

Comparison of Airway Response and Early Versus Late Recovery Profile During Sevoflurane and Desflurane Administration Via Laryngeal Mask Airway for Maintenance of Anaesthesia

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Received: 10-06-2023 / Revised: 16-07-2023 / Accepted: 09-08-2023

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Conflict of interest: Nil

Abstract:

Objective: The aim of our study was comparison of airway response and early versus late recovery profile during Sevoflurane and Desflurane administration via laryngeal mask airway for maintenance of anaesthesia.

Methods: Prospective randomized controlled study, 56 ASA grade I or II patient, aged 19 - 60 years who were posted for minor surgical procedures were enrolled in the study from June 2015 to May 2016. Patients were divided in two groups– Desflurane – group D and – Sevoflurane - group S. Heart rate, Systolic blood pressure, Diastolic blood pressure, Oxygen Saturation, Respiratory rate were measured intraoperatively till the end of surgery (max 120 minutes). Incidence of respiratory events –coughing, breath holding and laryngospasm were recorded intraoperatively as well as in post operative period till the patient has achieved modified Aldrete score of 10.

Results: All the demographic characteristics, ASA grading, baseline vital parameters were comparable in both the groups. There was no statistical difference in the mean arterial systolic blood pressure between the two groups. No significant difference is observed in respiratory rate at induction, intraoperatively and postoperatively among both the groups. There was no statistical difference after induction up to the end of the procedure in SpO₂ between the groups. 1 patient had single emergent cough episode whereas 3 patients had multiple coughing episode at the time of emergence in Desflurane group. The time taken to open the eyes, to obey the verbal commands, the time taken for orientation and to achieve Modified Aldrete score 10 was shorter in the group which received Desflurane. The time taken to sit, to first oral intake, the time taken for standing and ambulate unassisted was again shorter in the group which received Desflurane than the group which received Sevoflurane which is statistically significant (P value < 0.001).

Conclusion: The emergence (eye opening, obey the verbal commands, orientation and Modified Aldrete score 10) from anaesthesia was faster following the administration of Desflurane compared to Sevoflurane. In the group which received Desflurane, the Aldrete score was higher on arrival at the time of emergence, and at 10 minutes of arrival in the ICU. The time taken to reach an Aldrete score of 9 was lower in the group which received Desflurane. Recovery in PACU (post anaesthesia care unit) – (sit, first oral intake, standing and ambulate unassisted) was faster following the administration of Desflurane compared to Sevoflurane.

Keywords: LMA [Laryngeal mask airway], MAC [Mean Anaesthesia Concentration], PACU [post anaesthesia care unit].

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Introduction

Laryngeal mask airway is effective for securing the airway in short surgical procedures. [1] it can be used without use of muscle relaxants. Volatile anaesthetics are indispensable components of a balanced anaesthesia technique. Mainly used for the maintenance of anaesthesia. [2] Desflurane are relatively new potent inhalational agents that are widely used in both pediatric and adult anaesthesia, by virtue of its superior recovery profiles. Sevoflurane widely used inhalational agent. it has low blood: gas partition coefficient used to provide rapid induction.

Pharmacokinetic and pleasant odour of Sevoflurane makes induction feasible. Desflurane and Sevoflurane both afford smooth and rapid recovery from general anaesthesia. [3,4]

Therefore this study was undertaken for comparison of airway response and early versus late recovery profile during Sevoflurane and Desflurane administration via laryngeal mask airway for maintenance of anaesthesia. [5]

Materials and Methods

Study Design: Prospective randomized controlled study was conducted in the multispeciality surgical operation theatre and post anaesthesia care unit of Fortis Escorts Hospital, Jaipur and Department of Anaesthesiology L. N Medical college, Bhopal.

Study population and duration of study 56 ASA grade I or II patient, aged 19 - 60 years who were posted for minor surgical procedures were enrolled in the study. Patients were divided in two groups– Desflurane – group D and – Sevoflurane - group S.

Inclusion Criteria:

- a. Patients with ASA Grading I and II
- b. Patients between 19-60 years of age.

Exclusion Criteria:

- a) Patients with ASA Grading III, IV and V.
- b) Patients below 19 years and above 60 years of age.
- c) Pregnant patients.
- d) Patient with a cardiovascular abnormality.
- e) Patient refusal to give written consent for the study.

Methodology

When patient was in operation room, after premedication and induction of anaesthesia with injection Propofol, LMA insertion was done. Once the LMA was positioned and spontaneous ventilation resumed the study drugs were administered with 50% N₂O at a maintenance total gas flow of 1lit/minute.

Desflurane and Sevoflurane concentrations were used between 0.3 and 1 MAC. MAC value was assumed to equal to 6% Desflurane and 1.85 Sevoflurane. Additional Propofol and opioid were given as bolus dose if required.

Heart rate, Systolic blood pressure, Diastolic blood pressure, Oxygen Saturation, Respiratory rate were measured intraoperatively till the end of surgery (max 120 minutes). Incidence of respiratory events – coughing, breath holding and laryngospasm were recorded intraoperatively as well as in post operative period till the patient has achieved modified Aldrete score of 10.

Once the surgery is over anaesthetic agents were discontinued, patient ventilated with 100% oxygen and the LMA was removed once patient had regained consciousness. We determined time from discontinuation of anaesthesia to eye opening, respond to command and orientation to time and place, at an interval of every 2 minutes. Modified Aldrete score was obtained at every 5 minute interval after discontinuation of anaesthesia. Finally time to be fit for discharge from PACU defined by sitting, first oral intake (20 ml. of water), standing and to ambulate unassisted was recorded every 15 minutes once the Modified Aldrete score of 10 is achieved.

Observation Chart

This study was conducted in a prospective and randomized manner. The following observations were recorded and results were statistically analyzed.

Table 1: Comparison of Demographic Data Among the Two Groups

S. No.	Characteristics	Group S (N=28)	Group D (N=28)	P value
1	Mean Age ±SD	39.21±11.75 (19-56)	33.28±11.13 (19-58)	0.05
2	Sex			0.60
	Male	13 (46.43)	15 (53.57)	
	Female	15 (53.57)	13 (46.43)	
3	Mean Ht ± SD	163.35±8.06 (150 - 178)	166.03±9.36 (144 – 181)	0.26
4	Mean Wt ± SD	69.46±8.51 (50 – 82)	68.64±9.54 (50 – 90)	0.73
5	Mean BMI ± SD	25.98±2.15	24.90±2.88	0.12

Table 2: Comparison of ASA Grading among the Two Groups

S. No.	ASA Grade	Group S N= 28 n (%)	Group D N=28 (%)	P value
1	ASA Grade I	19 (67.86)	20 (71.43)	0.77
2	ASA Grade II	9 (32.14)	8 (28.57)	

No significant difference observed in distribution of cases according to ASA grade in both the groups.

Table 3: Comparison of Baseline Vital Parameters in the two groups

S. No.	Vitals	Group S (N= 28) Mean ± SD	Group D (N= 28) Mean ± SD	p value
1	Heart Rate (per minute)	85.68±4.65 (76 – 92)	84.53±6.88 (67 – 98)	0.47
2	Systolic Blood pressure (mm Hg)	125.68±8.96 (112 – 148)	123.28±10.68 (98 - 146)	0.36
3	Diastolic Blood pressure (mmHg)	80.25±6.13 (68 – 94)	78.68±8.57 (60 – 94)	0.43
4	Spo ₂ (%)	98 [98,100]*	100 [98.5,100]*	0.04
5	Respiratory rate (per minute)	19.5±1.53 (16 – 22)	20.11±1.29 (18 – 22)	0.11

*The data presented in this manner are all Median [Inter-quartile Range] (Mann – Whitney test)

No significant difference are observed in preoperative hemodynamic variables, respiratory rate among both the groups.

Table 4: Comparison of Respiratory Events among Two Groups

Respiratory Observations	Group S (N= 28)		Group D (N= 28)	
	Maintenance	Emergence	Maintenance	Emergence
Coughing				
No coughing	0	0	0	0
Single cough with SpO ₂ >95%	0	0	0	1
Multiple cough with SpO ₂ > 95%	0	0	0	3
Multiple cough with SpO ₂ < 95%	0	0	0	0
Multiple cough with SpO ₂ < 95%, re-require IV medication	0	0	0	0
Breath Holding	0	0	0	0
Laryngospasm	0	0	0	0

1 patient had single emergent cough episode whereas 3 patients had multiple coughing episode in Desflurane group. These findings are not statistically significant.

Table 5: Early Recovery parameters among the two groups

S. No.	Early Recovery Parameters	Group S (N= 28) Mean ± SD	Group D(N= 28) Mean ± SD	P value
1	Eye opening	17.07±2.40	6.92±1.67	<0.001
2	Respond to command	17.50±2.22	7.07±1.69	<0.001
3	Orientation	18.53±2.22	7.68±1.91	<0.001
4	Min. to Modified Aldrete score	19.82±2.51	9.46±2.08	<0.001

Table 6: Late Recovery parameters among the two groups

S. No.	Laterecovery parameters	Group S(N= 28) Mean ± SD	Group D (N= 28) Mean ± SD	P value
1	Sitting	45.0±6.23	24.47±2.08	<0.001
2	First oral intake	45.0±6.23	24.28±2.24	<0.001
3	Standing	52.86±5.84	25.53±3.93	<0.001
4	Ambulated unassisted	52.86±5.84	25.53±3.93	<0.001

Results

All the demographic characteristics, ASA grading, baseline vital parameters were comparable in both the groups (P value > 0.05). Initial rise in mean heart rate, seen in first 3 minutes, is under the effect of Desflurane anaesthesia. Subsequently more rise in mean heart rate is seen in Group D, the difference being significant after 10 minutes of duration. The mean difference progressively increases as duration increases (P value < 0.05). There was no statistical difference in the mean arterial systolic blood pressure between the two groups. Only in mid of surgery at 20 minutes statistically significant difference is noted between two groups. There was no significant difference in diastolic blood pressure up to 40 minutes between two groups. After 40 minutes difference became significant but at the end of surgery again there was no significant difference in diastolic blood pressure between two groups.

No significant difference is observed in respiratory rate at induction, intraoperatively and postoperatively among both the groups. There was no statistical difference after induction up to the end of the procedure in SpO₂ between the groups. 1 patient had single emergent cough episode whereas 3 patients had multiple coughing episode at the time of emergence in

Desflurane group. There was no coughing in any patient in Sevoflurane group. This finding was not statistically significant probably because of small sample size.

In our study the time taken to open the eyes, to obey the verbal commands, the time taken for orientation and to achieve Modified Aldrete score 10 was shorter in the group which received Desflurane than the group which received Sevoflurane which is statistically significant (P value < 0.001). In our study the time taken to sit, to first oral intake, the time taken for standing and ambulate unassisted was shorter in the group which received Desflurane than the group which received Sevoflurane which is statistically significant (P value < 0.001).

Statistical Analysis:

Sample size: Sample size calculation has been done using statistical analysis software stata 11.

Study population of 28 patients for each group is determined to have 99 % power at alpha = 0.05 to detect a difference of 15% in the time to early recovery with Desflurane group compared to Sevoflurane group. P value <0.05 is considered as statistically significant.

Statistical Analysis Plan: Continues data will be presented in mean \pm SD as well as categorical data will be presented in number (%). Statistical analysis of data among the groups will be done by student's t test for independent samples following normal distribution and for categorical value, Fisher's exact test was applied. Non parametric test was applied appropriately if the distribution is not normal.

Discussion

Desflurane and Sevoflurane are two commonly administered inhaled anaesthetic agents for outpatient surgeries due to their favourable pharmacokinetic and low incident of untoward side effects with LMA. Laryngeal mask airway is effective for securing the airway in short surgical procedures. It minimizes the dead space, can be used without use of muscle relaxants and less stimulating than endotracheal tube. The time taken for placement is also usually less. The incidence of coughing and interruption of spontaneous breathing are much less. [6,7]

Our study we compared the effect of Sevoflurane and Desflurane on incidence of coughing, breath holding and laryngospasm during maintenance of the anaesthesia and during emergence from the anaesthesia and comparison of early emergence (eye opening, respond to command, orientation, fast tracking score upon leaving operating room) & late recovery (sitting, first oral intake, standing, ambulate unassisted) between two groups. [8-11]

Sevoflurane and Desflurane are both fluorinated inhalational anaesthetic characterized by a low blood/gas partition coefficient that favors rapid emergence. A total of 56 patients, ASA I – II, posted for elective superficial surgical procedure who satisfy the inclusion and exclusion criteria were enrolled in our study. They were equally divided in two groups. [12]

Demographic Variables

Both the groups are homogenous in terms of age, sex, height, weight and ASA physical status. Nearly same values are seen when sex, weight and height are compared. Out of total 28 patients in Desflurane group 20 patients are ASA I and rest 8 patients are ASA II, whereas in Sevoflurane group, 19 patients are ASA I and rest 9 patients are ASA II. No significant difference is noted in any of these parameters with the P value \gg 0.05. [13-16]

Baseline Variables

Both groups are homogenous in terms of baseline variables i.e., Heart rate, blood pressure, respiratory rate with P value $>$ 0.05. Mean baseline oxygen saturation among Sevoflurane group was 98 and Mean baseline oxygen saturation among Desflurane group was 100, which is slightly significant between two group. [17-19]

Hemodynamic Variables

In our study, the mean heart rate increases significantly in Desflurane group. These findings were consistent with the study by Arain SR et al which showed that Desflurane titration increases HR. This was unlike the findings of Jindal et al, Nathanson et al which showed no statistical difference in the intraoperative HR. There was no significant difference in diastolic blood pressure up to 40 minutes between two groups. After 40 minutes difference became significant (more in Desflurane group) but at the end of surgery again there was no significant difference in diastolic blood pressure between two groups. These findings were consistent with the studies by Jindal et al, White PF et al and Nathanson et al. [20,21]

Respiratory Variables

No significant difference is observed in respiratory rate at induction, intraoperatively and postoperatively among both the groups with the P value \gg 0.05 (Table 7). There was no statistical difference after induction upto the end of the procedure in SpO₂ between the groups which received Desflurane and Sevoflurane at any point of time. [22]

Perioperative Airway Responses

In our study, the incidence of respiratory complication like coughing was found only in the group which received Desflurane compared to Sevoflurane. This difference was not statistically significant. Other respiratory complications like breath holding and laryngospasm was not found in both Desflurane and Sevoflurane group. [23] This was unlike the findings of Ana Stevanovic et al, Rachel Eshima McKay et al and Saros GB et al which found no difference in incidence of respiratory complications in the two groups. The result of our study are consistent with the result of Gildasio S. de Oliveria et al. Lema FE et al, White PF et al, Arain SR et al. Valley RD et al who also found that the overall incidence of coughing during perioperative period is more common in Desflurane group as compared to Sevoflurane group. [24]

Recovery

Early Recovery Early recovery was shorter in the group which received Desflurane than the group which received Sevoflurane in our study. This was in accordance with the findings from previously published studies by Ana Stevanovic et al., Jeong Min Kim et al., Ravi Jindal et al, Saros GB et al. (early recovery was 25-40% faster in patients anaesthetized with Desflurane), Mckay et al., Isik Y et al., Macario A et al., Earl M. Strum, MD et al., Gupta A et al., Kudret Dogru MD et al., Heavner et al., Cohen et al., Chen X et al, Mahmoud et al., Valley RD et al., Dupont et al. (early recovery was twice as fast with Desflurane than with Sevoflurane), E. Michael Tarazi, MD et al., Naidu-Sjosvard K et al., Welborn LG et al., Nathanson MH et al. This finding of ours was different from that of other studies conducted by

Gupta et al., Karlsen K L et al., Larsen et al., Behne M et al., Song et al.[25]

In our study, the group which received Desflurane had a higher Aldrete score at the time of emergence in the OR. The mean time taken to achieve Modified Aldrete score 10 was 9.46 minutes in Desflurane group and 19.82 minutes in Sevoflurane group (p value < 0.001). Also after 10 minutes of arrival in the ICU. The time taken to reach an Aldrete score of 9 was lower in the group, which received Desflurane. This finding was similar to that of Jindal et al, Earl M. Strum, MD et al., Kudret Dogru MD et al. [MAS (modified Aldrete score) >8 occurred significantly more rapidly in the Desflurane group than in the Sevoflurane group ($P < 0.001$).[26]

Late Recovery

Late recovery was shorter in the group which received Desflurane than the group which received Sevoflurane in our study. These findings are consistent with the studies done by McKay et al., Rachel Eshima McKay et al., Cohen et al., Mahmoud et al., Juvin P et al., Welborn LG et al. This finding of ours was different from that of other studies conducted by Macario A et al., Heavner et al., E. Michael Tarazi, MD et al. [27,28]

Conclusion

The intraoperative hemodynamic characteristics were comparable with both Desflurane and Sevoflurane. There was more incidence of coughing in the Desflurane group when compared to Sevoflurane group although this difference was not statistically significant. Other respiratory events like breath holding and laryngospasm was not found in either group.

The emergence (eye opening, obey the verbal commands, orientation and Modified Aldrete score 10) from anaesthesia was faster following the administration of Desflurane compared to Sevoflurane. In the group which received Desflurane, the Aldrete score was higher on arrival at the time of emergence, and at 10 minutes of arrival in the ICU. The time taken to reach an Aldrete score of 9 was lower in the group which received Desflurane. Recovery in PACU (post anaesthesia care unit),(sit, first oral intake, standing and ambulate unassisted) was faster following the administration of Desflurane compared to Sevoflurane.

Declarations:

Availability of data and material: Department of Anaesthesiology EHCC Hospital Jaipur Rajasthan and Department of Anaesthesiology L. N Medical college, Bhopal.

Code availability: Not applicable.

Consent to participate: Consent taken.

Ethical Consideration: There are no ethical conflicts related to this study.

Consent for publication: Consent taken

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