

Cardiovascular Operation: A Significant Risk Factor of Arytenoid Cartilage Dislocation/Subluxation after Anesthesia

Abstract

Background: Arytenoid cartilage dislocation/subluxation is one of the rare complications following tracheal intubation, and there have been no reports about risk factors leading this complication. From our clinical experience, we have an impression that patients undergoing cardiovascular operations tend to be associated with this complication. **Aims:** We designed a large retrospective study to reveal the incidence and risk factors predicting the occurrence and to examine whether our impression is true. **Settings and Designs:** This was a retrospective study. **Methods:** We retrospectively studied 19,437 adult patients who were intubated by an anesthesiologist in our operation theater from 2002 to 2008. The tracheal intubation was performed by a resident anesthesiologist managing the patients. Only patients whose postoperative voice was disturbed more than 7 days were referred to the Department of Otorhinolaryngology-Head and Neck Surgery and examined using laryngostroboscopy by a laryngologist to diagnose arytenoid cartilage dislocation/subluxation. We evaluated age, sex, weight, height, duration of intubation, difficult intubation, and major cardiovascular operation as risk factors to lead this complication. **Statistical Analysis:** The data were analyzed by logistic regression analysis to assess factors for arytenoid cartilage dislocation/subluxation after univariate analyses using logistic regression analysis. **Results:** Our analysis indicated that difficult intubation (odds ratio: 12.1, $P = 0.018$) and cardiovascular operation (odds ratio: 9.9, $P < 0.001$) were significant risk factors of arytenoid cartilage dislocation/subluxation. **Conclusion:** The present study demonstrated that major cardiovascular operation is one of the significant risk factors leading this complication.

Keywords: Airway, arytenoid cartilage dislocation/subluxation, cardiovascular operation, complication, tracheal intubation

Introduction

Laryngeal injury after cardiac operation is sometimes overlooked as a cause of postoperative hoarseness and dysphagia. Although vocal cord paralysis is rare, it is relatively well-recognized complication after cardiac surgery.^[1] On the other hand, arytenoid cartilage dislocation/subluxation is also one of the rare complications following tracheal intubation^[2] and shows similar clinical symptoms with vocal cord paralysis.^[2] This complication also results in voice disorders after operation and may significantly affect patient's satisfaction and activity after operation.^[3] In contrast with vocal cord paralysis, this complication can be recovered by early detection and treatment.^[3] Since the most prevalent symptom of this complication is hoarseness, we have paid attention to this symptom and referred patients whose postoperative hoarseness was prolonged more than 7 days to the Department of

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Otorhinolaryngology-Head and Neck Surgery for laryngeal observation of the larynx and differential diagnosis of voice disorder from 2002.^[4] Since this system was introduced, we have had a strong impression that patients undergoing cardiovascular operations tend to be associated with this complication. Thus, we designed this retrospective study to investigate whether cardiovascular operations are included in predicting risk factors for arytenoid dislocation/subluxation after tracheal intubation with a larger number of adult anesthetic patients in our hospital.

Methods

This retrospective study was approved by our Institutional Ethics Committee (#08307), and written informed consent from each patient was omitted because of the retrospective study design. This study included 19,670 adult patients, aged 18–77 years, who were intubated

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by an anesthesiologist in our operation theater from 2002 to 2008.

After arrival of the patient in the operating room, monitoring, including electrocardiography, noninvasive arterial pressure monitoring, pulse oximetry, and capnography, was established. An arterial catheter for invasive monitoring of arterial pressure, a central venous catheter, and a pulmonary arterial catheter are placed after induction of anesthesia, if necessary. After preoxygenation, general anesthesia was induced with intravenous thiamylal (5 mg/kg), propofol (2 mg/kg), or midazolam (5–10 mg). Patients were paralyzed with vecuronium to facilitate tracheal intubation. The patient's trachea was intubated by a resident anesthesiologist managing the patient first, and if the intubation was difficult, a staff anesthesiologist did instead. The following factors were standardized: tube size (men: internal diameter [ID] = 8.0 mm; women: 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 use of lidocaine gel (Xylocaine 2% jelly, AstraZeneca, Sweden). Anesthesia was maintained with a combination of volatile anesthetics (sevoflurane or isoflurane) with or without nitrous oxide, fentanyl, and sedative agents (propofol and midazolam). The choice of anesthetic maintenance was determined by the resident anesthesiologist managing the patient. Additional neuromuscular blocking drugs were used if required.

The anesthesiologists attending the patient made a consultation with the patient and heard the voice after anesthesia.^[4] Patients whose postoperative hoarseness was prolonged more than 7 days were referred to the Department of Otorhinolaryngology-Head and Neck Surgery, and a laryngologist with more than 15-year experience of clinical management of voice disorders examined the patients using laryngostroboscopy to determine the diagnosis of the voice disturbance, followed by observation of the larynx every 1 month. Arytenoids cartilage dislocation/subluxation was diagnosed based on the finding that the arytenoid fixes anteriorly or posteriorly out of the physiological track location between adductive and abductive position. In the present study, we calculated the incidence of arytenoid cartilage dislocation/subluxation after tracheal intubation and recorded the following data to determine significant factors to lead this complication; age, sex, weight, height, duration of intubation, difficult intubation, and major cardiovascular operation. The difficult intubation was defined as tracheal intubation which was not successful with direct laryngoscopy and required other devices for tracheal intubation, such as a flexible fiberoptic laryngoscope and the Bullard laryngoscope. Major cardiovascular operation included open heart operations, on- and off-pump coronary artery bypass graftings, and thoracic aortic surgeries. An abdominal aortic operation, a peripheral vascular operation, and a pacemaker implantation were not included.

Univariate predictor variable with $P < 0.1$ was considered for inclusion in multivariate models.

Based on 10,602 cases from 2002 to 2005, which included two cases of arytenoid cartilage dislocation/subluxation after tracheal intubation in 501 cases of major cardiovascular operations and five cases of the complication in 10,101 cases of other operations, an appropriate sample size was calculated based on Chi-square analysis to be 19,086 for detecting major cardiovascular operation as a significant risk factor for the complication at the significant level of 0.05 with a statistical power of 80%. Thus, we included cases of additional 3 years (2006–2008) to fulfill the sample size.

Data were expressed means \pm standard deviation (SD). The data were analyzed by logistic regression analysis to determine the significant risk factors, leading postoperative arytenoid cartilage dislocation/subluxation. Factors included in the multivariate regression analysis were selected among variables yielding $P < 0.1$ by univariate analysis. $P < 0.05$ was considered statistically significant.

Results

This study included 19,670 patients, but 233 patients were excluded because of postoperative tracheotomy, death without extubation, or incomplete data. Thus, 19,437 patients, mean age 56 years (SD: 16), were enrolled [Figure 1] in the study. Among them, we had 1374 cases of major cardiovascular operation and 18,063 cases of other operations. We found arytenoid cartilage dislocation/subluxation in 14 patients, and the incidence of this complication was calculated as 0.072% (95% confidence interval: 0.034%–0.110%).

In univariate analysis, variables with $P < 0.1$ included sex (male), height, duration of intubation, difficult intubation, and major cardiovascular operation [Table 1] and they were considered for inclusion in multivariate models. Logistic regression analysis revealed that height, difficult intubation, and major cardiovascular operation, but not sex or duration of intubation, were significant risk factors for arytenoid

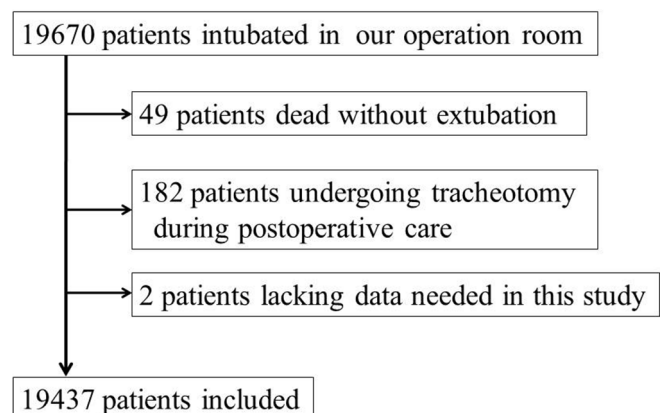


Figure 1: Patient inclusions and exclusions

cartilage dislocation/subluxation after tracheal intubation [Table 2].

Discussion

The principal finding of this study is that major cardiovascular operation as well as height and difficult intubation are significant risk factors leading to this complication.

The present result that major cardiovascular operation was a remarkable risk factor supports our impression and is clinically interesting. However, actually, we cannot reasonably explain why major cardiovascular operation is significantly associated with this complication. One may deduce that longer period of intubation associated with cardiovascular operations may facilitate the complication, but this is unlikely because our multivariate analysis clearly denied that duration of intubation was a significant risk factor [Table 2].

Although we do not have any definite evidence, we think that one possible explanation may be insertion of a probe of transesophageal echocardiography (TEE). This is a routine monitoring for used in patients undergoing a cardiovascular operation, and we used it for all patients suffering this complication in this study. A probe of TEE is usually inserted through the oral cavity and pharynx to the esophagus and subsequently removed in the presence

of a tracheal tube during anesthesia. Hence, it is likely that the arytenoid cartilage is sandwiched between the probe and the tracheal tube and external force during insertion or removal of the probe of TEE shift the location of the arytenoid, leading to the destruction of the crico-arytenoid joint. So far, definite evidence demonstrating the relationship between a probe of TEE and the complication has not been reported although one previous case report suggested the possible involvement of TEE in the complication after intubation.^[5] Another previous study by Rousou *et al.*^[6] reported that the odd of dysphagia for TEE patients was 7.8 times greater than for non-TEE patients after cardiac operations. Considering that dysphagia as well as hoarseness is included in major symptoms of arytenoids dislocation/subluxation,^[7] we speculate that dysphagia following TEE might be in part due to arytenoid dislocation/subluxation.

A previous case report has suggested that difficult intubation may be one of the risk factors for arytenoid dislocation/subluxation.^[8] However, there has been no clinical study to demonstrate that difficult intubation is a risk factor leading to this complication. The present data confirm that difficult intubation is one of the risk factors of the complication. In this study, the difficult intubation was defined as tracheal intubation which was not successful with direct laryngoscopy but could be performed with some other devices. Presumably, repeated trials of intubation using direct laryngoscopy and other devices may shift the arytenoid cartilage to extraordinary position through excessive mechanical invasion to the larynx, leading to the destruction of the crico-arytenoidal joint.

The present study also showed that tall height is a risk factor. This result is unexpected because there has been no report, suggesting the relationship between tall height and arytenoid dislocation. Now, we cannot present any reasonable speculation why height is a risk factor. Of course, there may be the possibility of type 1 error and further information would be needed to conclude the possibility of tall height as a risk factor for arytenoid dislocation.

So far, there are several reports speculating the incidence of arytenoid dislocation after intubation^[8-10] and they claimed that it may be <0.1% of tracheal intubations. The present study enrolled larger sample size (19,437) of adult patients through 7 years of observation period in a single university hospital and screened postoperative hoarseness, and the incidence for arytenoid dislocation/subluxation after tracheal intubation was calculated as 0.072%.

Several potential limitations of the present study should be considered. First, although we referred each patient showing postoperative persistent hoarseness to the Department of Otorhinolaryngology-Head and Neck Surgery, the Department did not routinely perform electromyography (EMG). Several previous studies

Table 1: Univariate analyses of demographic characteristics, length of intubation, intubation difficulty, and an operation factor (major cardiovascular operation) for arytenoid cartilage dislocation/subluxation after tracheal intubation

Variable	Beta	Odds ratio	95% CI	P
Sex (male)	0.983	2.672	1.114-8.523	0.097
Age	-0.007	0.993	0.962-1.025	0.670
Height	0.077	1.080	1.020-1.143	0.008
Weight	0.028	1.028	0.989-1.069	0.161
Duration of intubation	0.005	1.005	1.000-1.010	0.055
Difficult intubation	2.147	8.559	1.114-65.791	0.039
Major cardiovascular operation	2.288	9.851	3.451-28.116	<0.001

CI: Confidence interval

Table 2: Multivariate association with arytenoid cartilage dislocation/subluxation after tracheal intubation logistic regression analysis

Variable	Beta	Odd ration	95% CI	P
Sex (male)	-0.575	0.563	0.12-2.643	0.466
Height	0.90	1.094	1.018-1.176	0.014
Duration of intubation	0.002	1.002	0.994-1.010	0.599
Difficult intubation	2.491	12.077	1.525-95.641	0.018
Major cardiovascular operation	2.295	9.924	3.227-30.522	<0.001

CI: Confidence interval

suggested that EMG may be helpful to differentiate arytenoid dislocation/subluxation from vocal fold paralysis.^[3,11] Second, we did not distinguish dislocation and subluxation of the arytenoid. Logically, dislocation refers to complete separation of the joint cartilaginous surfaces, while subluxation is a partial dislocation that maintains some contact between the joint surfaces. However, these joint complications have similar clinical symptoms and outcomes, and it is not easy to distinguish complete or partial separation between the joint cartilages clinically.^[2] Accordingly, we omitted to distinguish these two disturbed conditions with vocal fold immobility. Third, all cases suffering postoperative hoarseness may not have been referred to the Department of Otorhinolaryngology-Head and Neck Surgery. For example, patients with seriously impaired circulatory or respiratory condition or those with preoperative hoarseness were hesitated to migrate to the department for consultation in spite of manifestation of hoarseness. Fourth, this study was performed with retrospective method. Thus, this may not provide the true incidence.

Conclusion

Our retrospective study shows that major cardiovascular operation is one of the significant risk factors to induce this complication.

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Conflicts of interest

There are no conflicts of interest.

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