Original Research Article

A Comparative Analysis between Desflurane and Propofol as Single Agent Anesthesia

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Abstract

Background: There is an ongoing quest to know which agent is the best for induction as well as maintenance of anesthesia. Desflurane is known to have a rapid onset and offset of action, thereby making it possible for the anesthetist to control the depth of anesthesia rapidly. Intravenous propofol with raid induction and recovery is currently a popular induction agent for surgical anesthesia. The present study was thus carried out to compare desflurane and propofol as single agent anesthesia in short elective surgeries.

Materials and methods: In this hospital based prospective comparative study, 60 patients scheduled for elective short surgery were taken. After routine pre-anesthetic work up, patients were induced with either **Group D:** O_2:N_2O (50:50) + Desflurane 3-4% or; **Group P:** O_2:N_20 (50:50) + Propofol 3-5 mg/kg. Baseline parameters, relevant intra-op details, ease of procedure, hemodynamic changes, recovery, and complication rate were compared between both groups. Statistical analysis was done using SPSS ver. 21.

Results: Baseline variables and other parameters like jaw opening, attempts for LMA and ease of insertion was comparable in both the groups ($p> 0.05$). Time to loss of consciousness and time to LMA insertion was significantly shorter with Propofol ($p<0.05$). Mean pulse rate and MAP was significantly higher in Desflurane group ($p< 0.05$). The Bispectral Index value and RASS score were comparable in both groups after 2 min. and 40 min. respectively. Modified Aldrete score was significantly higher in Desflurane group while Complication rate was comparable.

Conclusion: Inhaled desflurane provided acceptable conditions for LMA insertion and the intra-operative hemodynamic profile during anesthesia was stable. Desflurane can be considered as an

alternative induction agent when inhalational induction is required; bearing in mind that caution still needs to be exercised when desflurane is used in this manner.

Key words

Anesthesia, Desflurane, Inhalational agent, Propofol, Short elective Surgery.

Introduction

"There is an ongoing quest to know which agent is the best for induction as well as maintenance of anesthesia. Agents which show excellent induction and maintenance characteristics may not necessarily provide ideal recovery profile".

Desflurane is known to have a rapid onset and offset of action, thereby making it possible for the anesthetist to control the depth of anesthesia rapidly. It also appears to provide fairly cardiostable anesthesia with preservation of tissue perfusion even in face of hypotension [1]; however it is said to be irritating to the airway and therefore is not commonly used for inhalational induction [1, 2]. However, two studies have shown that controlled desflurane induction along with opioid premedication can be rapid and well tolerated [3, 4]. Another study has shown that addition of fentanyl reduced the incidence of cough from 25% to 5% [5]. Furthermore, premedication with both midazolam and fentanyl has also helped to markedly attenuate airway irritability [6].

Intravenous propofol is currently a popular induction agent for surgical anesthesia. Propofol has largely replaced sodium thiopental for induction of anesthesia as recovery from propofol is more rapid and clear as compared to thiopental. Despite the frequent use of propofol for the induction and maintenance of anesthesia for brief surgical procedures, volatile induction and maintenance of anesthesia (VIMA) remains appealing due to the theoretical advantages of enhanced safety and recovery as a result of monopharmacy [7]. Also VIMA does not require the use of expensive syringe pumps and has the added advantage of giving precise concentration of anesthetic agent.

As the least soluble agent (blood gas partition coefficient of 0.42), desflurane is eligible as an ideal inhaled anesthetic in such cases. However, many anesthesiologists feel that its pungent odor and tendency to irritate the upper airway make it unsuitable for maintenance, and more specifically, for induction of anesthesia. However, several studies [5, 6, 8] have demonstrated that desflurane can be used in inhalation induction, which may be useful as an alternative to intravenous propofol/ neuromuscular blocking drug induction if the maintenance of spontaneous ventilation is preferred or if anesthesia is required for brief procedures in patients with hemodynamic instability or hypovolemia. In such clinical situations, the use of a laryngeal mask airway (LMA) may also be beneficial because it is easy to place and does not require muscle relaxation. Inhalation induction with desflurane alone causes adverse airway events, such as coughing, bronchospasm, laryngospasm, and copious secretion of varying severity [6, 9]. However, these adverse airway responses seem to be related to acute administration at high concentrations [10] and inadequate doses or drugs as adjunctive medication [6, 11].

Therefore, we postulated that desflurane inhalation induction in combination with nitrous oxide (N2O) and a moderate dose (3 μg/kg) of fentanyl would be sufficient to optimize insertion conditions for an LMA and prevent the side effects caused by desflurane alone, when administered using a normal tidal volume breathing technique with a low initial inspired concentration followed by gradual increases. The present study was thus carried out to compare desflurane and propofol as single agent anesthesia in short elective surgeries.

Materials and methods

In this hospital based prospective comparative study, 60 patients scheduled for elective short surgery were taken. After obtaining consent from institutional ethical committee, and written informed valid consent, patients were divided into two groups of 30 each.

Inclusion criteria

- Age group- 18 to 60 years
- ASA grade I – II
- Elective short surgeries – requiring general anesthesia with laryngeal mask airway placement e.g. fibroadenoma, hernia, fistula, appendicitis.

Exclusion criteria

- Allergy to propofol /Egg allergy
- History of upper respiratory tract infection within 1 month of surgery
- Documented uncontrolled hypertension/chronic obstructive pulmonary disease
- Addiction to alcohol/drug abuse

Pre-operative preparation and examination

On the night before surgery, patients were visited and were explained about the type of surgery, anesthesia, post-operative pain relief, rescue medication etc. Visual Analogue Scale was shown to the patients and ability of patients to understand it was confirmed. Complete clinical examination of the patient was done including vitals like pulse, systolic and diastolic blood pressure, and examination of cardio respiratory, CNS and abdominal systems.

Anesthetic technique

Patients were taken to the operation theatre after confirming NBM status and written informed valid consent were checked. Following preloading with ringer's lactate 5-8 ml/kg and premedication with Glycopyrrolate 0.004 mg/kg, Fentanyl 3 mcg/kg and Midazolam 0.03 mg/kg, anesthesia was induced with:

Group D: O_2:N_2O (50:50) + Desflurane 3-4% by the tidal volume induction technique, stepping up by 1% with each breath until the loss of consciousness; or

Group P: O_2:N_20 (50:50) + Propofol 3-5mg/kg

Appropriate size LMA was chosen, lubricating jelly was applied over back of LMA, cuff was deflated and gently introduced by placing head and neck in neutral position, when the jaw is relaxed. Once positioned correctly, cuff was inflated with appropriate cuff inflation volume and LMA was connected to circuit. BIS was maintained between 40 to 60.

Maintenance:

Group D- O_2:N_2O (50:50) + desflurane (1-2%)

Group P- O_2:N_2O (50:50) + propofol 4 mg/kg/hr

Total propofol requirement was noted as mg/kg/hr at the end of surgery. Patients were monitored following induction to removal of LMA in post-operative recovery room for 1 hour. For each of the groups, the following were monitored: Conditions during LMA insertion: time to loss of consciousness, time to insertion of LMA, jaw opening, ease of insertion, number of attempts in both desflurane and propofol group.

Degree of jaw opening

Good: Jaw fully opened

Moderate: Jaw partially opened

Poor: Jaw needed to be prized open

Ease of insertion

Good: Insertion smooth and easy

Moderate: Insertion followed by cough, gag, excitatory movement that were self-limited and settled without intervention

Poor: Insertion was met with resistance and cough, gag, or excitatory movement that required treatment with propofol.

Hemodynamic changes were noted for every minute for first five minutes, then at 10 minutes interval till five minutes before propofol/ desflurane stopped. Any complication following induction to removal of LMA was also noted. Patients who complained of pain (as shown by visual analogue scale 3 or more) were given

rescue analgesic medication in the form of tramodol 100 mg IV and timing of rescue analgesic medication was noted.

Recovery scale used

- Modified Aldrete Scale: for discharge of patient
- RASS: for post-operative agitation and sedation
- Visual analogue scale

Statistical Analysis

Analysis of data was done by using SPSS software ver. 21. Data were statistically described in terms of mean (±SD), frequencies (number of cases) and percentages when appropriate. Data were tested first for normal distribution by Klomogorov - Smirnov test. Comparison of quantitative variables between the study groups was done using Student t test for independent samples if normally distributed. Mann–Whitney U test was used for non-normally distributed quantitative and ordinal data. For comparing categorical data, Chi square test was performed. Exact test was used instead when the expected frequency is less than 5. A probability value (p value) less than 0.05 was considered statistically significant.

Results

The two groups were comparable with respect to demographic characters like age, sex, weight and ASA grade and duration of surgery (p> 0.05). Jaw opening, attempts for LMA and ease of insertion was also comparable in both the groups (p> 0.05) (**Table - 1** and **Table - 2**). Time to loss of consciousness in Desflurane and Propofol groups was 238.30 sec and 41.60 sec respectively (p< 0.05). Time to LMA insertion was significantly shorter with Propofol group when compared with Desflurane group (52.87 sec vs 37 sec; p<0.05) (**Table - 3**). In our study mean pulse rate from 0 min to 65 min and mean arterial pressure at 0 min and from 5 min to 65 min was statistically significantly higher in Desflurane group in comparison to Propofol group (p< 0.05) (**Graph - 1** and **Graph - 2**). The Bispectral Index value at 0 min and 1min for desflurane was 74.87 and 68.93 in comparison to propofol which was 72.83 and 66.60 respectively (p< 0.05), while it was comparable in both groups after that (**Graph - 3**). RASS scale was significantly higher in Desflurane from 0 min to 30 min in comparison to Propofol (p< 0.05), whereas no significant difference in RASS scale was found in two groups from 40 min to 60 min (**Table - 4**). Modified Aldrete score was significantly higher in Desflurane in comparison to Propofol from 0min to 60min following extubation to 1hr stay in recovery room (p< 0.05) (**Table - 5**). Mean VAS score for Desflurane at 20 min and 30 min was 0.57 and 0.60 and for Propofol 0.20 and 0.27 respectively (p< 0.05) (**Table - 6**). Complication rate was comparable between Desflurane and propofol groups (13.3% vs 6.7%; p- 0.671) (**Table - 7**).

Table – 1: Comparison of Baseline variables among study groups.

Variable	Desflurane (n-30)		Propofol (n-30)		p-value
	Mean	SD	Mean	SD	
Age	28.80	12.14	25.43	7.30	0.20
Weight (Kg)	50.20	4.58	49.40	3.38	0.45
Duration of surgery (min)	54.67	12.99	59.17	11.82	0.17

Discussion

The purpose of our study was to compare Desflurane verses Propofol as single agent anaesthesia. The two groups were comparable with respect to demographic characters like age, sex, weight and ASA grade and duration of surgery (p> 0.05). Jaw opening, attempts for LMA and ease of insertion was also comparable in both the groups (p> 0.05).

Table – 2: Comparison of Pre-operative parameters among study groups.

Variable	Desflurane (n-30)		Propofol (n-30)		p-value
	N	%	N	%	
ASA grade I	30	100.0%	30	100.0%	1.00
Good Jaw Opening	25	83.3%	27	90.0%	0.71
Single attempt for LMA	26	86.7%	27	90.0%	1.00
Ease of Insertion - Good	26	86.7%	24	80.0%	0.49

Table – 3: Comparison of time for loss of consciousness and LMA insertion among study groups.

Variable	Desflurane (n-30)		Propofol (n-30)		p-value
	Mean	SD	Mean	SD	
Time to loss of consciousness (Sec)	238.30	57.93	41.60	8.56	< 0.01
Time to LMA insertion (Sec)	52.87	10.31	37.00	12.02	< 0.01

Table – 4: Comparison of RASS score among study groups.

RASS Score	Desflurane (n-30)		Propofol (n-30)		p-value
	Mean	SD	Mean	SD	
0 min	-0.53	0.507	-1.97	0.669	< 0.01
10 min	-0.1	0.305	-1.8	0.484	< 0.01
20 min	0	0	-1.1	0.548	< 0.01
30 min	0	0	-0.83	0.379	< 0.01
40 min	0	0	-0.13	0.346	0.375
50 min	0	0	0	0	1.0
60 min	0	0	0	0	1.0

Table – 5: Comparison of Aldrete score among study groups.

Aldrete Score	Desflurane (n-30)		Propofol (n-30)		p-value
	Mean	SD	Mean	SD	
0 min	8.57	0.568	7.77	0.43	< 0.01
10 min	9.27	0.521	8.17	0.461	< 0.01
20 min	9.87	0.346	8.67	0.479	< 0.01
30 min	10	0	8.87	0.346	< 0.01
40 min	10	0	8.97	0.183	< 0.01
50 min	10	0	9.23	0.43	< 0.01
60 min	10	0	9.37	0.49	< 0.01

Time for loss of consciousness and LMA insertion was significantly shorter in Propofol group. Our study was in agreement with Wai May Leong and Ee Lyn Ong [8] who did a prospective study on LMA insertion with Desflurane induction. Eighty patients undergoing elective surgery were randomized into two groups to receive either 2.5mg/kg propofol (n= 40) or tidal breath desflurane (n = 40) induction followed by LMA insertion. Time to loss of consciousness (s) was 104.1 ±32.1 in Desflurane group as compared to 57.5 ±17.9 in Propofol group while insertion of the LMA was also faster in propofol group (131.8 sec vs 228.6 sec; p<

0.01). Wrigley, et al. [12] compared induction and recovery characteristics of Desflurane with Propofol in 60 day care patients. Desflurane caused loss of consciousness in approximately 2 minutes during gaseous inductions. There was also a tendency for other recovery parameters to be faster in the patients receiving Desflurane though non-significant. They concluded that Desflurane would be a suitable agent for day care anaesthesia providing for a rapid recovery.

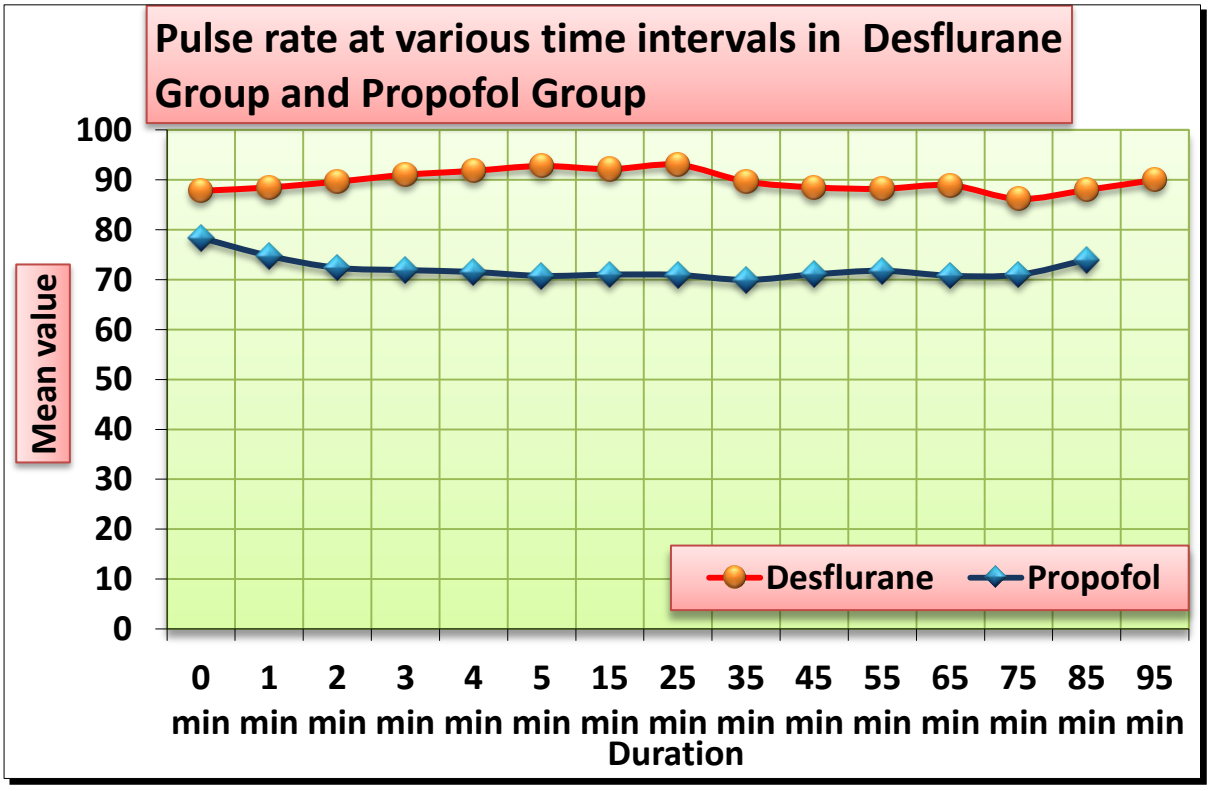
Table – 6: Comparison of VAS score among study groups.

VAS Score	Desflurane (n-30)		Propofol (n-30)		p-value
	Mean	SD	Mean	SD	
0 min	0	0	0.03	0.183	< 0.01
10 min	0.07	0.254	0.1	0.305	< 0.01
20 min	0.57	0.504	0.2	0.484	< 0.01
30 min	0.6	0.498	0.27	0.583	< 0.01
40 min	0.97	0.183	1.17	0.379	< 0.01
50 min	1	0.263	1.3	0.535	< 0.01
60 min	1.5	0.63	1.97	0.414	< 0.01

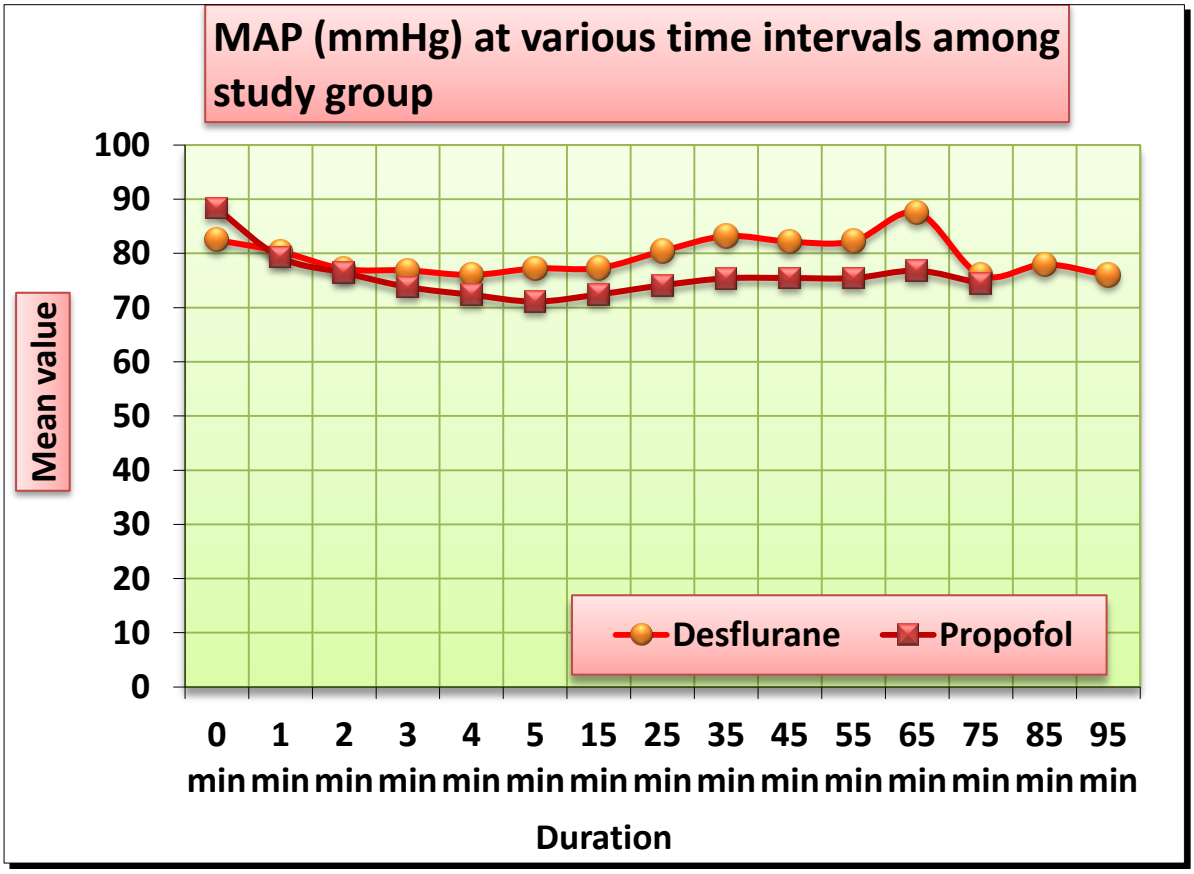
Table – 7: Comparison of complications among study groups.

Complications	Desflurane (n-30)		Propofol (n-30)		p-value
	N	%	N	%	
Cough	4	13.3%	2	6.7%	0.67
Nausea/ Vomiting	4	13.3%	2	6.7%	0.67

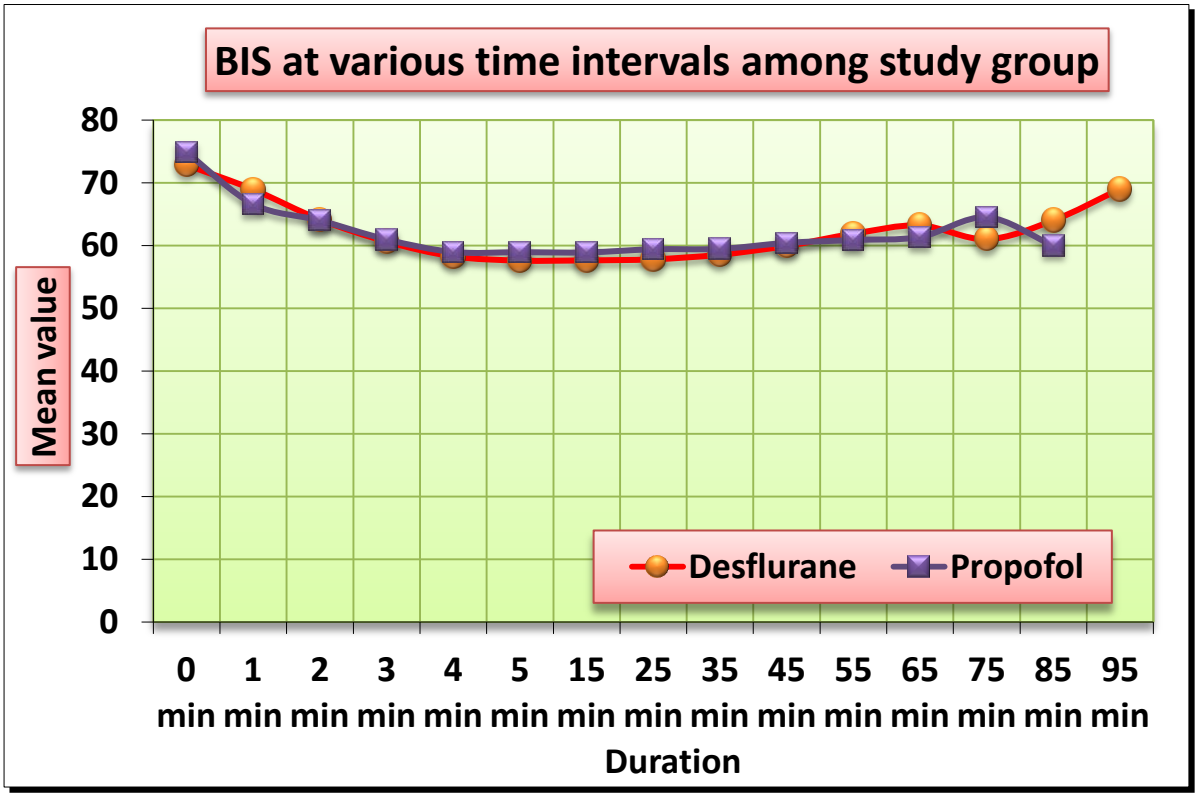
Graph – 1: Pulse rate at various time intervals in Desflurane group and Propofol group.



Graph – 2: MAP (mmHg) at various time intervals among study group.



Graph – 3: BIS at various time intervals among study group.



Mean pulse rate and MAP was significantly higher in Desflurane in comparison to Propofol. Desflurane produces greater sympathetic stimulation, and this stimulation becomes manifest at concentrations greater than 1 MAC [13]. The result of stimulation may be both a greater tendency to sustain cardiac output and blood pressure, and a greater effect on heart rate. Thus, at concentrations above 1 MAC (but not below 1 MAC), steady-state concentrations of desflurane produce a dose-related increase in heart rate. In addition, again at concentrations exceeding 1 MAC, abrupt increases in the imposed concentration of desflurane can cause transient (2-4 min) increases in blood pressure.

The BIS value at 0 min and 1 min for desflurane was 74.87 and 68.93 in comparison to propofol which was 72.83 and 66.60 respectively ($p< 0.05$). This was expected because desflurane concentrations were increased in a controlled stepwise fashion by tidal volume induction technique as compared to propofol.

Modified Aldrete score was significantly higher in Desflurane group in comparison to Propofol group from 0 min to 60 min following extubation to 1 hour stay in recovery room ($p<0.05$). RASS scale was significantly higher in Desflurane group from 0 min to 30 min in comparison to Propofol group whereas no significant difference in RASS scale was found in two groups from 40 min to 60 min. This was in agreement with study by Dajun Song, et al. [14] who compared Desflurane, Sevoflurane and Propofol for maintenance of anaesthesia and discharge criteria on arrival in the post anaesthesia care after Laproscopic tubal ligation surgery. They found that compared with the Propofol group, the times to awakening and to achieve a recovery score of 10 were significantly shorter. They concluded that compared with Propofol, Desflurane and Sevoflurane resulted in a higher percentage of outpatients being judged eligible for fast-tracking.

In our study, mean value for Visual Analogue Scale (VAS) for Desflurane at 20min and 30 min was 0.57 and 0.60 and for Propofol 0.20 and 0.27 respectively. This was significantly higher for Desflurane in comparison to Propofol group statistically ($p<0.05$). This was due to the rapid recovery profile of Desflurane leading to early weaning from anaesthesia in comparison to Propofol. However no analgesic was given at the end of surgery, as VAS never exceeded beyond 3. In our study we have tramadol 100 mg as rescue analgesia if VAS >3. So, both groups had no rescue analgesia requirement in the post-operative recovery room. Therefore we concluded that postoperative analgesia requirement was not clinically significant in both groups.

None of the patient had nausea/vomiting during induction and maintenance in Desflurane and Propofol group. During recovery, 4 patients in Desflurane group and 2 patients in Propofol group had associated nausea and vomiting. However, we found no statistical significance in both groups in the study ($p>0.05$). Gupta, et al. [15] compared recovery profile after ambulatory anesthesia with propofol, isoflurane, sevoflurane and desflurane in a systemic review and found out no differences between propofol and isoflurane in early recovery. However, early recovery was faster with desflurane compared with propofol and isoflurane and with sevoflurane compared with isoflurane ($p<0.05$).

In our study 13.3% of patients had cough with Desflurane during induction compared to 6.7% in Propofol group ($p>0.05$). This was in agreement to study by Yong, et al. [16] who studied Desflurane requirements for laryngeal mask airway insertion during inhalation induction in 22 patients. They postulated that desflurane inhalation induction in combination with nitrous oxide (N_2O) and a moderate dose (1.5 μg/kg) of fentanyl would be sufficient to optimize insertion conditions for an LMA and prevent the side effects caused by desflurane alone (coughing, laryngospasm, gag), when administered using a normal tidal volume breathing technique with a

low initial inspired concentration followed by gradual increases. They demonstrated that N2O-desflurane inhalation induction with a normal tidal breathing technique after premedication with fentanyl can be used safely without any adverse airway events in nonparalyzed patients.

Our study was also in agreement with Wai May Leong and Ee Lyn Ong [8] who did a prospective study on LMA insertion with Desflurane induction. Eighty patients undergoing elective surgery were randomized into two groups to receive either 2.5mg/kg propofol (n = 40) or tidal breath desflurane (n = 40) induction followed by LMA insertion. Airway excitation and cough, a main concern during induction with desflurane, occurred in 5% of patients. This contrast in the incidence of airway irritation when compared to other studies (reported incidences of 26%–59%) could be explained by several factors [5].The addition of fentanyl has been reported to help attenuate airway irritability [5, 6]. The low blood gas solubility of desflurane could have permitted quick establishment of deep levels of anesthesia and ablation of airway reflexes when delivered in this manner [6]. The use of nitrous oxide in conjunction with desflurane instead of just desflurane in oxygen could have helped to reduce the period of cough and excitation because the second gas effect enhances the uptake of desflurane [12]. Nitrous oxide itself has an anesthetic effect that is additive to that of desflurane [17]. Therefore induction is accelerated with decreased occurrences of excitation [18]. However, desflurane induction should still be used with caution even with the aid of fentanyl and nitrous oxide, given its potential to cause respiratory complications.

Conclusion

Propofol has better induction characteristics than Desflurane. Both agents provide good intra-op hemodynamic stability. Recovery characteristics were remarkably better in Desflurane than Propofol. However, airway irritability and postoperative analgesia requirement did not differ in both groups. In conclusion, inhaled desflurane provided acceptable conditions for LMA insertion and the intra-operative hemodynamic profile during anesthesia was stable. Desflurane can be considered as an alternative induction agent when inhalational induction is required; bearing in mind that caution still needs to be exercised when desflurane is used in this manner.

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