

ORIGINAL RESEARCH

Effect of Sevoflurane versus isoflurane on middle ear pressure

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ABSTRACT

Background: It has been observed that changes in middle ear pressure during anesthesia can range from +400 mm H₂O (392 daPa) when nitrous oxide is administered to as low as +500 mm H₂O (+490 daPa) once it is stopped. The present study was conducted to compare the effects of sevoflurane versus isoflurane on middle ear pressure. **Materials & Methods:** 68 children age ranged 8-14 years of both genders were selected. On the day before surgery, ENT exams were performed, and patients were split into two groups of 34. Sevoflurane was given to group II, while isoflurane was given to group I. In order to verify the routine immittance screening of patients' ME, tympanometric functions were assessed using a middle ear analyzer. **Results:** Group I had 18 males and 16 females and group II had 17 males and 17 females. The mean height was 125.8 cm in group I and 121.6 cm in group II, weight in group I patients was 35.4 kgs and group II patients was 31.8 kgs, time of surgery was 35.2 minutes in group I and 28.6 minutes in group II, and time of anesthesia was 56.4 minutes in group I and 51.2 minutes in group II. The difference was significant ($P < 0.05$). The mean middle ear pressure at T₀ was -18, at T₁ was 28, at T₂ was 76 and at T₃ was 107 in group I. It was -19, 31, 84 and 138 at T₀, T₁, T₂ and T₃ respectively in right ear. It was -16, 35, 84 and 117 in group I and -14, 41, 78 and 140 at T₀, T₁, T₂ and T₃ respectively in left ear. The difference non-significant ($P > 0.05$). **Conclusion:** Since the rise in middle ear pressure under isoflurane anesthesia was less than that of sevoflurane, it can be used safely for ENT procedures.

Key words: Middle ear pressure, isoflurane, sevoflurane

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INTRODUCTION

It has been observed that changes in middle ear pressure during anesthesia can range from +400 mm H₂O (392 daPa) when nitrous oxide is administered to as low as +500 mm H₂O (+490 daPa) once it is stopped.¹ The tensor palati and levatorpalati muscles' contractions and the opening of the eustachian tubes during "deglutition" often equalize the pressures between the middle and outer ears.² Pressure equalization typically happens passively concurrently with tube opening. Pharyngeal muscle reflexes are inhibited during anesthesia, which could cause the pressure equalization to be further delayed.³ Some patients may experience negative middle ear pressure (MEP) following general anesthetic surgery, and 3.3% of cases were observed to have otitis media with effusion. This syndrome is thought to emerge as a result of gas dynamics in the ME cavity brought on by inhalation anesthesia and temporary obstruction of the Eustachian tube brought on by surgery.⁴

By inhaling through the Eustachian tube or diffusing from the circulation, the volatile anesthetic drugs enter the ME and alter the MEP. Ear pain, temporary or permanent hearing loss, hemotympanium, disarticulation of the stapes, rupture of the tympanic membrane, serous otitis media, displacement of the tympanic membrane graft, and failure of ossicular chain repair are some of the consequences that can result from an increase in MEP.⁵ The present study was conducted to compare the effects of sevoflurane versus isoflurane on middle ear pressure.

MATERIALS & METHODS

The present study consisted of 68 children age ranged 8-14 years of both genders. Their parents gave their written consent to participate in the study.

Data such as name, age, gender etc. was recorded. On the day before surgery, ENT exams were performed, and patients were split into two groups of 34. Sevoflurane was given to group II, while isoflurane was given to group I. In order to

verify the routine immittance screening of patients' ME, tympanometric functions were assessed using a middle ear analyzer. In order to perform tympanometric tests, the type A curve on normal MEP ranges from -100 to +500 daPa. At time 0, the patient was sitting one day prior to the procedure (T0); at time 1, the patient was lying supine on the operating

table before the procedure (T1); at time 2, following the induction of anesthesia and endotracheal intubation (T2); and at time 3, shortly after the anesthesia was withdrawn (T3). Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of patients

Groups	Group I (34)	Group II (34)
Agent	Isoflurane	Sevoflurane
M:F	18:16	17:17

Table I shows that group I had 18 males and 16 females and group II had 17 males and 17 females.

Table II Intraoperative characteristics

Characteristics	Group I	Group II	P value
Height (cm)	125.8	121.6	0.81
Weight (Kg)	35.4	31.8	0.73
Time of surgery (mins)	35.2	28.6	0.04
Time of anesthesia (mins)	56.4	51.2	0.42

Table II, graph I shows that mean height was 125.8 cm in group I and 121.6 cm in group II, weight in group I patients was 35.4kgs and group II patients was 31.8 kgs, time of surgery was 35.2 minutes in group I and 28.6 minutes in group II, and time of anesthesia was 56.4 minutes in group I and 51.2 minutes in group II. The difference was significant (P< 0.05).

Graph I Intraoperative characteristics

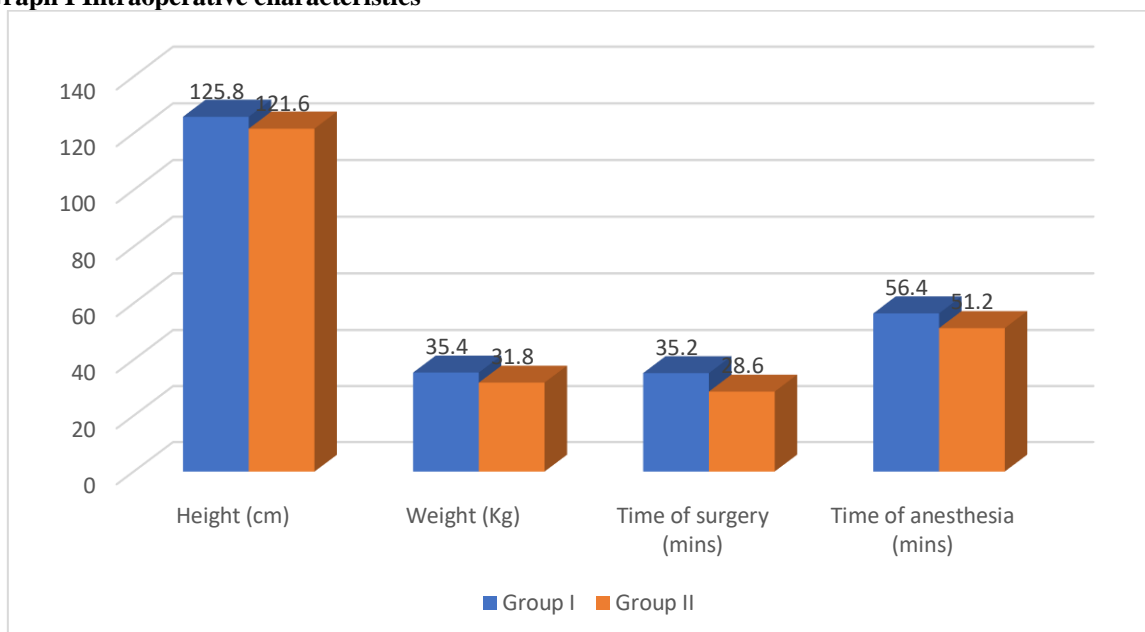


Table III Assessment of middle ear pressure

Time of measurement	Right ear		P value	Left ear		P value
	Group I	Group II		Group I	Group II	
T0	-18	-19	0.90	-16	-14	0.87
T1	28	31	0.81	35	41	0.92
T2	76	84	0.72	84	79	0.95
T3	107	138	0.01	117	143	0.04

Table III shows that mean middle ear pressure at T0 was -18, at T1 was 28, at T2 was 76 and at T3 was 107 in group I. It was -19, 31, 84 and 138 at T0, T1, T2 and T3 respectively in right ear. It was -16, 35, 84 and 117 in group I and -14, 41, 78 and 140 at T0, T1, T2 and T3 respectively in left ear. The difference non-significant (P> 0.05).

DISCUSSION

Compared to intravenous anesthetics, inhalant anesthetics have the potential to penetrate the middle ear (ME) area during anesthesia administration and can impact ME status by raising MEP to a greater degree. According to reports, the Eustachian tube may force an effusion out of the ME if MEP rises as a result of inhalant anesthesia.^{6,7} This could result in an ear that was preoperatively diagnosed with otitis media with effusion being discovered to be dry during surgery, which could lead to an incorrect tympanostomy tube insertion choice.^{8,9} The present study was conducted to compare the effects of sevoflurane versus isoflurane on middle ear pressure.

We found that group I had 18 males and 16 females and group II had 17 males and 17 females. Ozturk et al¹⁰ evaluated the effects of sevoflurane and TIVA with propofol on middle ear pressure and to show the importance of anesthesia without using any inhalational agents during middle ear surgery. In this study, 25 male children that were scheduled for circumcision were randomised into two groups. Group I (n=13) received TIVA with propofol and group II (n=12) received sevoflurane. Baseline tympanometry reading was performed on each ear just before anesthesia. The next tympanometry reading was taken 10min after applying the laryngeal mask. The mean MEP values in 26 ears of 13 boys in group I did not show any significant difference before and after the anesthesia with propofol ($p>0.05$). In group II mean MEP values in 24 ears of 12 boys showed a significant increase after the anesthesia with sevoflurane ($p<0.001$). No significant difference was found between the MEP values of the two groups before the anesthesia ($p>0.05$), and MEP values measured during the anesthesia were significantly higher in group II ($p=0.007$).

We found that the mean height was 125.8 cm in group I and 121.6 cm in group II, weight in group I patients was 35.4 kgs and group II patients was 31.8 kgs, time of surgery was 35.2 minutes in group I and 28.6 minutes in group II, and time of anesthesia was 56.4 minutes in group I and 51.2 minutes in group II. In their investigation, Nader et al¹¹ used tympanometry to evaluate middle ear compartment pressures in 27 randomly selected knee arthroscopy patients throughout the procedure and during the recovery period. The maximum negative pressure (MNP) and maximum positive pressure (MPP) gradients were shown to positively correlate with PONV ($P < .05$). While only two out of eleven patients in the control group experienced nausea, vomiting, and vertigo symptoms, six out of sixteen patients in the nitrous oxide (N₂O) treatment group experienced PONV. The median MPP and MNP of the patients who did not have PONV were 155 and -52, respectively. The median MPP and MNP of the individuals who suffered from PONV were 179 and -164, respectively. This indicates that the N₂O therapy group saw a markedly higher incidence of PONV.

We found that the mean middle ear pressure at T0 was -18, at T1 was 28, at T2 was 76 and at T3 was 107 in group I. It was -19, 31, 84 and 138 at T0, T1, T2 and T3 respectively in right ear. It was -16, 35, 84 and 117 in group I and -14, 41, 78 and 140 at T0, T1, T2 and T3 respectively in left ear. Azab et al¹² randomized patients between the ages of 6 and 14 who were having tonsillectomy surgery into two groups and examined the effects of isoflurane and sevoflurane on MEP. Following thiopental and suxamethonium induction, group 1 received isoflurane and group 2 received sevoflurane to maintain anesthesia. MEP was considerably higher in T1, T2, and T3 in both groups compared to the baseline value in T0. At T3, there were no changes between groups at any point in time; however, group 1 (isoflurane group) saw a considerably smaller rise in MEP than group 2 (sevoflurane groups) toward the conclusion of anesthesia (103 ± 68 vs. 138 ± 99 , $P < 0.01$ in the right ear and 112 ± 82 vs. 141 ± 101 , $P < 0.01$, the left ear).

CONCLUSION

Authors found that since the rise in middle ear pressure under isoflurane anesthesia was less than that of sevoflurane, it can be used safely for ENT procedures.

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