

ORIGINAL ARTICLE

Assessment of effects of sevoflurane and isoflurane on middle ear pressure

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ABSTRACT:

Background: When anesthesia is administered, inhaled anesthetics have a greater potential to penetrate the middle ear (ME) area and alter ME status by raising middle ear pressure (MEP) compared to intravenous anesthetics. The present study was conducted to compare the effects of sevoflurane and isoflurane on middle ear pressure. **Materials & Methods:** 78 cases of both genders were split into two groups of 39. Group I patients received isoflurane and group II sevoflurane. The following times were measured: T0, one day prior to the procedure, when the patient was seated; T1, preoperative, when the patient was supine on the operating table; T2, following the induction of anesthesia and endotracheal intubation; and T3, shortly after the anesthesia was withdrawn (T3). **Results:** ASA grade I was seen in 20 and II in 19 in group I and grade I in 22 and II in 17 in group II. The mean weight in group I patients was 34.5 Kg and group II patients was 33.7 kgs, height was 125.1 cm in group I and 123.7 cm in group II. Time of surgery was 34.7 minutes in group I and 28.5 minutes in group II. The mean time of anesthesia was 53.8 minutes in group I and 50.4 minutes in group II. The difference was non-significant ($P > 0.05$). The mean middle ear pressure at T0 was -18 at T1 was 29, at T2 was 76 and at T3 was 105 in group I in right ear. It was -19, 32, 84 and 138 at T0, T1, T2 and T3 respectively in group II. It was -17, 35, 84 and 116 in group I and -14, 40, 79 and 142 at T0, T1, T2 and T3 respectively in left ear. The difference non-significant ($P > 0.05$). **Conclusion:** Because the rise in middle ear pressure during isoflurane anesthesia was less than that of sevoflurane, it is safe to use during ENT procedures.

Keywords: middle ear pressure, Eustachian tube, otitis media

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INTRODUCTION

When anesthesia is administered, inhaled anesthetics have a greater potential to penetrate the middle ear (ME) area and alter ME status by raising middle ear pressure (MEP) compared to intravenous anesthetics. By diffusion from the circulation or by insufflations through the Eustachian tube, the volatile anesthetic drugs enter the ME and alter the MEP.² A rise in MEP can result in consequences such as stapes disarticulation, tympanic membrane rupture, ear discomfort, temporary or permanent hearing loss, hemotympanium, serous otitis media, tympanic membrane graft displacement, and unsuccessful ossicular chain repair.³

According to reports, the Eustachian tube may force effusion out of the ME as a result of an increase in MEP brought on by inhalant anesthesia.⁴ This could result in the incorrect choice being made about the placement of a tympanostomy tube if an ear that was preoperatively identified as having otitis media with effusion is discovered to be dry after surgery.⁵

Negative MEP can occur in certain patients during general anesthetic surgery, and otitis media with effusion was noted in 3.3% of cases. This phenomenon is thought to be developed by gas dynamics in the ME cavity brought on by inhalation anesthesia and temporary obstruction of the

Eustachian tube brought on by surgery.^{6,7} The present study was conducted to compare the effects of sevoflurane versus isoflurane on middle ear pressure.

MATERIALS & METHODS

The present study was conducted on 78 cases of both genders. All gave their written consent to participate in the study.

Data such as name, age, gender etc. was recorded. On the day prior to surgery, ENT examinations were performed, and patients were split into two groups of 39. Group I patients received isoflurane and group II sevoflurane. Using a middle ear analyzer, tympanometric functions were assessed in order to verify the patients' standard immittance screening for ME. Tympanometric measurements were made using the type A curve classification method, which covers standard MEP ranges of -100 to +500 daPa. The following times were measured: T0, one day prior to the procedure, when the patient was seated; T1, preoperative, when the patient was supine on the operating table; T2, following the induction of anesthesia and endotracheal intubation; and T3, shortly after the anesthesia was withdrawn (T3). Results thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I Intraoperative characteristics

Characteristics	Group I	Group II	P value
ASA grade I/II	20:19	22:17	0.95
Weight (Kg)	34.5	33.7	0.18
Height (cm)	125.1	123.7	0.54
Time of surgery (mins)	34.7	28.5	0.76
Time of anesthesia (mins)	53.8	50.4	0.91

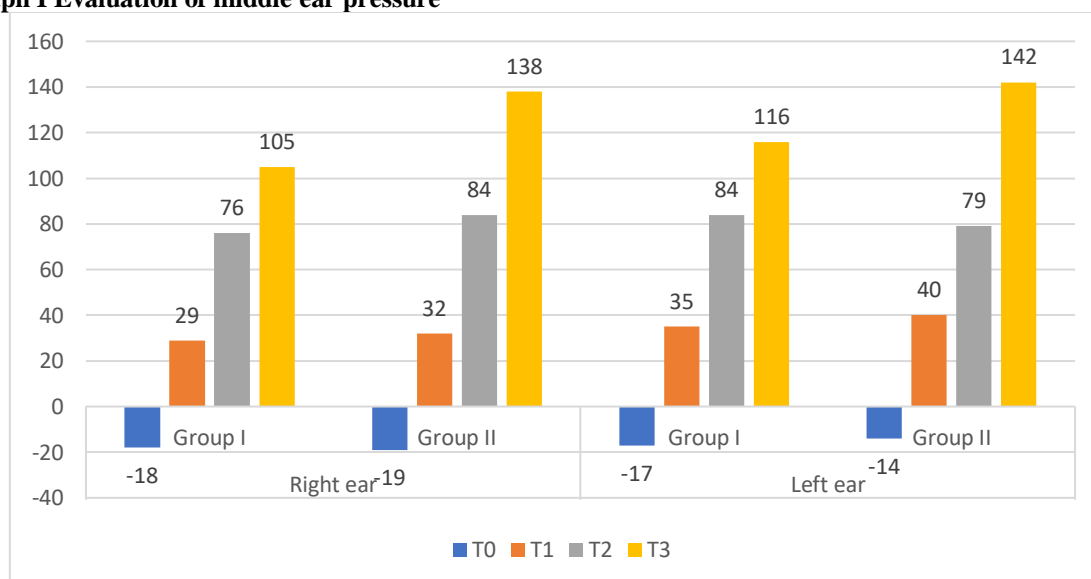
Table I shows that ASA grade I was seen in 20 and II in 19 in group I and grade I in 22 and II in 17 in group II. The mean weight in group I patients was 34.5 Kg and group II patients was 33.7 kgs, height was 125.1 cm in group I and 123.7 cm in group II. Time of surgery was 34.7 minutes in group I and 28.5 minutes in group II. The mean time of anesthesia was 53.8 minutes in group I and 50.4 minutes in group II. The difference was non-significant ($P > 0.05$).

Table II Evaluation of middle ear pressure

Time of measurement	Right ear			Left ear		
	Group I	Group II	P value	Group I	Group II	P value
T0	-18	-19	0.97	-17	-14	0.51
T1	29	32	0.57	35	40	0.92
T2	76	84	0.73	84	79	0.95
T3	105	138	0.04	116	142	0.01

Table II, graph I shows that mean middle ear pressure at T0 was -18 at T1 was 29, at T2 was 76 and at T3 was 105 in group I in right ear. It was -19, 32, 84 and 138 at T0, T1, T2 and T3 respectively in group II. It was -17, 35, 84 and 116 in group I and -14, 40, 79 and 142 at T0, T1, T2 and T3 respectively in left ear. The difference non-significant ($P > 0.05$).

Graph I Evaluation of middle ear pressure



DISCUSSION

A number of investigators have reported MEP variations resulting from inhalant anesthesia; previous studies have primarily used nitrous oxide, halothane, sevoflurane, and desflurane in comparison with total intravenous anesthetics with propofol.^{8,9} It has also been reported that volatile anesthetic agents pass into the ME by insufflations through the Eustachian tube and/or by diffusion from the circulation and cause changes in the MEP.¹⁰ The present study was conducted to compare the effects of sevoflurane versus isoflurane on middle ear pressure.

We found that ASA grade I was seen in 20 and II in 19 in group I and grade I in 22 and II in 17 in group II. The mean weight in group I patients was 34.5 Kg and group II patients was 33.7 kgs, height was 125.1 cm in group I and 123.7 cm in group II. Time of surgery was 34.7 minutes in group I and 28.5 minutes in group II. The mean time of anesthesia was 53.8 minutes in group I and 50.4 minutes in group II. Ozturk Oet al¹¹ evaluated the effects of desflurane on middle ear pressure. In this study, 38 ears of 19 male children that were scheduled for circumcision were included. Baseline tympanometry reading was performed on each ear just before anesthesia. After

induction anesthesia with propofol a laryngeal mask was applied and desflurane administration was started. The next tympanometry reading was taken at 5th, 10th and 15th minute after administration and at the 10th minute after the cessation of desflurane. Mean MEP values before anesthesia in 38 ears of 19 boys were -10.32 ± 33.14 . After starting the administration of desflurane 5th minute mean value was 71.15 ± 60.42 , at the 10th minute 111.56 ± 59.03 and at the 15th minute it increased to 120.50 ± 54.14 , and these measurements were significantly higher than the starting value ($p < 0.001$). After cessation of desflurane mean MEP value dropped to 57.56 ± 79.06 , but compared with the starting value this was also significantly higher ($p < 0.001$).

We observed that the mean middle ear pressure at T0 was -18 at T1 was 29 , at T2 was 76 and at T3 was 105 in group I in right ear. It was -19 , 32 , 84 and 138 at T0, T1, T2 and T3 respectively in group II. It was -17 , 35 , 84 and 116 in group I and -14 , 40 , 79 and 142 at T0, T1, T2 and T3 respectively in left ear. Karabiyik L et al¹² investigated the effect of nitrous oxide on the middle ear pressure, comparing inhalational anaesthesia with nitrous oxide and halothane and total intravenous anaesthesia with propofol-alfentanil. Fifty patients with normal healthy ears were divided into two groups. In one group ($n = 25$), anaesthesia was induced with thiopentone 6 mg kg^{-1} , and maintained with halothane 1% and nitrous oxide 66% in oxygen. In the other group ($n = 25$), anaesthesia was induced with alfentanil $25 \text{ micrograms kg}^{-1}$ and propofol 2 mg kg^{-1} , and maintained with an infusion of alfentanil $10 \text{ micrograms kg}^{-1} \text{ min}^{-1}$ for the first 10 min and then with $0.5 \text{ microgram kg}^{-1} \text{ min}^{-1}$ and with propofol $10 \text{ mg kg}^{-1} \text{ h}^{-1}$ for the first 10 min , $8 \text{ mg kg}^{-1} \text{ h}^{-1}$ for the following 10 min and $6 \text{ mg kg}^{-1} \text{ h}^{-1}$ thereafter. Patients were ventilated with an oxygen-air mixture ($\text{FIO}_2 = 0.33$). Middle ear pressures were measured during the pre-, intra- and post-anaesthetic period in both ears. A progressive rise was observed in the first group, whereas values were within the normal limits clinically and there was no statistically significant change in those receiving total intravenous anaesthesia during the intra-anaesthetic period. The time to reach peak pressure with inhalational anaesthesia was 60 min ($181.5 \text{ mmH}_2\text{O}$) and to return to normal was 30 min ($49.5 \text{ mmH}_2\text{O}$) after cessation of nitrous oxide administration. The incidence of nausea and vomiting was less in the patients not receiving nitrous oxide.

The shortcoming of the study is small sample size.

CONCLUSION

Authors found that because the rise in middle ear pressure during isoflurane anesthesia was less than that of sevoflurane, it is safe to use during ENT procedures.

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