Prolonged hoarseness and arytenoid cartilage dislocation after tracheal intubation

H. Yamanaka1, Y. Hayashi1*, Y. Watanabe2, H. Uematu1 and T. Mashimo1

1Department of Anesthesiology, Osaka University Medical School, 2-2, Yamada-oka, Suita, Osaka 565-0871, Japan. 2Department of Oto-Rhino-Laryngology, International University of Health and Welfare Mita Hospital, Tokyo, Japan

*Corresponding author. E-mail: yhayashi@anes.med.osaka-u.ac.jp

Background. Hoarseness is a common complication after tracheal intubation and prolonged hoarseness may be very limiting for a patient. This study was designed to examine the duration of hoarseness after tracheal intubation and to identify risk factors that may increase the duration of hoarseness.

Methods. We prospectively studied 3093 adult patients (aged 18–77 yr), over a 3 yr period who required tracheal intubation. Postoperative hoarseness was assessed on the day of operation and on postoperative days 1, 3, and 7 by standardized interview by the resident anaesthetist managing the patient. If postoperative hoarseness was still present on postoperative day 7, the patient was followed up until complete resolution. We evaluated age, gender, weight, Cormack grades, duration of intubation, and the anaesthetic agents used as factors affecting the duration of hoarseness after tracheal intubation.

Results. Hoarseness was observed in 49% of patients on the day of surgery and in 29%, 11%, and 0.8% on 1, 3, and 7 postoperative days, respectively. Multiple regression analysis showed that patient age and duration of intubation, but not gender, weight, Cormack grades, or the agents used, were significant predictors of increased duration of hoarseness after tracheal intubation. We found three patients with arytenoid cartilage dislocation (0.097%) in our study population.

Conclusions. The age of the patient and duration of intubation were significant factors in the duration of hoarseness after tracheal intubation. In addition, the incidence of arytenoid cartilage dislocation was 0.097%.

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Hoarseness is a common complication after tracheal intubation and may be very limiting for a patient after anaesthesia. Previous reports suggest that the incidence of postoperative hoarseness varies widely from 16% to 55%. This variation may be due to timing of assessment of hoarseness after anaesthesia, as postoperative hoarseness has been reported to reduce daily after anaesthesia. Thus, it is useful to examine the time course of recovery from hoarseness after tracheal intubation. However, there is little information about the time course of recovery. In addition, although prolonged hoarseness after anaesthesia is known to be unusual, it is also clinically important to explore the exact outcome of this complication.

Arytenoid dislocation is a rare complication after tracheal intubation, which can significantly affect the patient’s satisfaction and activity after anaesthesia. Although the incidence of this complication is thought to be <0.1%, there is no prospective and systemic study of the incidence of this complication.

This study was designed to examine the duration of hoarseness after anaesthesia and the final outcome of patients who had hoarseness lasting >7 days after anaesthesia. We also examined whether age, gender, weight, duration of anaesthesia, choice of anaesthetic agent, and intubation difficulty increases the duration of hoarseness after tracheal intubation.
Methods

The protocol was approved by our institutional human investigation committee and written informed consent was obtained from each patient. We prospectively enrolled patients (ASA I or II) undergoing general anaesthesia with tracheal intubation into this study. Patients who were admitted to the intensive care unit after operation or in whom the trachea was not extubated in the operating theatre were withdrawn from the study. In the operating theatre, monitoring, including electrocardiography, non-invasive arterial pressure, pulse oximetry, and capnography, was established. After preoxygenation, general anaesthesia was induced with i.v. thiamylal (5 mg kg\(^{-2}\)) or propofol (2 mg kg\(^{-1}\)). Vecuronium was used to facilitate tracheal intubation. The patient’s trachea was intubated by the resident anaesthetist managing the patient and subsequently, if the intubation was difficult, by a staff anaesthetist. The following factors were standardized: tube size (males: ID=8.0 mm; females: ID=7.5 mm), cuff inflation with room air until no leak with ventilation was heard followed by adjusting the cuff volume intermittently when nitrous oxide is applied; and the use of lidocaine gel (Xylocaine 2% jelly, AstraZeneca, Sweden). Anaesthesia was maintained with combination of volatile anaesthetics (sevoflurane or isoflurane) with or without nitrous oxide and fentanyl or total i.v. anaesthesia (propofol and fentanyl). The choice of anaesthetic maintenance was determined by the resident anaesthesiologist managing the patient. Additional neuromuscular blocking drugs were used if required.

Assessment of postoperative hoarseness was done by a resident anaesthetist who interviewed the patient for pre-anaesthetic evaluation and managed the patient. He visited the patient on the day of operation (in the evening after the operation) and first, third, and seventh day after anaesthesia and talked with the patient to compare the patient’s voice with that before anaesthesia. Recovery of hoarseness after anaesthesia was defined as when the patient did not complain of hoarseness and the resident assessed full recovery of the patient’s voice. If postoperative hoarseness persisted >7 days, the patient was examined by a vocal cord specialist (Y.W.) using video-laryngo-stroboscopy and any necessary additional investigations. We recorded the following data to determine significant factors to increase the duration of hoarseness after tracheal intubation: age, gender, weight, Cormack grades,\(^{12}\) duration of intubation, and the anaesthetics used. A large retrospective study\(^{10}\) found four cases of arytenoid cartilage dislocation in 13 698 intubations (0.029%). We considered that at least 3000 patients would be a primary point to find a case of arytenoid cartilage dislocation.

Data were expressed as means (SD). Multiple linear regression analysis was performed to evaluate the factors to increase the duration of postoperative hoarseness. \(P<0.05\) was considered statistically significant.

Results

A total of 3139 patients were enrolled, but 46 were excluded because of incomplete data or not being extubated in the operating theatre. Thus, data for 3093 patients [mean age 53 yr, 1356 (44%) males, and 1737 (56%) females] were analysed. The mean duration of intubation was 283 (SD 172) min. Hoarseness was observed in 49% of patients on the day of surgery and this decreased to 29%, 11%, and 0.8% on 1, 3, and 7 postoperative days, respectively (Fig. 1).

Twenty-five patients (0.8%) still had hoarseness on the seventh postoperative day (Table 1). We found arytenoid cartilage dislocation in three patients and these patients recovered after surgical treatment of the dislocated cartilage. We also found vocal cord paralysis in four patients. Three of them recovered after a long period, but one patient did not. Seven patients with no identifiable pathological change, all spontaneously recovered within 2 weeks. In addition, two other patients did not agree to examination of the vocal cords, but also recovered within 2 weeks. Two patients had recurrent laryngeal nerve paralysis due to operation and were withdrawn from the multiple regression analysis.

Multiple regression analysis showed that age and duration of intubation, but not gender, weight, Cormack grades, or the anaesthetic agents used, were significant factors in the increased duration of hoarseness after tracheal intubation (Table 2).

Discussion

We found that hoarseness occurred in 49% of patients with tracheal intubation on the day of operation and persisted for >1 week in 0.8% of our patients. Our data showed that age and duration of intubation were significant factors to increase the duration of hoarseness after

![Fig 1 Incidence of postoperative hoarseness. The parentheses show the actual number of patients with postoperative hoarseness and the error bar shows 95% confidence intervals for the proportion.](https://academic.oup.com/bja/article-abstract/103/3/452/244488/244488)
but other studies have not noted this effect of lidocaine gel. 

Multiple linear regression analysis showed that this may be a significant factor of postoperative hoarseness. We think that this result is not surprising. However, to our knowledge, there is no report to show age as a significant factor of postoperative hoarseness and one previous smaller study did not show that age was a significant predictor. Several clinical studies have found postoperative sore throat and hoarseness to be more common in females, but this was not the case in our study. It has been shown that postoperative hoarseness is reduced by the use of smaller tubes and we used a smaller tracheal tube for female patients which may have had an effect on our data.

Several predictors of hoarseness after anaesthesia have been studied previously. Consistent with a previous report, multiple linear regression analysis showed that duration of intubation was a strong predictor to increase the duration of hoarseness after tracheal intubation. A longer duration of anaesthesia may produce greater airway injury. Our study also demonstrated that age was a significant factor of postoperative hoarseness. We think that this result is not surprising. However, to our knowledge, there is no report to show age as a significant factor of postoperative hoarseness and one previous smaller study did not show that age was a significant predictor. Several clinical studies have found postoperative sore throat and hoarseness to be more common in females, but this was not the case in our study. It has been shown that postoperative hoarseness is reduced by the use of smaller tubes and we used a smaller tracheal tube for female patients which may have had an effect on our data.

In our study, 25 patients did not recover from hoarseness by the seventh postoperative day, including the surprising finding in three patients of arytenoid cartilage dislocation. This complication may occur at intubation or exubation or insertion of a too large a tube, but the precise mechanism is not well elucidated, and some clinical case reports showed that it may be resolved spontaneously. This complication is considered to be very rare and our data showed that the incidence was 0.097%. This is similar to one previous report which found one arytenoid cartilage dislocation in 1000 direct laryngoscopic intubations, but higher than in a retrospective survey which found four cases in 13,698 intubations (0.029%) over a 3 yr period. Although the precise incidence of this complication is not known, two previous reports suggested that it may occur more frequently than previously believed. A larger prospective study is required to define the precise incidence of this complication.

### Table 1: Outcome of patients with hoarseness lasting >7 days (25 patients). ENT: ear, nose, and throat

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number of patients</th>
<th>Course of each patient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ENT examination</td>
</tr>
<tr>
<td>Arytenoid cartilage dislocation</td>
<td>3</td>
<td>15 postoperative days</td>
</tr>
<tr>
<td>Vocal cord oedema</td>
<td>1</td>
<td>14 postoperative days</td>
</tr>
<tr>
<td>Vocal cord oedema and erosion</td>
<td>1</td>
<td>8 postoperative days</td>
</tr>
<tr>
<td>Vocal cord paralysis</td>
<td>4</td>
<td>21 postoperative days</td>
</tr>
<tr>
<td>Unknown cause of hoarseness</td>
<td>7</td>
<td>9 postoperative days</td>
</tr>
<tr>
<td>Recurrent nerve paralysis due to operation</td>
<td>2</td>
<td>9 postoperative days</td>
</tr>
<tr>
<td>Unable to follow-up</td>
<td>7</td>
<td>8 postoperative days</td>
</tr>
</tbody>
</table>

### Table 2: Multivariable linear regression model of potential predictors of increased duration of hoarseness after anaesthesia

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter estimation (95% confidence limits)</th>
<th>se</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.7747 (-0.0211 to 0.1722)</td>
<td>0.04276</td>
<td>0.00037</td>
</tr>
<tr>
<td>Age (male)</td>
<td>0.0067 (-0.0011 to 0.0122)</td>
<td>0.04276</td>
<td>0.00184</td>
</tr>
<tr>
<td>Sex (male)</td>
<td>0.1427 (-0.0628 to 0.3481)</td>
<td>0.04276</td>
<td>0.10490</td>
</tr>
<tr>
<td>Weight</td>
<td>-0.0056 (-0.0144 to 0.0033)</td>
<td>0.04276</td>
<td>0.21624</td>
</tr>
<tr>
<td>Duration of intubation</td>
<td>0.0018 (0.0013 to 0.0024)</td>
<td>0.04276</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>0.0399 (-0.2783 to 0.3580)</td>
<td>0.04276</td>
<td>0.80691</td>
</tr>
<tr>
<td>Volatile anaesthetics</td>
<td>-0.0234 (-0.5871 to 0.5403)</td>
<td>0.04276</td>
<td>0.93541</td>
</tr>
<tr>
<td>(sevoflurane; isoflurane)</td>
<td>-0.0214 (-0.5421 to 0.5771)</td>
<td>0.04276</td>
<td>0.95126</td>
</tr>
<tr>
<td>Cormack scale</td>
<td>0.0963 (-0.0214 to 0.2140)</td>
<td>0.04276</td>
<td>0.10959</td>
</tr>
</tbody>
</table>

The incidence of postoperative hoarseness in our population (49%) is similar to or greater than the incidences reported previously. We chose a tracheal tube of internal diameter 8.0 mm for men and 7.5 mm for women as is our routine practice. The use of smaller diameter tubes may reduce hoarseness after anaesthesia. In addition, the use of cuff pressure monitoring devices and periodic measurement of pressure would reduce mucosal damage and hoarseness, although we intermittently adjusted the cuff volume when nitrous oxide is applied. We used lidocaine gel to the cuff of a tracheal tube and this has been shown to increase the incidence of hoarseness. This may have contributed to the higher incidence of hoarseness, but other studies have not noted this effect of lidocaine gel. Several predictors of hoarseness after anaesthesia have been studied previously. Consistent with a previous report, multiple linear regression analysis showed that duration of intubation was a strong predictor to increase the duration of hoarseness after tracheal intubation. A longer duration of anaesthesia may produce greater airway injury. Our study also demonstrated that age was a significant factor of postoperative hoarseness. We think that this result is not surprising. However, to our knowledge, there is no report to show age as a significant factor of postoperative hoarseness and one previous smaller study did not show that age was a significant predictor. Several clinical studies have found postoperative sore throat and hoarseness to be more common in females, but this was not the case in our study. It has been shown that postoperative hoarseness is reduced by the use of smaller tubes and we used a smaller tracheal tube for female patients which may have had an effect on our data.

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There are several potential limitations in our study. First, there is the possibility of beta errors associated with the statistical analysis. Increased score on the Cormack scale, for example, tended to increase the duration of hoarseness after tracheal intubation, although our analysis did not reach statistical significance ($P = 0.109$; Table 2). A larger sample size may have shown significance.

Secondly, the diagnosis of hoarseness included the judgment of the resident visiting after operation and complaint of hoarseness by the patient. Thus, there is the possibility that a patient complained of hoarseness rather than throat discomfort. However, there were few cases in which these two criteria were not consistent.

In conclusion, hoarseness occurred in almost half of our patients on the day of operation, but hoarseness lasting for >1 week was unusual. Age and duration of intubation were significant factors in hoarseness after tracheal intubation. In addition, we found arytenoid cartilage dislocation in three patients.

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