetic complications. The anesthetic technique should also

Table 4: Mean heart rate and blood pressure at different intervals

Time	Mean ± SD	
	Heart rate	Blood pressure
Base-line value	82.0 ± 11.36	86.70 ± 7.33
After induction	83.95 ± 16.80	84.40 ± 15.87
5-min after intubation	78.85 ± 11.46	83.00 ± 14.48
10-min after intubation	79.10 ± 14.13	85.40 ± 10.42
15-min after intubation	77.95 ± 13.52	82.70 ± 9.26
End of the surgery	75.00 ± 16.16	85.40 ± 8.24
2-min after extubation	89.35 ± 17.21	87.70 ± 8.06
On arrival in the recovery room	81.35 ± 9.49	85.30 ± 5.93
After 15-min in recovery room	80.60 ± 8.0	85.20 ± 5.89
After 30-min in recovery room	79.40 ± 9.22	86.00 ± 3.61
Friedman’s test		
F	16.27	7.17
P	0.57 (NS)	0.62 (NS)

NS: Not significant, SD: Standard deviation

Table 5: Assessment of early recovery

Recovery criteria	Mean ± SD or %
Time taken to obey commands (min)	42.60 ± 9.09
Time taken to for full orientation (min)	47.85 ± 8.18
Time taken for spontaneous eye opening (min)	43.45 ± 9.11
Time taken to count backwards (min)	50.90 ± 9.14
Positive face hand test at 15 (min)	100
Aldrete score at 15 (min)	11.65 ± 0.75
Time to reach Aldrete score 12/12 (min)	15.90 ± 1.89

SD: Standard deviation

Table 6: Postoperative observations

Recovery criteria	n (%) / mean ± SD
Un-aided sitting time (min)	119.00 ± 20.56
Picture card test score (out of 10)	5.80 ± 1.47
Picking up matches test (7 matches in s)	67.95 ± 5.72
Ball bearing test (number of marbles in 3 min)	9.80 ± 2.57
Time taken to walk (min)	172.25 ± 39.25
Time taken to void urine (min)	163.75 ± 55.96
Number of patients who had nausea/vomiting	0
Awareness of intraoperative events	0
Giddiness	0
Headache	0
Pain at IV site	0
Consent for repeat anesthetic	18 (90)
Others (chills)	7 (35)

IV: Intravenous, SD: Standard deviation

enable the patient to return rapidly to normal activities with minimal reliance on recovery room staff or support at home. The present study evaluated propofol for induction and maintenance of anesthesia and its usefulness in orthognathic surgeries.

Induction and intubation

Rapid and smooth induction is expected in any good anesthetic technique. Propofol causes smooth loss of consciousness in one arm-brain circulation, but many patients (as high as 50%) complained of moderate to severe pain as the drug is being injected. Many methods have been developed to obviate this pain. McCluskey *et al.*^[11] showed that the addition of lidocaine to propofol reduced the pain significantly. Picard and Tramer^[12] reported in their review that among the 100 patients

treated with lidocaine 40 mg with a rubber tourniquet at the forearm for 30–120 s before the injection of propofol, approximately, 60 will not have any pain who would have had pain had they not received lidocaine.

In general, propofol is a safe anesthetic agent. However, as quoted by Bienert *et al.*^[9] propofol infusion syndrome is a rare and potentially lethal adverse drug event associated with high doses (>4 mg/kg/h or >67 µg/kg/min) and long-term (>48 h) use of propofol. Furthermore, it can be observed with lower doses and after shorter duration of sedation. Neuroexcitatory events including gross movements, tremor, twitching, and hiccough during induction are other drawbacks of propofol as reported by Garg and Dehran.^[13] However, none of the patients in our study had any such effects.

Maintenance of anesthesia

The anesthetic technique should provide adequate depth of anesthesia to suit surgical needs and cardiorespiratory stability. Maintenance of anesthesia in all the cases of our study was done, administering a step-down continuous infusion technique to maintain hemodynamic stability. This was also suggested by Bennet *et al.*,^[14] comparing the use of traditional bolus technique with continuous infusion technique for administration of propofol. Five patients (25%) needed supplements of anesthetic, due to lack of coordination of anesthesia time, and surgical time. The effect of propofol on respiratory system could not be documented since controlled ventilation was used intraoperatively. All patients received supplemental O₂ after extubation and in the recovery room. There was no fall in SPO₂ in any of the patient at any time, similar to the findings of Bennett *et al.*^[14]

Hemodynamic effects

Propofol is a cardiovascular depressant. Induction with propofol causes hypotension. In this study, none of the patients had hypotension as the patients were preloaded with Ringer's lactate infusion before induction. Risk factors associated with a higher incidence of hypotension are old age, patients with cardiac disease, concomitant use of opioids, etc.

Blood pressure (mean)

In the present study, the baseline mean arterial pressure (MAP) was 86.70 ± 7.33 mm of Hg. After induction, the MAP was 84.40 ± 15.87 mm of Hg, but the difference was insignificant. This finding corroborates with the findings of Dárdai and Szeredi.^[15] In contrast, Galletly and Larsen^[16] reported significant fall in MAP which may be attributed to the fact that majority of the patients belonged to ASA III and IV grades and underwent major vascular and neurosurgical procedures.

Heart rate

In the present study, the baseline mean HR was found to be 82 ± 11.36. None of the patients suffered from bradycardia after induction which may be probably because of the protective effect of parasympatholytic premedication with glycopyrrolate. The lowest value recorded in our study was 53 beats/min. However, the differences were not significant; HRs started falling slightly after 10 min of intubation and gradually reached baseline values 5 min later in the recovery room, coinciding with the findings of Dárdai and Szeredi.^[15] This reduction in HR might be attributed to the additive effects of propofol, fentanyl, and vecuronium bromide. Of note, propofol did not produce much change in mean BP and HR and aided in cardiovascular stability in ASA-I patients, as in studies done by Gimenes *et al.*^[17] and Dárdai and Szeredi.^[15]

The average blood loss in orthognathic surgeries with general anesthesia involving inhalational agents varies between 300 and 500 ml depending on surgical technique. In this study, the average blood loss is 250 ml. A reduced amount of blood loss may be due to lack of hypertensive peaks in total intravenous anesthesia (TIVA). As our study involved small sample, further evaluation should be done pertaining to this aspect.

Recovery from anesthesia

Speed of recovery is the primary end point in trials investigating anesthesia for day-care surgery. To fully evaluate patient recovery, all phases of recovery should be considered. In this study, early recovery or emergence from anesthesia has been measured by the time taken to obey oral commands, to become fully oriented and spontaneous eye opening, by the face-hand test and modified Aldrete scores.

The intermediate recovery or fitness to go home has been assessed using cognitive and psychomotor function tests namely, time taken to count backward, picture card tests, picking up matches, and ball bearing test.

The patients in our hospital, who underwent various orthognathic surgical procedures, are not discharged the same day because of administrative reasons. Hence, instead of assessing the discharge time this study has assessed the time taken to sit up unaided, time taken to walk, to tolerate oral fluids, and to avoid urine. This was in accordance with Korttila's^[18] study on the stages of recovery, guidelines for safe discharge, and various reasons for unanticipated hospital admission. Assessment of late phase of recovery that needs sophisticated equipment has not been carried out in our study.

In the present study, propofol, when used for both induction and maintenance significantly, shortened

the time to obey simple commands, full orientation and eye opening to approximately 7, 9, and 10 min. Korttila *et al.*^[19] also concluded that patients undergoing ambulatory surgery propofol infusion is preferable to thiopentone-isoflurane anesthesia because it may allow faster discharge home. Valanne^[20] observed a similar difference in time to full orientation (11 vs. 16.5 min) when comparing maintenance using propofol versus isoflurane in dental surgery. In our study, the mean time to obey oral commands, full orientation, and spontaneous eye opening were 42, 43, and 47 min, respectively. When compared to other studies,^[21-23] these values were reasonably high as the assessment of recovery was made after stopping the propofol infusion. Propofol infusion was stopped 30 min before the end of surgery, anticipating speedy recovery and to minimize the rebound effect of propofol, as the duration of surgeries was relatively long (4 h).

Limitations of above-mentioned tests may be wrong assessments if there are problems of communication (hearing deficit, language) or residual neuromuscular paralysis. In addition, there might be observer variations. Face-hand test is based on the principal that a touch on the face is more readily perceived than a simultaneous touch of equal intensity and duration applied to the hand. This test is found to be a sensitive test for assessment of recovery in adults. In the present study, the test was performed at 15 min after extubation.

At this time, all the patients were fully oriented and were able to obey oral commands. All the patients demonstrated positive face-hand test, confirming minimal residual effects of propofol being used as TIVA. This correlates with the findings of Korttila *et al.*^[19]

Maintenance of airway, breathing, and circulation are as important as return of consciousness. Many scoring systems have been devised to objectively assess the recovery and guide the transfer of patients from operating room to recovery area. Steward's scale assesses three parameters (level of consciousness, movement, and respiration) to grade recovery. The Aldrete score assigns a score of 0, 1, or 2 for activity, respiration, consciousness, skin color, BP, and HR. A score of 12 indicates the best possible condition and the patients do not need intensive monitoring or nursing care.

In all the patients in our study, the Aldrete score at 15 min and the time taken to reach a score of 12/12 were noted. The mean score at 15 min was 11.65 and the average time taken to reach 12/12 was 15.90 min. This shows propofol is excellent as far as early recovery is concerned. The patients anesthetized with propofol need close attention only for the first 15 min after extubation and thereafter can be safely left unattended

with only routine monitoring and nursing care. This is in corroboration with previous research.^[23] In this study, 90% (18/20) patients were treated with rigid fixation that enabled us to avoid postoperative airway complications. Only 10% (2/20) of patients required intermaxillary fixation who did not show anticipated airway complications. Contrary to the findings of Knolle *et al.*,^[24] Rai *et al.*^[25] and Lallo *et al.*,^[26] who claimed difficulty in airway management with propofol, we did not come across any of the complications in our patients.

Assessment of intermediate phases of recovery

There is uniform acceptance in the assessment of early phase of recovery. But so far there has been no consensus in criteria and tests to assess intermediate phase of recovery or home readiness.

Counting backward

Korttila *et al.* performed the test by asking the patients to subtract "3" repeatedly from "107" until "50" is reached. This was slightly modified in our study to accommodate the wide variation in literacy level of our patients. The familiarity of the patient with numbers was assessed preoperatively and if needed they were asked to count backward in two's or tens from 100, 50, or 20 and baseline performance was noted. Postoperatively, the test was first carried out after the patients was fully oriented and then, repeated every 2 min till the baseline performance was reached. It was found that the average time taken was around 50 min.

Picture card test

Following anesthesia, the ability to learn new facts or experiences and recall them after a short lapse of time is often severely impaired for long periods, even after the full recovery of other mental functions. Most of the patients in our study were able to recall only 5–6 out of 10 objects in the picture card after a lapse of 30 min, the exact mean value being 5.80 ± 1.47 . This finding is in corroboration with the findings of Pawar and Malde.^[27]

Picking up matches

The test required recovery of visual perception, motor recovery, and eye-hand coordination. In our study, the task was completed with an average time of 68 s.

Ball bearing test

Requires recovery of manual dexterity and coordination to a greater extent than the previous test. In this study, on average they were able to pick up only 9–10 balls in 3 min.

Counting backward test demonstrated that propofol affected past memory (ability to recall numbers) to a lesser extent. However, learning new facts after anesthesia and

recent memory were seen to be difficult as shown by poor performance in picture card test. Similarly, motor activity requiring finer movements and coordination seemed to be difficult in all the patients after TIVA using propofol. Cillo^[28] also experienced similar findings.

Discharge criteria

Each hospital has its own criteria for discharge depending on the facilities available, the type of patients, and the surgery performed. In our hospital, the patients who underwent surgery are discharged only the next day because of administrative reasons. Hence, outcome measures such as discharge time, hospital cost, and unplanned readmission rate could not be studied. Instead, in our study, the time taken for un-aided sitting, to walk without support to tolerate oral fluids and to void urine has been studied. Fulfillment of these criteria is desirable before discharge following orthognathic surgery.

It is evident that the time taken to sit up, walk, drink, and void urine is considerably shorter using TIVA with propofol. They seemed more alert and confident and were enthusiastic and cooperative for early ambulation and in performing psychomotor function tests, which was observed in almost all of our patients.

CONCLUSION

Based on the results of present study, propofol, a short-acting IV anesthetic agent, is excellent for use for induction and maintenance of anesthesia among patients undergoing various combinations of orthognathic surgical procedures. The objectives of anesthesia for ambulatory surgery, including rapid onset, swift emergence with few side effects, and a favorable safety profile, were achieved by propofol. None of the patients had hypotension, and no significant change was observed in HR and BP. Propofol provides sound sedation or anesthesia with a quick on/offset that is ideal for treatment in an outpatient setting for those who are properly trained and equipped in the administration of deep sedation and general anesthesia. Early and intermediate recovery was also found to be satisfactory.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Faigel DO, Baron TH, Goldstein JL, Hirota WK, Jacobson BC, Johanson JF, *et al.* Guidelines for the use of deep sedation and anesthesia for GI endoscopy. *Gastrointest Endosc* 2002;56:613-7.
2. American Society of Anesthesiologists Task Force on Sedation and Analgesia by Non-Anesthesiologists. Practice guidelines for sedation and analgesia by non-anesthesiologists. *Anesthesiology* 2002;96:1004-17.
3. Sedation and monitoring of patients undergoing gastrointestinal endoscopic procedures. American Society for Gastrointestinal Endoscopy. *Gastrointest Endosc* 1995;42:626-9.
4. Jung M, Hofmann C, Kiesslich R, Brackertz A. Improved sedation in diagnostic and therapeutic ERCP: Propofol is an alternative to midazolam. *Endoscopy* 2000;32:233-8.
5. Wehrmann T, Kokabpik S, Lembcke B, Caspary WF, Seifert H. Efficacy and safety of intravenous propofol sedation during routine ERCP: A prospective, controlled study. *Gastrointest Endosc* 1999;49:677-83.
6. Vargo JJ, Zuccaro G Jr., Dumot JA, Shermock KM, Morrow JB, Conwell DL, *et al.* Gastroenterologist-administered propofol versus meperidine and midazolam for advanced upper endoscopy: A prospective, randomized trial. *Gastroenterology* 2002;123:8-16.
7. Nelson DB, Barkun AN, Block KP, Burdick JS, Ginsberg GG, Greenwald DA, *et al.* Propofol use during gastrointestinal endoscopy. *Gastrointest Endosc* 2001;53:876-9.
8. Bryson HM, Fulton BR, Faulds D. Propofol: An update of its use in anaesthesia and conscious sedation. *Drugs* 1995;50:513-59.
9. Bienert A, Wiczling P, Grzeskowiak E, Cywinski JB, Kusza K. Potential pitfalls of propofol target controlled infusion delivery related to its pharmacokinetics and pharmacodynamics. *Pharmacol Rep* 2012;64:782-95.
10. Mellin-Olsen J, Staender S, Whitaker DK, Smith AF. The Helsinki declaration on patient safety in anaesthesiology. *Eur J Anaesthesiol* 2010;27:592-7.
11. McCluskey A, Currer BA, Sayeed I. The efficacy of 5% lidocaine-prilocaine (EMLA) cream on pain during intravenous injection of propofol. *Anesth Analg* 2003;97:713-4.
12. Picard P, Tramèr MR. Prevention of pain on injection with propofol: A quantitative systematic review. *Anesth Analg* 2000;90:963-9.
13. Garg R, Dehran M. Convulsions with propofol: A rare adverse event. *J Postgrad Med* 2009;55:69-71.
14. Bennett J, Shafer DM, Efav D, Goupil M. Incremental bolus versus a continuous infusion of propofol for deep sedation/general anesthesia during dentoalveolar surgery. *J Oral Maxillofac Surg* 1998;56:1049-53.
15. Dárdai E, Szeredi L. Comparison of propofol-fentanyl or midazolam-fentanyl intravenous anaesthesia for carotid endarterectomy. *Acta Chir Hung* 1998;37:177-82.
16. Galletly DC, Larsen PD. Cardioventilatory coupling during anaesthesia. *Br J Anaesth* 1997;79:35-40.
17. Gimenes AM, de Araujo Aguiar AJ, Perri SH, de Paula Nogueira G. Effect of intravenous propofol and remifentanyl on heart rate, blood pressure and nociceptive response in acepromazine premedicated dogs. *Vet Anaesth Analg* 2011;38:54-62.
18. Korttila K, Tammisto T, Ertama P, Pfäffli P, Blomgren E, Häkkinen S. Recovery, psychomotor skills, and simulated driving after brief inhalational anesthesia with halothane or enflurane combined with nitrous oxide and oxygen. *Anesthesiology* 1977;46:20-7.
19. Korttila K, Ostman P, Faure E, Apfelbaum JL, Prunskis J, Ekdawi M, *et al.* Randomized comparison of recovery after propofol-nitrous oxide versus thiopentone-isoflurane-nitrous oxide anaesthesia in patients undergoing ambulatory surgery. *Acta Anaesthesiol Scand* 1990;34:400-3.

20. Valanne J. Recovery and discharge of patients after long propofol infusion vs. isoflurane anaesthesia for ambulatory surgery. *Acta Anaesthesiol Scand* 1992;36:530-3.
21. O'Hare RA, Mirakhur RK, Reid JE, Breslin DS, Hayes A. Recovery from propofol anaesthesia supplemented with remifentanyl. *Br J Anaesth* 2001;86:361-5.
22. Ortolani O, Conti A, Chan YK, Sie MY, Ong GS. Comparison of propofol consumption and recovery time in Caucasians from Italy, with Chinese, Malays and Indians from Malaysia. *Anaesth Intensive Care* 2004;32:250-5.
23. Khalid A, Siddiqui SZ, Aftab S, Sabbar S, Haider S. Recovery profile – A comparison of isoflurane and propofol anesthesia for laparoscopic cholecystectomy. *J Coll Physicians Surg Pak* 2008;18:329-33.
24. Knolle E, Oehmke MJ, Gustorff B, Hellwagner K, Kress HG. Target-controlled infusion of propofol for fiberoptic intubation. *Eur J Anaesthesiol* 2003;20:565-9.
25. Rai MR, Parry TM, Dombrovskis A, Warner OJ. Remifentanyl target-controlled infusion vs. propofol target controlled infusion for conscious sedation for awake fiberoptic intubation: A double blind randomized controlled trial. *Br J Anaesthesiol* 2008;100:125-30.
26. Lallo A, Billard V, Bourgain JL. A comparison of propofol and remifentanyl target-controlled infusions to facilitate fiberoptic nasotracheal intubation. *Anesth Analg* 2009;108:852-7.
27. Pawar S, Malde A. Time course of psychomotor, cognitive and ambulatory recovery after propofol day case anesthesia: A randomized double blind study. *Internet J Anesthesiol* 2010;23(1).
28. Cillo JE Jr. Propofol anesthesia for outpatient oral and maxillofacial surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1999;87:530-8.