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Postintubation Tracheal Ruptures

— A case report —

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Tracheobronchial ruptures (TBR) rarely complicate surgical procedures under general anesthesia. Seemingly uneventful intubations can result in injury to the trachea, which often manifests as hemoptysis and subcutaneous emphysema. We present 2 patients with postintubation TBR who were treated surgically and discuss considerations in the management of this potentially lethal injury.

Key words: 1. Tracheal rupture
2. Intubation, intratracheal

CASE REPORT

1) Patient 1

A 68-year-old woman who had a history of lumbar spine surgery under general anesthesia at another center was transferred to our hospital with dyspnea and subcutaneous emphysema. One hour after extubation, she had hemotysis and dyspnea. During the following six hours, progressive subcutaneous emphysema and dyspnea developed. She was 145 cm tall and weighed 45 kg. A chest showed subcutaneous emphysema of the neck and pneumomediastinum (Fig. 1A). Thoracic computed tomography (CT) scans showed subcutaneous emphysema and the disappearance of tracheal posterior membranous wall continuity (Fig. 1B). We decided on an emergency operation. She reached the operating table 7 hours after lumbar spine surgery. During operation, a fiberoptic bronchoscope was used to verify double-lumen endobronchial tube placement, and showed a linear tracheal laceration of the posterior membranous wall at the distal part of the trachea (Fig. 1C). She underwent a right thoracotomy and tracheal repair of about 7 cm of a membranous tracheal linear laceration arising 3 cm from the carina (Fig. 1D). During the suturing of the laceration, the endotracheal tube was withdrawn several times to allow good exposure of the tracheal tear.

The laceration was repaired with 4-0 Monosyn interrupted stitches (B. Braun Aesculap AG & Co KG, Tuttlingen, Germany), starting from the proximal end of the tear. Once the laceration was repaired, the anesthesiologist advanced the original orotracheal tube beyond the suture.

2) Patient 2

A 52-year-old woman who had a history of lumbar spine surgery under general anesthesia at another center was transferred to our hospital with subcutaneous emphysema. She reported having dyspnea and presented with subcutaneous emphysema. She was 158 cm tall and weighed 60 kg. She had a history of percutaneous coronary intervention due to non-ST elevation myocardial infarction 3 years prior. Chest

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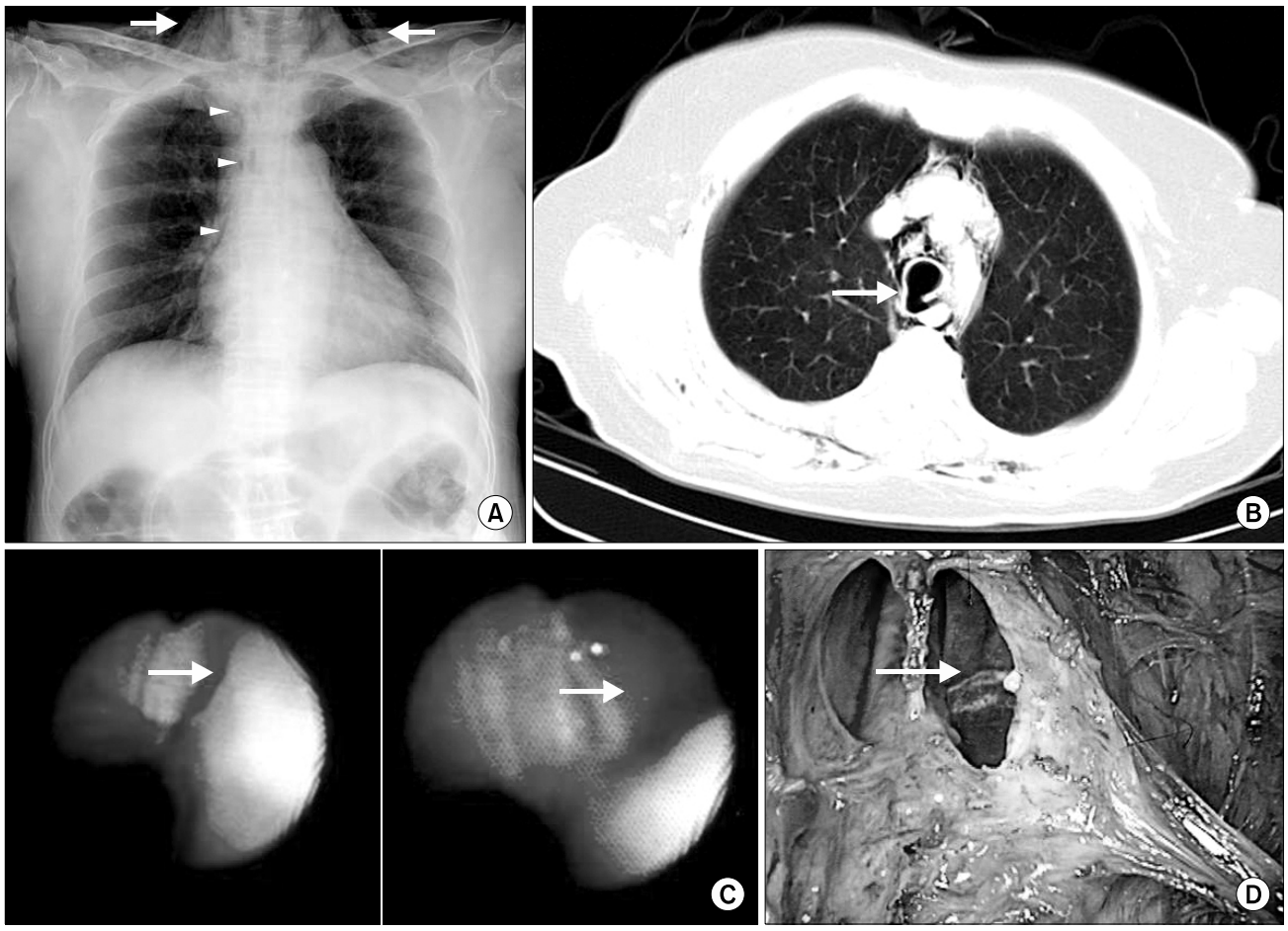

Fig. 1. A chest film shows subcutaneous emphysema of the neck and pneumomediastinum (A), and computed tomography scans of the chest show subcutaneous emphysema and disappearance of tracheal posterior membranous wall continuity (B). A fiberoptic bronchoscope reveals a linear tracheal laceration of the posterior membranous wall at the distal part of the trachea (C). Intraoperative photographs show a membranous tracheal linear laceration of about 7 cm arising 3 cm from the carina (D).

film showed a marked pneumomediastinum and subcutaneous emphysema of the neck (Fig. 2A). Thoracic computed tomography (CT) scans showed marked pneumomediastinum and pneumopericardium, but did not show lesions warranting suspicion of tracheal or esophageal injury (Fig. 2B). The next day, progressive subcutanoues emphysema and dyspnea developed. A fiberoptic-bronchoscopy was performed. Bronchoscopy confirmed a 4-cm posterior membranous tracheal laceration approximately 5 cm from the carina (Fig. 2C). She was immediately brought to the operating table. She reached the operating table 23 hours after lumbar spine surgery. She also underwent a right thoracotomy and tracheal repair (Fig. 2D) in which the same technique as patient 1 was utilized without the double-lumen endobronchial tube placement.

The postoperative course was uneventful, and the patients were discharged at the sixth and fifth postoperative days, respectively. Bronchoscopic follow-up showed a complete repair of the posterior tracheal wall tear (Fig. 3), and there were neither symptoms nor signs of tracheal stenosis (Fig. 4).

DISCUSSION

Despite the large number of intubations performed every day, postintubation tracheal rupture (PiTR) is a very rare but complication of general anesthesia. The first case series of PiTR was not published until 1995 [1] and an estimate of the

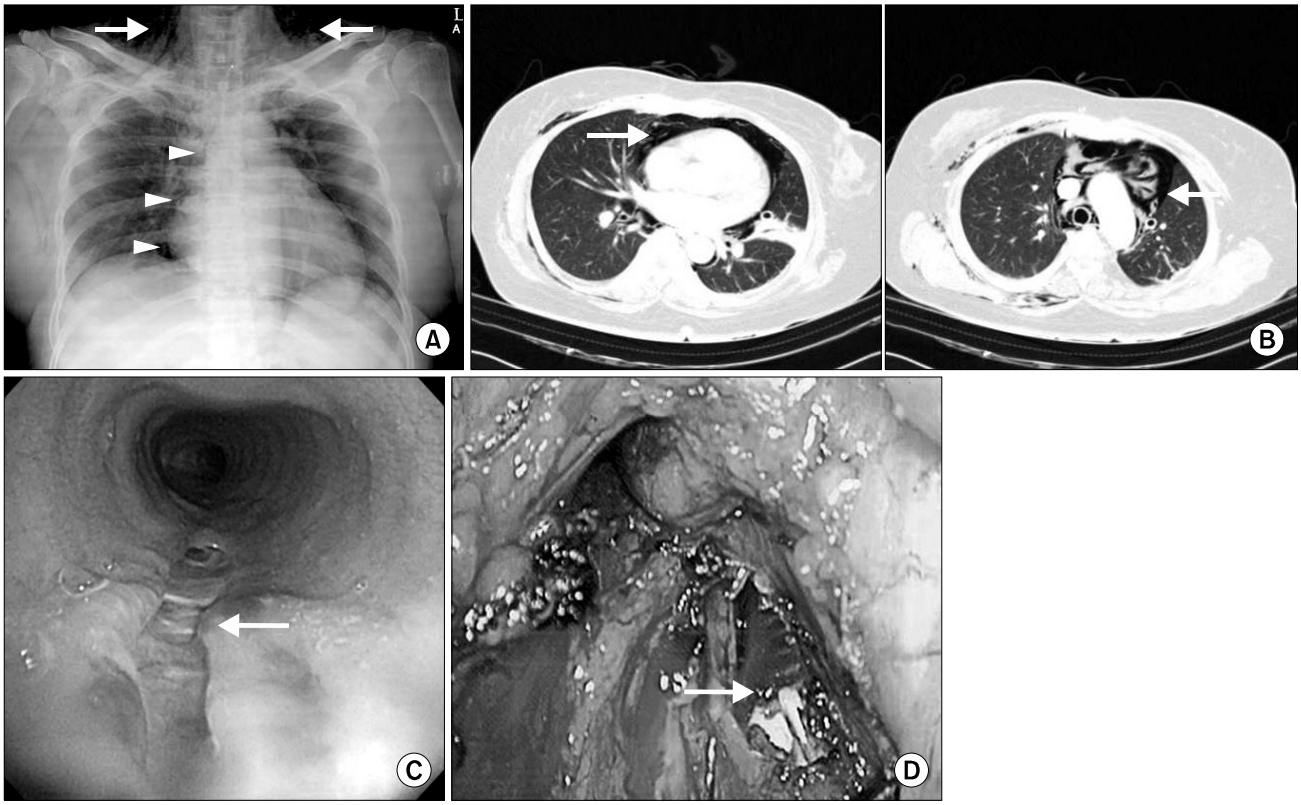

Fig. 2. A chest film shows a marked pneumomediastinum and subcutaneous emphysema of neck (A) and computed tomography scans of chest show marked pneumomediastinum and pneumopericardium but does not show lesions indicating tracheal or esophageal injury (B). Bronchoscopy reveals a 4-cm posterior membranous tracheal laceration approximately 5 cm from the carina (C). Intraoperative photographs show membranous tracheal linear laceration about 4 cm in length (D).

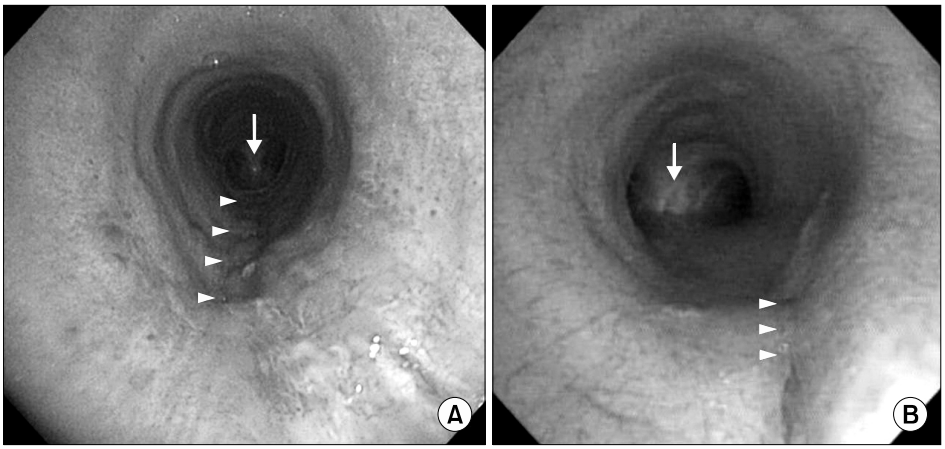

Fig. 3. Bronchoscopic follow-up shows a complete repair of the posterior tracheal wall tear (A=Patient 1; B=Patient 2).

incidence in the last decade ranged from 0.05% to 0.37% of all orotracheal intubations performed [2].

PiTR should be differentiated from tracheobronchial injuries of traumatic origin since the different mechanisms lead to different morphologic appearances and therapeutic options. Traumatic TBR is usually the result of blunt chest trauma and appears as horizontal or irregularly shaped disruptions involving the main carina and often extending into the main

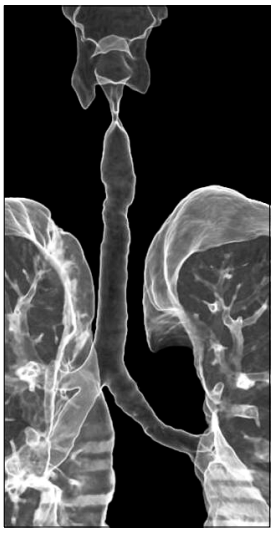

Fig. 4. Tracheobronchus 3D reconstruction of the first patient shows a well repaired trachea and no tracheal stenosis.

bronchi. PiTR, in contrast, usually presents as longitudinal lacerations of the posterior tracheal wall, either centrally or laterally, such that the membranous wall is avulsed from its cartilaginous insertion [2,3].

The exact mechanism underlying the lesion is uncertain. There is a series of risk factors that contribute to PiTR; these factors may be divided into mechanical and anatomical. Mechanical factors include multiple forced attempts at intubation, inexperience of the health professional, endotracheal tube introducers that protrude beyond the tip of the tube, overinflation of the cuff (diffusion of nitric oxide into the cuff), incorrect positioning of the tip of the tube, repositioning the tube without deflation of the cuff, inappropriate tube size, significant cough, and movements of the head and neck while the patient is intubated [3]. The anatomical factors include congenital tracheal abnormalities, weakness of the pars membranosa of the trachea, chronic obstructive pulmonary disease and other inflammatory lesions of the tracheobronchial tree, diseases that alter the position of the trachea (mediastinal collections, lymph nodes, or tumors), chronic use of steroids, advanced age, and female sex [3]. In the latter aspect, age also appears to play a role because, in the series published, there was not only evidence of female predominance, but the mean age of these women was over 50 years in the majority of the series published [3,4].

Some authors have suggested that PiTR may present more frequently in women because the pars membranosa is weaker in women than in men, the use of endotracheal tubes of a larger size than appropriate for women, or that women are not as tall and, as a consequence, the endotracheal tube is positioned significantly more distantly in a trachea that is already smaller [5]. In the studies by Marty-Ane et al. [1], all patients had a height under 165 cm. Our experience is similar to those reported by other centers concerning the patients (short women) [5], the type of intubation (single-lumen or double-lumen tube) [6], and the site of the tear (the pars membranosa) [2,3].

The first signs of its presence usually appear within 12 hours of intubation [2,3,7]. Except for the case of intraoperative evidence, the appearance of symptoms such as head and neck emphysema, hemoptysis, and dyspnea should raise the suspicion of tracheobronchial ruptures.

Very often, the clinical manifestations of the lesion are not immediately obvious, and presentation can mimic that of other clinical conditions. Early diagnosis or, if this is not possible, high clinical suspicion may be associated with lower mortality, since either would likely lead to earlier therapeutic maneuvers. A delay in diagnosis could favor the onset of mediastinitis, with deterioration in the clinical situation [2,8].

Clinical suspicion must be followed by diagnostic confirmation, which is achieved by direct visualization of the tracheal rupture by bronchoscopy. This procedure provides data on the exact site and of the lesion, helps to plan the therapeutic approach, and can be used to reposition the tube or reintubate the patient if this is necessary [2].

Although bronchoscopic evaluation is the gold standard for diagnosis, CT scanning may provide valuable information. Radiologic signs that suggest a TBR include subcutaneous emphysema without evidence of pneumothorax, irregularity in the posterior tracheal membrane, overdistention of the endotracheal balloon, and a displaced endotracheal tube in relation to the trachea [2,3]. Indeed, our initial suspicion that the first patient had a TBR was based on her CT scan findings.

Consensus has not yet been reached on the management of PiTR [2,3,7-9]. Early surgical repair has traditionally been considered the cornerstone of therapy for PiTR [1,2,4-8,10]. Recommendations regarding management of TBR complicat-

ing intubation have historically been based on experiences with blunt tracheobronchial ruptures in which surgical repair is usually required.

However, over the past 20 years, nonoperative management of TBR has been proposed for select patients in the following circumstances: stable vital signs, easy achievement of an adequate functional respiratory status under mechanical ventilation or in spontaneous ventilation, absence of esophageal injury, minimal mediastinal fluid collection, nonprogressive pneumomediastinum or subcutaneous emphysema, absence of sepsis, short ruptures, and delayed diagnosis [2,3,7-10]. If there is enough distance between the tear and the carina, the injury can often be excluded with the cuff of the endotracheal tube. In such circumstances, the use of an endotracheal tube with a subglottic suction port will avoid the pooling of secretions at the level of the injury. For TBR that involve the distal third of the trachea or extend into the carina, selective main stem bronchus intubation has had a high rate of success. In all cases, ventilator settings should attempt to minimize high inspiratory pressures and tidal volumes to avoid exacerbating the tear [2,3,7,9]. Because of the risk of mediastinitis, wide-spectrum antibiotics should be administered for at least 1 week after the injury has been identified. Complete healing usually occurs within 1 month, unless factors such as steroid use, immunosuppression, or severe malnutrition impede healing [7]. The use of expandable tracheal stents for the treatment of TBR has been described and recommended for patients who are poor surgical candidates with lesions not amenable to observation alone [11].

Operative management of TBR has been well described [1,2,4-8,10]. The surgical technique will depend on the type and of the lesion. In patients with lacerations of the proximal two-thirds of the trachea, a cervical approach is preferred [2,3,10]. A longitudinal anterior tracheotomy is made to access the injury, which is then closed primarily. Injuries in the distal one-third are best accessed through a right thoracotomy, with direct repair of the laceration without resection [2,3,10]. The length of the TBR as an indication for surgical management has been debated. Kaloud et al. recommended operating for any TBR lesion greater than 1 cm in length [5]. Gabor et al. [10], in cases of mixed iatrogenic and blunt tracheobronchial injuries, recommended that ruptures greater than 2 cm in length be repaired. Jougon et al., in contrast, proposed nonoperative management if the TBR was smaller than 4 cm [7]. In the future, minimally invasive techniques such as videothoracoscopy may also be used.

Treatment is controversial, although it appears that conservative management is associated with a better outcome. The results of the recent larger case series published demonstrate that there is ever more evidence to support conservative management [2,3,7,9], allowing for the possible closure of the tracheal tear by adopting an expectant (conservative) approach. Moreover, some series have demonstrated that surgical repair in critically ill patients is a procedure with a mortality that can reach 71% [2].

The treatment guidelines until recently were based on a heterogeneous series of case reports involving different etiologies. Thus, goals when treating such patients should include early recognition, appropriate antibiotic coverage, careful selection of operative candidates, and proper endotracheal tube and ventilator management.

We suggest that, except for selected cases in which nonsurgical therapy is indicated, surgery is the treatment of choice in the vast majority of postintubation tracheal injuries. When treated optimally, selected patients with TBR can fully and more quickly recover from surgical intervention than nonsurgical therapy.

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