

Original Research

A comparative study of sevoflurane versus isoflurane on middle ear pressure in ENT surgeries

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ABSTRACT:

Background: Normally pressures between the middle and outer ear are equalized by the actions of the tensor palati and levator palati muscle contractions and opening of the eustachian tubes during deglutition. The present study was conducted to compare the effects of sevoflurane versus isoflurane on middle ear pressure (MEP). **Materials & Methods:** 48 children age ranged 6-12 years of both genders were divided into 2 groups of 24 each. Group I received isoflurane and group II received sevoflurane. Tympanometric functions were evaluated using middle ear analyzer to check the standard imittance screening of the ME of patients. **Results:** Group I had 14 males and 10 females and group II had 12 males and 12 females. The mean weight in group I patients was 34.1 Kg and group II patients was 32.2 kgs, height was 120.4 cm in group I and 118.4 cm in group II, ASA grade I was seen in 13 and II in 11 in group I and grade I in 14 and II in 10 in group II, time of anesthesia was 52.4 minutes in group I and 49.2 minutes in group II and time of surgery was 34.7 minutes in group I and 29.5 minutes in group II. The difference was non- significant ($P > 0.05$). The mean middle ear pressure at T0 was -18 at T1 was 27, at T2 was 74 and at T3 was 104 in group I. It was -19, 30, 82 and 136 at T0, T1, T2 and T3 respectively in right ear. It was -16, 34, 81 and 113 in group I and -13, 39, 78 and 140 at T0, T1, T2 and T3 respectively in left ear. The difference non- significant ($P > 0.05$). **Conclusion:** During isoflurane anesthesia the rise of middle ear pressure was comparatively lower than sevoflurane.

Key words: Middle ear pressure, isoflurane, sevoflurane

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INTRODUCTION

Changes in middle ear pressure during anesthesia have been reported to range from +400 mm H₂O (392 daPa) during nitrous oxide administration and as low as +500 mm H₂O (+490 daPa) after its cessation.¹ Normally, pressures between the middle and outer ear are equalized by the actions of the tensor palati and levator palati muscle contractions and opening of the eustachian tubes during "deglutition."² Normally, pressure equalization is a passive phenomenon occurring simultaneously with tube opening. During anesthesia, pharyngeal muscle reflexes are obtunded, which may further delay the pressure equalization.³ Surgery under general anesthesia may lead to negative middle ear pressure (MEP) in some patients, and otitis

media with effusion was reported in 3.3% of cases. Gas dynamics in the ME cavity induced by inhalation anesthesia and transient blockage of the Eustachian tube induced by surgery are considered to be involved in the development of this phenomenon.⁴

The 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.⁵ Increase in MEP may cause complications such as ear pain, transient or permanent hearing loss, hemotympanium, disarticulation of stapes, tympanic membrane rupture, serous otitis media, displacement of tympanic membrane graft, and failure of ossicular chain repair.⁶ The present study was conducted to

compare the effects of sevoflurane versus isoflurane on middle ear pressure (MEP).

MATERIALS & METHODS

The present study comprised of 48 children age ranged 6-12 years of both genders. They were included in the study after obtaining written consent from their parents.

Demographic profile such as name, age, gender etc. was recorded. ENT examinations were carried out on the preoperative day and patients were divided into 2 groups of 24 each. Group I received isoflurane and group II received sevoflurane. Tympanometric functions were evaluated using middle ear analyzer to

check the standard imittance screening of the ME of patients. Tympanometric tests were performed using classification as; type A curve on normal MEP ranges between -100 and +500 daPa. Measurements were recorded as follows: at time 0, 1 day before the operation while the patient was in the sitting position (T0); time 1, preoperative when the patient lay supine on the operating table (T1); time 2, after the induction of anesthesia and endotracheal intubation (T2); and time 3, soon after withdrawal of anesthesia (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	Group II
Agent	Isoflurane	Sevoflurane
M:F	14:10	12:12

Table I shows that group I had 14 males and 10 females and group II had 12 males and 12 females.

Table II Intraoperative characteristics

Characteristics	Group I	Group II	P value
Weight (Kg)	34.1	32.2	0.12
Height (cm)	120.4	118.4	0.23
ASA grade I/II	13:11	14:10	0.91
Time of anesthesia (mins)	52.4	49.2	0.81
Time of surgery (mins)	34.7	29.5	0.17

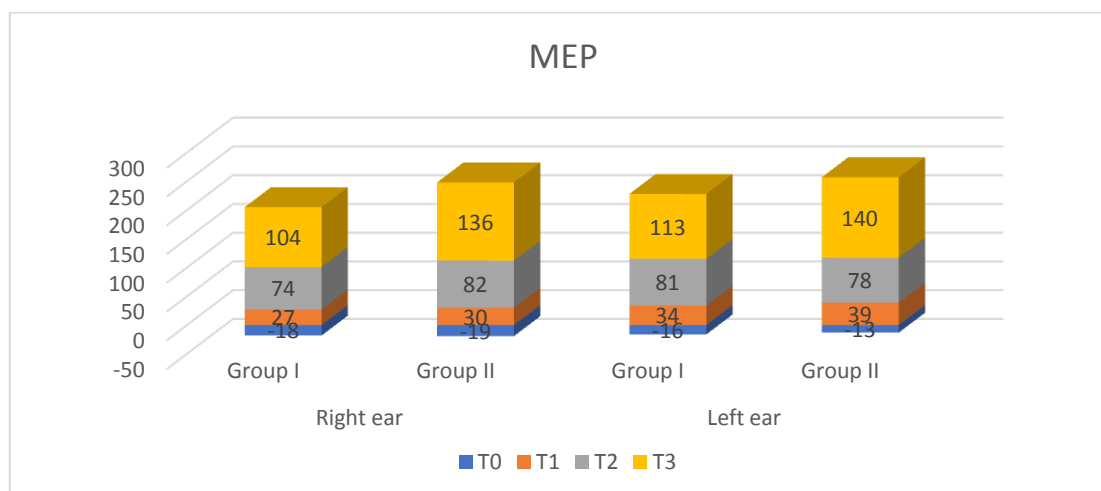
Table II shows that mean weight in group I patients was 34.1 Kg and group II patients was 32.2 kgs, height was 120.4 cm in group I and 118.4 cm in group II, ASA grade I was seen in 13 and II in 11 in group I and grade I in 14 and II in 10 in group II, time of anesthesia was 52.4 minutes in group I and 49.2 minutes in group II and time of surgery was 34.7 minutes in group I and 29.5 minutes in group II. The difference was non-significant ($P > 0.05$).

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	-13	0.84
T1	27	30	0.81	34	39	0.90
T2	74	82	0.72	81	78	0.92
T3	104	136	0.01	113	140	0.01

Table III, graph I shows that mean middle ear pressure at T0 was -18 at T1 was 27, at T2 was 74 and at T3 was 104 in group I. It was -19, 30, 82 and 136 at T0, T1, T2 and T3 respectively in right ear. It was -16, 34, 81 and 113 in group I and -13, 39, 78 and 140 at T0, T1, T2 and T3 respectively in left ear. The difference non-significant ($P > 0.05$).

Graph I Assessment of middle ear pressure



DISCUSSION

Inhalant anesthetic agents may enter the middle ear (ME) space during the administration of anesthesia and can affect ME status by increasing middle ear pressure (MEP) to a larger extent than intravenous anesthetics.⁷ It has been reported that an increase in MEP because of inhalant anesthesia may cause effusion to be pushed out of the ME by the Eustachian tube.⁸ This may cause an ear, preoperatively diagnosed to have otitis media with effusion, to be found dry during surgery, leading to a wrong decision of insertion of a tympanostomy tube.⁹ The present study was conducted to compare the effects of sevoflurane versus isoflurane on middle ear pressure (MEP).

In present study group I had 14 males and 10 females and group II had 12 males and 12 females. Cinamon et al¹⁰ included 26 adult volunteers having 52 normal, healthy ears had tympanometric ME pressures measured in an upright and recumbent positions. Recordings were obtained immediately after positioning and after 3 minutes. The main outcome measure was the pressure difference between upright and recumbent measurements, that is, positional ME pressure change. All ME pressure recordings were within (-)100 to (+) 55 mm H₂O. An instant and significant ($P < .001$) pressure elevation was recorded in all ears once position changed from upright to recumbent. The average pressure increment was 19 mm H₂O. Once a recumbent ear was repositioned upright it demonstrated an immediate pressure drop and regaining the initial ME pressure. Assuming the volume of a normal ME cleft as 8 mL and following Boyle's law, an ME volume alteration of about 17 μ L was required to induce such pressure change. Positional pressure changes were within the range of normal daily ME pressure variations. The instantaneous pressure changes and reversibility may be explained by filling and emptying of blood vessels within the ME cleft, following gravity causing an alteration of the aerated volume. Individual

differences of pressure change may follow variability of ME cleft volume, its surface, and vessel density.

We found that mean weight in group I patients was 34.1 Kg and group II patients was 32.2 kgs, height was 120.4 cm in group I and 118.4 cm in group II, ASA grade I was seen in 13 and II in 11 in group I and grade I in 14 and II in 10 in group II, time of anesthesia was 52.4 minutes in group I and 49.2 minutes in group II and time of surgery was 34.7 minutes in group I and 29.5 minutes in group II. Nader et al¹¹ in their study middle ear compartment pressures were measured by tympanometry in 27 randomly assigned knee arthroscopy patients throughout the surgical procedure as well as into recovery. A positive correlation between the maximum positive pressure (MPP) and maximum negative pressure (MNP) gradient and PONV was demonstrated ($P < .05$). The incidence of PONV in the nitrous oxide (N₂O) treatment group was 6 of 16 patients, whereas only 2 of 11 patients in the control group developed nausea, vomiting, and vertigo symptoms. Those patients that did not experience PONV demonstrated a median MPP of 155 with a median MNP of -52. The patients that experienced PONV exhibited a median MPP of 179 with a median MNP of -164. This demonstrates a significant increase in the incidence of PONV in the N₂O treatment group.

We observed that mean middle ear pressure at T0 was -18 at T1 was 27, at T2 was 74 and at T3 was 104 in group I. It was -19, 30, 82 and 136 at T0, T1, T2 and T3 respectively in right ear, It was -16, 34, 81 and 113 in group I and -13, 39, 78 and 140 at T0, T1, T2 and T3 respectively in left ear. Azab et al¹² compared the effects of isoflurane and sevoflurane on MEP in patients between 6 and 14 years of age undergoing tonsillectomy operation were randomized into two groups. Group 1 received isoflurane and group 2 received sevoflurane for maintenance of anesthesia after induction with thiopental and suxamethonium in both groups. In comparison with the baseline value in

T0, MEP was significantly increased in T1, T2, and T3 in the two groups. There were no differences between groups at all times, but at the end of anesthesia at T3, the increase in MEP was significantly lower in group 1 (isoflurane group) than in group 2 (sevoflurane groups) (103 ± 68 vs. 138 ± 99 , $P < 0.01$ in the right ear and 112 ± 82 vs. 141 ± 101 , $P < 0.01$ in the left ear).

CONCLUSION

Authors found that during isoflurane anesthesia the rise of middle ear pressure was comparatively lower than sevoflurane and thus can be safely used in ENT surgeries.

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