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Short Communication

Risk Factors for Nausea and Vomiting after Day Care General Anesthesia in Mentally Challenged Patients Undergoing Dental Treatment

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Abstract

Clinically, the incidence of postoperative nausea and vomiting (PONV) may be higher in mentally challenged patients than in normal healthy patients. The aim of this study was to investigate the risk factors for PONV after day care general anesthesia in mentally challenged patients undergoing dental treatment. We analyzed data on 231 day care general anesthesia cases involving mentally challenged patients undergoing dental treatment. Anesthetic records for the past 5 years were investigated retrospectively. Ten items (age, body weight, sex, duration of general anesthesia, use of propofol, use of sevoflurane, use of nitrous oxide, use of neostigmine, treatment accompanied with bleeding, and transfusion volume) were selected as risk factors for PONV. Postoperative nausea and vomiting was evaluated using the postoperative check sheet and linear discriminant analysis was performed to distinguish PONV incidence using the 10 items as independent variables. The reliability of the linear discriminant function was evaluated using a misjudgment rate and information criteria (AIC). Postoperative nausea and vomiting was observed in 13 cases out of 231 cases. The discriminant function with the smallest AIC (−25.0718) consisted of two independent variables: \( y = -0.077x_1 - 0.001x_2 + 0.0716 \) (\( x_1 = \) use of propofol, \( x_2 = \) age). The misjudgment rate was 31.6%. This result suggests that PONV decreases when propofol is used and that the incidence of PONV decreases with age. To investigate other risk factors, an additional analysis was performed using 83 out of the 231 cases in which sevoflurane was used as an anesthetic agent. The results of the subgroup analysis suggest that the incidence of PONV decreases in male patients and higher weight patients, although the patient’s body weight may be related to age, as the study cohort included many children. It is suggested that the major risks for PONV in mentally challenged patients after day care general anesthesia are no use of propofol, lower age, female sex and lower weight.

Key words: Postoperative nausea and vomiting—Mental retardation—Day care general anesthesia—Dental treatments—Linear discriminant analysis
**Introduction**

Postoperative nausea and vomiting (PONV) is an unpleasant complication. It may cause not only patient discomfort, but also aspiration pneumonia, an elevation of the intracranial pressure or electrolyte abnormality due to dehydration \(^1\). Dental treatment for patients with mental retardation or autism has been frequently performed under day care general anesthesia. Prevention of PONV is important in such cases because it is difficult to explain to them the signal symptoms of PONV due to their poor communication abilities. In addition, unexpected hospitalization or prolongation of recovery time induced by PONV could cause major stress in such patients.

The guidelines for the prevention and treatment of PONV \(^7\) state that prevention will depend on the PONV risk score of each patient. In adult patients, female sex, non-smoking status and a history of PONV/motion sickness are patient-specific risk factors for PONV \(^2\). Anesthetic risk factors include the use of volatile anesthetic agents \(^1\), nitrous oxide \(^12\) or intraoperative and postoperative opioids \(^2\). A previous report \(^14\) suggested that patients with mental retardation or autism were at high risk of vomiting repeatedly after general anesthesia. Our own clinical experience bears out this assertion. However, to our knowledge, no studies have investigated the risk factors for PONV in mentally challenged patients. It is also unclear whether the risk factors for PONV would be the same among patients with or without mental retardation.

The aim of this study was to investigate the risk factors for PONV after day care general anesthesia in mentally challenged patients undergoing dental treatment. Anesthetic records for the past 5 years were investigated retrospectively to analyze patient-specific and anesthetic risk factors as independent variables using linear discriminant analysis.

**Methods**

We analyzed data on 231 day care general anesthesia cases at Tokyo Dental College Chiba Hospital performed between 2004 and 2008. All cases involved dental treatment for patients with mental retardation or autism. Where anesthetic records were insufficient, these cases were excluded from the analysis.

Ten items were selected as risk factors for PONV based on the risk factors of normal healthy patients reported in previous studies \(^1,2\). These included age, body weight, sex, duration of general anesthesia, use of propofol, use of sevoflurane, use of nitrous oxide, use of neostigmine, treatment accompanied with bleeding (for example, tooth extraction), and transfusion volume. Postoperative nausea and vomiting was evaluated using a postoperative check sheet completed by the patient’s guardians. Postoperative nausea and vomiting was recognized when there was a recording that vomiting had occurred or that actions indicative of nausea such as repeated gagging or spitting were observed within 24 hr after general anesthesia.

Linear discriminant analysis was performed using a statistical software package (Excel DE KANTAN TAHENYOU KAISEKI in Japanese).
to distinguish PONV incidence using the 10 items mentioned above as independent variables. Categorical variables (sex, use of drugs, treatment accompanied by bleeding) were coded for the analysis, as shown in Table 1. The reliability of the linear discriminant function was evaluated using a misjudgment rate and information criteria (AIC). It was assumed that PONV would occur when \( y > 0 \) in the linear discriminant function. Based on the reliability of the discriminant function and the coefficient of independent variables, the relationship of each risk factor and PONV incidence was investigated.

### Results

Patients included 149 men and 82 women. Thirteen patients were mentally challenged and had cerebral infantile palsy. The details of the results are shown in Table 2. Postoperative nausea and vomiting was observed in 15 cases out of 231 cases and PONV incidence was 5.6%. No serious complications caused by PONV were observed in any case.

Using statistical software, the combination of independent variables yielding the discriminant function with the smallest AIC was extracted from among all combinations of the 10 items targeted. The 6 most reliable linear discriminant functions are shown in Table 3. The discriminant function with the smallest AIC (−25.0718) consisted of two independent variables: \( y = -0.077x_1 - 0.001x_2 + 0.0716 \) (\( x_1 = \) use of propofol, \( x_2 = \) age). The misjudgment rate was 31.6%. This result suggests that PONV decreases when propofol is used and that the incidence of PONV decreases with age.

### Table 2 Results of the investigation based on anesthesia records

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>149</td>
<td>82</td>
</tr>
<tr>
<td>Use of propofol</td>
<td>123</td>
<td>108</td>
</tr>
<tr>
<td>Use of sevoflurane</td>
<td>83</td>
<td>148</td>
</tr>
<tr>
<td>Use of nitrous oxide</td>
<td>66</td>
<td>165</td>
</tr>
<tr>
<td>Use of neostigmin</td>
<td>83</td>
<td>148</td>
</tr>
<tr>
<td>Treatments with bleeding</td>
<td>95</td>
<td>136</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>21.5±10.8</td>
<td></td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td>47.4±19.5</td>
<td></td>
</tr>
<tr>
<td>Duration of the general anesthesia (min)</td>
<td>134.2±41.0</td>
<td></td>
</tr>
<tr>
<td>Transfusion volume (ml)</td>
<td>615.8±286.7</td>
<td></td>
</tr>
</tbody>
</table>

(Number of cases)

(Mean ± SD)

### Table 3 Linear discriminant functions

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>AIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: ( y = -0.0892x_1 + 0.0591 )</td>
<td>(AIC: -24.4055)</td>
</tr>
<tr>
<td>2: ( y = -0.077x_1 - 0.001x_2 + 0.0716 )</td>
<td>(AIC: -25.0718)</td>
</tr>
<tr>
<td>3: ( y = -0.0772x_1 - 0.0009x_2 - 0.0004x_3 + 0.0747 )</td>
<td>(AIC: -23.1231)</td>
</tr>
<tr>
<td>4: ( y = -0.0743x_1 - 0.0009x_2 + 0.0001x_3 - 0.039x_4 + 0.0808 )</td>
<td>(AIC: -20.2695)</td>
</tr>
<tr>
<td>5: ( y = -0.0455x_1 - 0.0003x_2 + 0.0004x_3 - 0.0374x_4 + 0.1338x_5 - 0.0615 )</td>
<td>(AIC: -19.5514)</td>
</tr>
<tr>
<td>6: ( y = -0.0433x_1 - 0.0001x_2 + 0.0011x_3 - 0.0339x_4 + 0.1315x_5 + 0.0002x_6 - 0.0952 )</td>
<td>(AIC: -18.7315)</td>
</tr>
</tbody>
</table>

\( x_1: \) Use of propofol, \( x_2: \) Age, \( x_3: \) Transfusion volume, \( x_4: \) Treatments with bleeding, \( x_5: \) Use of sevoflurane, \( x_6: \) Duration of general anesthesia
To investigate other risk factors, an additional analysis was performed using 83 out of the 231 cases in which sevoflurane was used as an anesthetic agent (Table 4). In this subgroup, PONV was observed in 10 cases and the incidence was 12.0%. Age, use of propofol, and use of sevoflurane were excluded from the analysis. Therefore, the linear discriminant analysis was performed with only the remaining 7 items as independent variables. The 6 most reliable linear discriminant functions of this analysis are shown in Table 4. According to the results of this analysis, the most reliable linear discriminant function consisted of two independent variables: \( y = -0.0655x_1 - 0.0001x_2 + 0.051 \) (\( x_1 = \text{sex, } x_2 = \text{body weight} \)). The result of the subgroup analysis suggests that the incidence of PONV decreases in male patients and decreases with increase in body weight. The AIC of this linear discriminant function was 54.5423, and the misjudgment rate was 31.6%.

### Discussion

Our results suggest that the risk for PONV in mentally challenged patients after day care general anesthesia reduces when propofol is used and the patient’s age is higher. The results of additional analysis suggest that risk is also reduced when the patient’s sex is male and body weight is heavier. These results are generally consistent with those in normal healthy patients.

One of the reasons why propofol is effective for prevention of PONV is its antiemetic activity\(^5\). A previous report\(^6\) showed that administration of 0.5 mg/kg propofol was effective in preventing PONV after breast cancer surgery in female patients. Although the mechanism for this effect remains to be fully elucidated, Hammas \( et al. \)\(^9\) suggested that propofol exerts an inhibitory effect on serotonin receptors in the gastrointestinal tract. Another study\(^4\) in rats suggested that the antiemetic activity of propofol was produced by a decrease in serotonin in area postrema and cerebrospinal fluid. According to some reports\(^5,10\), serotonin levels in cerebrospinal fluid were elevated in autistic patients. However, our results showed that propofol was also effective in preventing PONV in mentally challenged and autistic patients to the same level as that in normal healthy patients.

In the guidelines for prevention and treatment of PONV, the risk factors for postoperative vomiting in children are basically similar to those in adults, although there are the following differences: first, PONV is rare in children younger than 2 yr; second, the vomiting incidence is twice as frequent among children as among adults; third, risk increases with age, decreasing after puberty; and fourth, sex-related differences are not observed before puberty.

In this study, the average age of the patients was 21.5 yr. Although overall incidence of PONV was 5.6% in this study, PONV was observed in 8 of 63 patients (12.7%) whose age was under 13 yr. The fact that age was detected as the second risk factor following

### Table 4 Linear discriminant functions (subgroup analysis)

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>AIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: ( y = -0.065x_1 + 0.0462 )</td>
<td>54.5565</td>
</tr>
<tr>
<td>2: ( y = -0.0655x_1 - 0.0001x_2 + 0.051 )</td>
<td>54.5423</td>
</tr>
<tr>
<td>3: ( y = -0.0643x_1 + 0.0001x_2 - 0.03394x_3 + 0.0747 )</td>
<td>56.5299</td>
</tr>
<tr>
<td>4: ( y = -0.0669x_1 + 0.0002x_2 - 0.0244x_3 - 0.0004x_4 - 0.0094 )</td>
<td>60.3022</td>
</tr>
<tr>
<td>5: ( y = -0.0712x_1 - 0.0005x_2 - 0.0123x_3 - 0.0001x_4 + 0.0051x_5 + 0.0948 )</td>
<td>61.5764</td>
</tr>
<tr>
<td>6: ( y = -0.0617x_1 - 0.0004x_2 - 0.0258x_3 + 0x_4 - 0.0404x_5 - 0.0598x_6 + 0.1106 )</td>
<td>63.3607</td>
</tr>
</tbody>
</table>

\( x_1: \text{Sex, } x_2: \text{Body weight, } x_3: \text{Use of neostigmin, } x_4: \text{Treatments with bleeding, } x_5: \text{Transfusion volume, } x_6: \text{Use of nitrous oxide} \)
use of propofol may have resulted from the higher incidence of PONV in mentally challenged children.

The results of the subgroup analysis revealed that male patients were at lower risk for PONV in the mentally challenged. It is reported that PONV incidence is higher in females because of the influence of sex hormones such as gonadotropin, estrogen, and progesterone. The results of this study are well consistent with this earlier report.

On the other hand, in this study, risk for PONV reduced with increase in body weight, which is not consistent with earlier reports indicating obesity as a general risk factor for PONV. The results of this study may have been influenced by the patients’ age. In this study, body weight may have been influenced by age, as the study cohort included many children. In this study, it was impossible to analyze body mass index as an independent variable due to insufficient data.

In this study, the risk for PONV reduced when propofol was used and the patient’s age was high in mentally challenged patients after day care general anesthesia. This suggests that administration of propofol is effective in preventing PONV in mentally challenged patients. Other strategies to prevent PONV such as suction of gastric contents before awaking from general anesthesia or use of H2 receptor antagonists may be effective, especially in the case of mentally challenged pediatric patients because the risk for PONV would be increased.

In conclusion, the results of this study suggest that the major risks for PONV in mentally challenged patients after day care general anesthesia are no use of propofol, lower age, female sex and lower weight.

References


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