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Analysis of endotracheal intubation-related judicial precedents in South Korea

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Background: Medical malpractice during endotracheal intubation can result in catastrophic complications. However, there are no reports on these severe complications in South Korea. We aimed to investigate the severe complications associated with endotracheal intubation occurring in South Korea, via medicolegal analysis.

Methods: We retrospectively analyzed the closed judicial precedents regarding complications related to endotracheal intubation lodged between January 1994 and June 2020, using the database of the Supreme Court of Korea. We collected clinical and judicial characteristics from the judgments and analyzed the medical malpractices related to endotracheal intubation.

Results: Of 220 potential cases, 63 were included in the final analysis. The most common event location was the operating room (n = 20, 31.7%). All but 3 cases were associated with significant permanent or more severe injury, including 31 deaths. The most common problems were failed or delayed intubation (n = 56, 88.9%). Supraglottic airway device was used in 5.2% (n = 3) cases of delayed or failed intubation. Fifty-one (81%) cases were ruled in favor of the plaintiff in the claims for damages, with a median payment of Korean Won 133,897,845 (38,000,000, 308,538,274). The most common malpractice recognized by the court was that of not attempting an alternative airway technique (n = 32, 50.8%), followed by violation of the duty of explanation (n = 10, 15.9%).

Conclusions: Our results could increase physicians' awareness of the major complications related to endotracheal intubation and help ensure patient safety.

Keywords: Airway management; Complications; Emergency treatment; Intratracheal intubation; Medical legislation; Medical liability.

Introduction

Endotracheal intubation is an important airway procedure to secure airway patency and ensure adequate ventilation in patients with respiratory depression or those undergoing general anesthesia [1]. Since a delay of only a few minutes in securing the airway can cause hypoxic brain injury or death, medical malpractice during endotracheal intubation could lead to catastrophic complications.

Previous closed claims analyses related to airway management, including endotracheal intubation, have been mainly performed in the field of anesthesiology [2,3]. According to the closed claims database of the American Society of Anesthesiologists (ASA) since 1990, respiratory complications are the second most common damaging event, and diffi-

cult intubation is the most common respiratory event leading to claims [2]. Another closed claims analysis of the ASA focusing on difficult intubation reported a total of 179 claims related to difficult airway management between 1985 and 1999 and revealed that serious complications, such as brain damage or death, occurred in approximately 63% of these cases [3].

However, to the best of our knowledge, no reports have focused on severe complications resulting from medical malpractice related to endotracheal intubation in South Korea. Therefore, we aimed to examine the rare but severe complications and possible medical malpractice associated with endotracheal intubation via the analysis of medical malpractice legal judgments.

Materials and Methods

Data collection

We analyzed closed judicial precedents from the publicly available judgment database of the Supreme Court of Korea. We searched all civil proceedings that were decided by the court between January 1, 1994 and June 31, 2020 using the following terms: 'endotracheal' and 'intubation.' We included medical malpractice litigation cases related to endotracheal intubation itself. We excluded cases related to airway procedures other than endotracheal intubation. We also excluded cases related to complications that occurred during an intubated state or extubation. The Institutional Review Board of Seoul National University Hospital (No. 02010-075-1163) approved this retrospective study. Since the judgments were provided to the researcher after de-identification, the need for informed consent was waived.

This analysis was conducted in a similar manner as our previous medicolegal studies [4,5]. Each precedent text included detailed clinical information related to the events, the plaintiff's claim, and the court decisions regarding medical malpractice. Three anesthesiologists (HY Cho, SJ Lee, and S Yoon) scrutinized the precedent texts, collecting the following variables: demographics (including age and sex), department of primary defendant physician, type of medical institution (local clinic, hospital), location of event, reason for tracheal intubation, and the types and severities of the complications. The severity of complications was evaluated using the 10-point National Association of Insurance Commissioners (NAIC) scale (0: no obvious injury, 1: emotional only, 2: temporary insignificant, 3: temporary minor, 4: temporary major, 5: permanent minor, 6: permanent significant, 7: permanent major, 8: permanent grave, 9: death) [6]; and classified as low (0–2), medium (3–5), or high (6–9) [5]. During the second review, we investigated the potential predictors of difficult tracheal intubation [7], the number of laryngoscopic attempts, whether or not alternative airway intervention was performed, and the duration from the determination of intubation to intubation (min) in cases associated with delayed intubation. We also collected legal data including the detailed claims of plaintiffs, opinion of the court, and final claimed and awarded amounts. The defendant's allegations were classified into violation of the duty of care and violation of the duty of explanation. The violation of the duty of care was subclassified into the following 8 categories during the second review: no attempt of alternative airway technique, physician inexperience, no confirmation of endotracheal intubation, inappropriate tube size, pulmonary aspiration, upper airway trauma, absence of intubation instruments, and inappropriate management of bronchospasm. The classification process was conducted by 2 anesthesiologists (HY Cho and H-J Lee) independently. In the case of a conflict between the 2 authors, the decision was made after discussion with a third author (SH Shin). Additionally, we performed a subgroup analysis in pediatric patients during the revision process.

Statistical analysis

Descriptive statistical analysis was performed using MedCalc version 19.5.3 (MedCalc Software Ltd., Belgium). We did not perform comparative statistics because our data could not represent all complications caused by endotracheal intubation in South Korea, and we could not know the accurate denominators. Continuous data are described as medians and interquartile ranges, and categorical data are described as numbers and percentages.

Results

A total of 220 cases from 408 judgments were reviewed for eligibility. Among them, 157 were excluded and 63 cases were included in the final analysis. The general characteristics of the cases are presented in Table 1. Intubation was performed for respiratory depression management in 48 (76.2%) cases and for general anesthesia in 15 (23.8%) cases. The NAIC severity level was high (6–9) for 60 (95.2%) claims, with a total of 31 (49.2%) deaths.

The type of problems identified by researchers are provided in Table 2. The most common problem was delayed intubation (n = 56, 88.9%). Failed intubation occurred in 2 patients. In these 2 cases, tracheal intubation was attempted for general anesthesia and the patients were awakened after intubation failure. Accidental bronchial intubation occurred in 2 pediatric patients.

Table 3 presents the detailed information of the cases related to delayed or failed intubation. Predictors of difficult tracheal intu-

Table 1. General Characteristics of the Cases in This Study

Characteristics	Total (n = 63)
Sex (Male/Female/Not described)	25 (39.7)/22 (34.9)/16 (25.4)
Age at the time of event, years	15 (23.8)/3 (4.8)/24 (38.1)/4 (6.3)/17 (27.0)
(< 10/10–19/20–59/ ≥ 60/Not described)	
Institution (Local clinic/Hospital)	8 (12.7)/55 (87.3)
Location of event	
Operating room	20* (31.7)
Emergency room	15 (23.8)
General ward	13 (20.6)
Intensive care unit	9 (14.3)
Diagnostic procedure room	4† (6.3)
Post-Anesthesia Care Unit	2 (3.2)
Cause of intubation (Respiratory depression/General anesthesia)	48 (76.2)/15 (23.8)
Clinical outcomes	
High (NAIC score 6–9)	60‡ (95.2)
Medium (NAIC score 3–5)	2 (3.2)
Low (NAIC score 0–2)	1 (1.6)

Values are presented as number (%). NAIC: National Association of Insurance Commissioners. *Causes of intubation at operating room: general anesthesia, n = 15 (23.8); respiratory depression during local anesthesia, n = 2 (3.2); respiratory depression after extubation, n = 1 (1.6); respiratory depression immediately after birth, n = 2 (3.2). †Esophagogastroduodenoscopy, n = 3 (4.8); bronchoscopy, n = 1 (1.6). ‡This included 31 deaths.

Table 2. Type of Alleged Problems

Classification*	Total (n = 63)
Delayed intubation	56* (88.9)
Aspiration of gastric contents	4 (6.3)
Upper airway trauma	4† (6.3)
Accidental bronchial intubation	2 (3.2)
Failed intubation	2 (3.2)

Values are presented as number (%). *There were 5 cases involving 2 or more events: 3 cases of delayed intubation and aspiration of gastric contents; 1 case of delayed intubation, aspiration of gastric contents, and upper airway trauma; and 1 case of delayed intubation and bronchial intubation. †Tooth injury, n = 2 (3.2); laryngeal injury, n = 1 (1.6); vocal cord injury, n = 1 (1.6).

bation were identified in 43 (74.1%) of these cases. The most common predictor was airway obstruction (n = 33, 56.9%), followed by limited mouth opening (n = 13, 22.4%). In all cases, the initial attempt was direct laryngoscopy, and there were ≥ 3 laryngoscopic attempts in 34 (58.6%) cases. Subsequent alternative airway procedures were performed in 19 (35.8%) cases. The supraglottic airway device (SAD) was used in 5.2% (n = 3) cases of delayed or failed intubation, and all of these were performed by anesthesiologists.

The legal outcomes of the malpractice claims related to intubation are shown in Table 4. A total of 51 (81%) claims resulted in payments to the plaintiffs, with a median payment of Korean Won (KRW) 133,897,845 (38,000,000, 308,538,274). The most common type of violation of the duty of care claimed by the plaintiff was that of no attempt of alternative airway management (n = 47, 74.6%), followed by physician inexperience (n = 15, 23.8%). The most common type of violation of the duty of care recognized by the court was also that of no attempt of alternative airway management (n = 32, 50.8%), followed by physician inexperience (n = 8, 12.7%). All physicians whose inexperience was recognized as malpractice were non- anesthesiologists. Of the cases in which an inappropriate tube size was claimed to be malpractice, 5 were pediatric patients and 2 were adult patients. Violation of the duty of explanation was recognized in 10 cases (15.9%), and among them, there were 2 cases of violation of the duty of explanation alone without violation of the duty of care. The reasons for their recognized malpractices were as follows: no explanation prior to scheduled intubation for general anesthesia (n = 8), explanation by a nurse (n = 1), and insufficient explanation regarding tooth injury by an attending surgeon (n = 1). Supplementary Tables 1–4 show the results of the subgroup analysis in pediatric patients.

Discussion

In this study, we analyzed 63 judicial precedents associated with endotracheal intubation complications in the Korean court system. The main finding was that the majority of cases were related to delayed intubation, and the most common type of malpractice recognized by the court was that of no attempt of alternative air-

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Table 3. Detailed Information of the Cases Related to Delayed or Failed Intubation

Characteristics	Total (n = 58)
Failed intubation	2 (3.4)
Predictors of difficult tracheal intubation	43 (74.1)
Airway obstruction from any cause	33* (56.9)
Limited mouth opening	13 (22.4)
Short neck	12 (20.7)
Secretions/blood in airway	5 (8.6)
History of cervical operation	3 (5.2)
History of cervical irradiation	1 (1.7)
Swollen tongue	2 (3.4)
Mallampati grade III or IV	1 (1.7)
Number of predictors (0/1/≥2)	15 (25.9)/21 (36.2)/ 22 (37.9)
Department of the first intubation attempter (Anesthesiologist/Internal medicine doctor/ Emergency medicine doctor/Pediatrician/Others/Not described)	18[†] (31.0)/10 (17.2)/6 (10.3)/3 (5.2)/9[‡] (15.5)/11 (19.0)
Calling for help	14 (24.1)
Number of endotracheal intubation attempts (1/2/≥3/Not described)	7 (12.1)/14 (24.1)/34 (58.6)/3 (5.2)
Alternative airway intervention (Tracheostomy/Cricothyroidotomy/Supraglottic airway device)	11 (19.0)/5 (8.6)/3 (5.2)
Duration from the determination of intubation to airway securement (min)[§]	20 (14, 35)

Values are presented as median (Q1, Q3) or number (%). *Causes of airway obstruction: upper airway edema, n = 21 (36.2); neck abscess, n = 5 (8.6); neck hematoma, n = 5 (8.6); tracheal stenosis, n = 2 (3.4). [†]Received a request for help in 3 cases. [‡]General physician, n = 4 (6.9); neurosurgeon, n = 2 (3.4); orthopedic surgeon, n = 1 (1.7); obstetrician, n = 1 (1.7); family medicine doctor, n = 1 (1.7). [§]Two failed intubation cases were excluded.

Table 4. Judicial Characteristics

Characteristics	Total (n = 63)
Claim conclusion	
Dismissal/Settlement/Recognition of violation	12 (19.0)/11 (17.5)/40 (63.5)
Violation of the duty of care (contended by plaintiffs/recognized by the court)	
No attempt of alternative airway technique	47 (74.6)/32 (50.8)
Physician inexperience	15 (23.8)/8 (12.7)
No confirmation of endotracheal intubation	9 (14.3)/7 (11.1)
Inappropriate tube size	7 (11.1)/6 (9.5)
Pulmonary aspiration	4 (6.3)/4 (6.3)
Upper airway trauma	4 (6.3)/2 (3.2)
Absence of intubation instruments*	2 (3.2)/1 (1.6)
Inappropriate management of bronchospasm	1 (1.6)/1 (1.6)
Violation of the duty of explanation related to complications following intubation (contended by plaintiffs/recognized by the court)	19 (30.2)/10 (15.9)
Amount for damage—Korean Won	
Claims of plaintiffs (n = 63)	393,759,292 (162,046,444, 699,732,701)
Recognition of the court (n = 51)	133,897,845 (38,000,000, 308,538,274)

Values are presented as median (Q1, Q3) or number (%). *No endotracheal tube, n = 1 (1.6); no endotracheal tube for pediatric patient, n = 1 (1.6).

way technique, followed by violation of the duty of explanation. All but 3 cases were associated with major permanent injuries, and approximately 50% of the patients died. To the best of our knowledge, this is the first study to focus on malpractice cases related to endotracheal intubation in South Korea, providing important information to mitigate medical liability and ensure patient safety.

In South Korea, there have been 2 closed claims analyses related to this issue in the field of anesthesiology. According to the analyses of anesthesia-related medical disputes using the Korean Society of Anesthesiologists database, >50% of the anesthesia-related disputes were associated with airway management [8,9]. However,

only 11 of the 182 cases were associated with endotracheal intubation itself, and no further analysis was performed regarding this issue. Unlike these studies, our study focused on the adverse events related to endotracheal intubation itself, including events occurring in other medical disciplines in addition to anesthesiology, since physicians from any discipline can encounter an emergency situation requiring endotracheal intubation.

In other countries, previous medicolegal studies on malpractice related to endotracheal intubation have been reported [7,10,11]. According to a recent analysis of the anesthesia closed claims database in the United States regarding difficult tracheal intubation between 2000 and 2012, inappropriate management of a difficult airway was identified in 73% (71/97) cases [7]. The malpractices identified in that study were failure to use a supraglottic airway device as a bridge, perseveration (defined as ≥ 2 attempts using the same method), delay in surgical airway management, inadequate preoperative or airway evaluation, and lack of backup plan for difficult tracheal intubation. In a study of the UK national audit database regarding major complications associated with airway management, the majority of cases were found to occur during anesthesia (133/184, 72.3%), while the remaining cases occurred in the intensive care unit and emergency department [10]. In this study, the most common airway problems during anesthesia were related to tracheal intubation including delayed or difficult intubation, failed intubation, and 'can't intubate can't ventilate' (CICV) scenarios, which accounted for 39% of all events [10]. Another closed claims analysis of airway and respiratory complications associated with anesthesia in the UK, between 1995 and 2007, reported that airway-related claims had high fatality rates, and the most common claims were associated with airway trauma, primarily during tracheal intubation [11]. As in previous studies, the cases included in our study showed a high fatality rate, most of which were associated with delayed intubation.

In our study, the most common types of malpractice contended by plaintiffs and recognized by the court were that of no attempt of alternative airway technique. In the cases related to delayed or failed intubation, there were ≥ 3 laryngoscopic attempts in approximately 60% of cases. Repetitive attempts can worsen intubation conditions and delay intubation [12]. Moreover, repetitive attempts are reportedly associated with patient morbidity [13,14]. Therefore, the difficult airway society (DAS) guideline recommends limiting the number of laryngoscopic attempts to 3, suggesting the use of a SAD as the next step [15,16]. SADs can be useful in rescue airway due to their reported high success rate in difficult airway situations [17,18]. However, in our study, a SAD was used or attempted in only 5.2% of cases, which was lower than the rate of surgical airway management. In a large retrospective study using the Danish anesthesia database, it was reported that SADs were only used or attempted in 12.4% of difficult airway situations despite their prominent role in difficult airway management guidelines [19]. In a Japanese nationwide study of the adequacy of resource availability in difficult airway management in the emergency department, SAD availability was approximately 50%, and the main reasons for its limited use were the preference for surgical airway management, lack of familiarity, and the misconception that a SAD would not be useful in an emergency situation [20]. Since our study could not identify the reason for the low rate of SAD use in difficult airway situations, further studies regarding its availability in South Korea are required.

Additionally, if a difficult airway is expected, physicians should be prepared to perform rescue airway techniques following failure of the primary method [12]. Although the predictors of difficult tracheal intubation were noted in 74.1% of the cases related to delayed or failed intubation, alternative airway techniques were used only in approximately 33% of cases, and other instruments such as fiberoptic bronchoscopes and video laryngoscopes, which can be useful in difficult airway situation [21,22], were not used. It is reported that anesthesiologists tend to adhere to the routine method even if difficult tracheal intubation is anticipated, in which case the probability of proceeding to the CICV situation state is > 60% [3,12]. Therefore, along with risk assessment for difficult tracheal intubation, preparation for alternative airway methods is required when difficult tracheal intubation is anticipated. In addition, in hospital, alternative methods such as SADs and cricothyroidotomy kits should be available for emergency situations in which risk assessment might be difficult.

Violations of the duty of explanation was the second most common type of malpractice contended by plaintiffs and recognized by the court. To avoid such malpractice, the anesthesiologist should be aquainted with the following aspects. First, according to the Medical Service Act in Korea, possible complications related to the scheduled procedures should be notified to the patient in advance [23]. Therefore, for scheduled intubation, such as general anesthesia, detailed information of its possible complications should be provided to the patient. Second, medical personnel other than physicians are not allowed to perform the duty of explanation in the place of physicians [23]. Additionally, even if the possible complications are explained by a physician, it could be recognized as a violation of the duty of explanation if the explanation is insufficient. In this study, the explanation of possibile tooth injury without prior dental evaluation and explanation of possible alternative methods to avoid it by an attending surgeon was recog-

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nized as violation of the duty of explanation. Third, the duty of explanation can be exempted in the case of an emergency [23]. In this study, the violation of the duty of explanation was not recognized as malpractice when the endotracheal intubation was conducted in an unexpected emergency.

Physician inexperience was the third most common type of malpractice contended by plaintiffs and recognized by the court. There is a learning curve for successful endotracheal intubation, and previous studies have reported that > 50 endotracheal intubation procedures were required for a success rate of > 90% [24,25]. However, as it is difficult for non-anesthesiologists to gain sufficient experience in tracheal intubation [26], institutional policies such as anesthesiology-based airway training for non-anesthesiologists are needed to compensate for this problem [27]. There is also a need for education on alternative airway techniques such as SADs and videolaryngoscopes that can increase the success rate for inexperienced physicians in difficult airway situations [28,29].

We also performed a subgroup analysis in pediatric patients. The most common types of malpractice contended by plaintiffs and recognized by the court in these patients were that of no attempt of alternative airway techniques and no use of SAD in cases related to delayed intubation. In addition, we were able to identify predictors of difficult tracheal intubation in only about half of pediatric patients. There could be technical airway difficulties in pediatric patients as their airway anatomy is different from that of adults [30]. Therefore, prediction of difficult tracheal intubation might be more important in these patients, and alternative airway techniques such as SADs should be prepared, even if there are no such predictive factors. SADs were also recommended for rescue airway according to the guideline for unanticipated difficult airway in pediatric patients [31].

There are several limitations to this study. First, since our data were skewed toward rare and severe complications due to the nature of the study, our cases did not represent the comprehensive features of endotracheal intubation. Second, the clinical information described in the precedent text was limited, particularly in dismissed cases. Third, despite the relatively long study period (26 years), we could not investigate the temporal trends of malpractices related to tracheal intubation due to the small number of cases. One retrospective study reported the decline in the incidence of difficult tracheal intubation over a 14-year period, and this result might be due to advances in airway management [32]. Fourth, the amount of compensatory damage could not represent the magnitude of the malpractice, since it was determined not only by the degree of disability and malpractice but also by the loss of wages considering a patient's life expectancy and expected salary. Further, it should also be considered that the amount of compensatory damages has been increasing with the recent uplift of the maximum working age (60 to 65 years) and the increase in hospital liability ratio judged by the court [33]. Lastly, since there was no description regarding the CICV state in the judicial precedents, we found it difficult to judge compliance with the DAS guideline in each case [15]. Despite these limitations, our findings provide useful information on rare but severe complications and consequently improve patient safety.

In conclusion, physicians should be prepared to avoid serious adverse events that may arise from delay in or failure of endotracheal intubation. To this end, physicians should be well-acquainted with the latest difficult airway guideline [15], able to predict difficult airways, and proficient in alternative airway methods. Additionally, the necessary infrastructure should be readily available in difficult airway situations. Through this study, we hope to increase physicians' awareness of the severe complications associated with endotracheal intubation to prevent medical liability.

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Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

Author Contributions

Hye-Yeon Cho (Data curation; Formal analysis; Writing – original draft)
SuHwan Shin (Data curation; Formal analysis; Writing – review & editing)
SangJin Lee (Data curation; Formal analysis)
Susie Yoon (Data curation; Writing – review & editing)
Hojin Lee (Conceptualization; Formal analysis; Supervision; Writing – original draft; Writing – review & editing)

Supplementary Materials

Supplementary Table 1. General characteristics of the cases in pediatric patients
Supplementary Table 2. Type of alleged problems in pediatric patients
Supplementary Table 3. Detailed information of the cases related

to delayed or failed intubation in pediatric patients
Supplementary Table 4. Judicial characteristics in pediatric patients

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