**Middle ear pressure changes with sevoflurane and propofol-remifentanil**

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**Abstract.** Middle ear pressure changes with sevoflurane and propofol-remifentanil. The present study aimed to compare the effects of sevoflurane (a commonly used inhalation anesthetic) and intravenous propofol on middle ear pressure (MEP) and determine the more appropriate option for middle ear operations. Fifty-seven American Society of Anesthesiologists risk class I-II patients aged 18-65 years who were not scheduled for ear or tympanic membrane operations were included in the study. The patients were randomly divided into two groups using the sealed envelope method. Propofol (0.2-0.5 mg/kg; Group P) and sevoflurane (1-2%; Group S) were used to maintain anesthesia. Baseline tympanometry was conducted on both ears and recorded before anesthesia was induced. Four additional measurements were performed and recorded at 5, 10, 15, and 30 minutes after induction. All post-induction MEP values were significantly higher than baseline measurements in Group S (P<0.05 for all); there were no differences between post-induction and baseline measurements in Group P. At 10, 15, and 30 min post-induction, MEP values were significantly higher in Group S than in Group P (P<0.05). Sevoflurane increased MEP values significantly compared with propofol anesthesia. We conclude that propofol can be used more reliably than sevoflurane in middle ear operations.
recorded in the operating room before the induction of anesthesia, while they were awake. In Group S, thiopental sodium 5 mg/kg, fentanyl 1 mcg/kg, and rocuronium 0.6 mg/kg were used to induce anesthesia; in group P, propofol 2 mg/kg, remifentanil 1 mcg/kg, and rocuronium 0.6 mg/kg were used to induce anesthesia. All patients were intubated. The duration of intubation was recorded in minutes. After the induction of anesthesia, Group S patients received 1.25 MAC sevoflurane during maintenance of anesthesia. Group P patients were administered a propofol infusion (0.2-0.5 mg/min) and remifentanil (0.5-1 mcg/kg/min) during maintenance. All patients received 100% O2 during maintenance; N2O was not administered because it might affect the tympanometric pressure. Three additional tympanometric measurements were conducted and recorded at 5, 10, 15, and 30 minutes of anesthesia induction. An ear nose throat (ENT) physician who was blinded to the study groups collected all tympanometric measurements. Measurements were obtained from both ears of 30 patients in Group P and Group S separately. Data were compared separately for the patients’ left and right ears. Tympanometric measurements were determined using a Jerger type A curve on normal MEP ranges between -200 and +200 decapascals (daPa). The total duration of operation was recorded for all patients.

A power analysis was performed to determine the number of patients to be included in the study groups. The analysis led to the decision to include 30 patients in each group; a total sample size of 60 patients was considered statistically appropriate (α=0.01, β=0.20, 1- β=0.80). The power of the test was p=0.80467. The data were analyzed statistically using SPSS software (version 14.0). Mann-Whitney U (inter-group) and Wilcoxon tests (intra-group) were used to analyze the data. P-values <0.05 were considered statistically significant.

Results

A total of 57 patients were included in the study after two patients in Group P (n=28) and one patient in Group S (n=29) were excluded because we were unable to conduct the measurements correctly during the study period. When the patients’ demographic data and duration of operation and intubation were compared, no differences were observed (Table 1). The groups also did not differ regarding HR, MAP, or SPO2 recorded during the operation.

MEP values at 5, 10, 15, and 30 minutes were significantly higher than the baseline measurements obtained before induction in Group S (p<0.05 for all). In contrast, there was no difference between the post-induction and baseline values in Group P (Figures 1, 2).

When the groups’ MEP values of both ears were compared, no differences were observed between the values obtained at baseline and at 5 minutes post-induction; however, the MEP values at 10, 15, and 30 minutes were significantly higher in Group S than in Group P (Figures 1, 2).

Discussion

This study compared inhaled sevoflurane with the totally intravenous anesthesia (TIVA) propofol regarding their effects on MEP measurements. Propofol was not associated with MEP changes, in

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Demographic characteristics and duration of operation</th>
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<tbody>
<tr>
<td></td>
<td>Group P (n=28)</td>
</tr>
<tr>
<td>Age, years</td>
<td>43.59±12.1</td>
</tr>
<tr>
<td>Women/Men</td>
<td>14/14</td>
</tr>
<tr>
<td>Height, cm</td>
<td>165.72±9.1</td>
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<tr>
<td>Weight, kg</td>
<td>76.9±11.8</td>
</tr>
<tr>
<td>ASA class I/II</td>
<td>10/18</td>
</tr>
<tr>
<td>Duration of operation, min</td>
<td>52.5±17.1</td>
</tr>
</tbody>
</table>

Note. Sex and ASA class data are presented as n. Age, height, weight, and duration of operation data are presented as mean ±SD.
Middle ear pressure changes with anesthetics

Contrary to the studies reporting that IV anesthetics have advantages during middle ear surgeries and minimal effect on MEP, a comparison of IV anesthetics and inhalation anesthetics by Chinn et al.\textsuperscript{10} stated that they have similar intraoperative and hemodynamic effects and that the use of short-acting inhalation anesthetics (e.g., isoflurane and desflurane) could obtain excellent results. In contrast to this rare finding, it is generally reported in the literature that IV anesthetics are more advantageous for the middle ear than inhalation anesthetics. Under these circumstances, preferring IV anesthetics over inhaled anesthetics during middle ear operations is the correct decision.

A study by Albera et al.\textsuperscript{11} that evaluated the effects of sevoflurane and propofol on cochlear blood circulation found that sevoflurane had a higher protective effect on inner ear microcirculation. Several studies evaluating the effects of inhalation anesthetics have obtained different results.\textsuperscript{12-15} Similarly, miscellaneous studies have revealed that IV anesthetics have more positive results than inhalation anesthetics.\textsuperscript{2,4,11}

Inhalation anesthetics cause an increase in MEP compared with IV anesthetics.\textsuperscript{2,4,8} Jellish et al.\textsuperscript{9} compared IV propofol-fentanyl and propofol-remifentanil with standard inhalation anesthetics during middle ear surgeries and reported that IV anesthetics had more hemodynamic and clinical advantages. Ozturk et al.\textsuperscript{4} found that sevoflurane increased MEP similar to other inhalation agents and reported that TIVA with propofol is safer than sevoflurane anesthesia during middle ear operations. Although the results of the study of Ozturk et al.\textsuperscript{4} appear similar our present findings, there is an important difference: they studied children (4-11 years old), while our study included adult patients (18-65 years old).

Karabiyik et al.\textsuperscript{8} observed no pressure differences in a study in which they used TIVA with propofol-alfentanil. They concluded that TIVA decreased the problems associated with inhalation anesthetics during these operations.

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Inhalation anesthetics easily pass to the middle ear during anesthesia maintenance and increase MEP. In a 2007 study that focused on desflurane’s effects on MEP, Ozturk et al.\textsuperscript{15} observed that desflurane increased MEP significantly. Acar et al.\textsuperscript{1} compared the effects of desflurane and isoflurane...
and found that isoflurane increased MEP significantly compared with desflurane.

In conclusion, sevoflurane increased MEP values significantly compared with propofol anesthesia. We conclude that propofol can be used more reliably than sevoflurane during middle ear operations.

References


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