Tracheo-innominate artery fistula (TIF) is a surgical emergency with high mortality rates. Reported incidence is 0.1%–1.0% after tracheostomy with peak incidence 3 days to 6 weeks post procedure. TIF is usually fatal once it bleeds. For the successful management of TIF, treatment should be initiated immediately with the special considerations kept in mind. We describe two cases of TIF, and its clinical characteristics are reviewed in accordance with relevant literature.

Keywords: tracheo-innominate artery fistula (TIF), tracheostomy, high-lying innominate artery

Introduction

Tracheo-innominate artery fistula (TIF) needs to be addressed surgically, once it gets clinically evident. Even if timely initiation of proper measures is performed, it is very difficult to rescue the patient. Two cases of TIF were reviewed in terms of its resuscitation procedure and following surgical repair with the general idea of TIF described.

Case 1

A 20-year-old man who had been tracheostomized for 5 years due to respiratory failure caused by Duchenne muscular dystrophy was referred to us for abrupt intratracheal bleeding. To secure the airway and to find the source of bleeding, we performed flexible bronchoscopy that showed no active bleeding distal to the cannula tip. However, bleeding occurred again inside the tracheal tube. With the cuff of the tube maintained in the maximum hyperinflated state and the tracheostomy wound digitally compressed, the patient was immediately transferred to the operating room for surgical hemostasis. Unfortunately, we had no time to perform a computed tomography (CT) scan for this patient because this was an emergency case. A review of the CT scan, which had been taken about a year before, suggested that the TIF was probably above the sternal notch (Fig. 1). Therefore, unlike in the standard procedure, herein we made a supra-sternal incision. After identifying the trachea and the overriding innominate artery, we successfully encircled the artery proximally and distally to the trachea and found the fistula posterior to the high-lying innominate artery. We debrided the fistulous segment of the innominate artery and reconstructed the artery in end-to-end fashion. Finally, the fistula of the trachea was repaired by suturing and the sternocleidomastoid flap was positioned between the trachea and artery to provide a mechanical barrier (Fig. 2). After controlling the blood flow of the fistulous segment of the artery, intra-tracheal bleeding was not observed. The amount of intra-operative bleeding was about 300 mL, and the operative time was 93 min. The post-operative course was uneventful with no sign of rebleeding. However, according to the findings of the CT
Case 2

An 11-year-old female who had been tracheostomized for about 5 years due to recurrent aspiration pneumonia caused by cerebral palsy was brought to us by ambulance for massive intra-tracheal bleeding. On arrival, she was in cardiopulmonary arrest, and CPR was initiated. Temporarily, the bleeding was stopped. To secure the airway, flexible bronchoscopy was performed, and at this point TIF was not confirmed endobronchially. A few hours later, our thoracic team was consulted due to the rebleeding, and we had no choice but to take the patient immediately to the OR. With median sternotomy, we exposed the TIF of about 3 mm in diameter; however, the patient lost too much blood to be resuscitated, resulting in a fatal hypovolemic cardiac arrest and, unfortunately, she expired during the operation.

Discussion

The incidence of TIF in patients who have undergone tracheostomy is 0.1% to 1.0%. Any bleeding around the tracheostomy site or hemoptysis might indicate the massive bleeding due to TIF; hence, even a small amount of bleeding should not be neglected. Sentinel bleeding is found in more than 50% patients who develop massive bleeding caused by TIF with peak incidence of 3 days to 6 weeks following tracheostomy.

Several authors suggested some contributing factors for TIF formation, such as low tracheostomy below the 3rd to 4rd tracheal rings, over inflated cuffs, prolonged tracheostomy, and neck/chest deformity. In our case, the patient had deformed thorax with Duchenne muscular dystrophy and had undergone prolonged tracheostomy, both of which are well-known risk factors. Similar to Iodice et al., we speculate that the deformed chest of this patient placed the innominate artery high over the trachea, resulting in close and tight contact between the artery and trachea. Considering the high mortality rate after bleeding, it is necessary to perform flexible fiberoptic bronchoscopy for patients who have even a small amount of intra-tracheal bleeding with the above mentioned risk factors. If bronchoscopy reveals a suspicious finding for TIF, surgical ligation of the innominate artery should be the choice of treatment.

Immediate surgical control of the bleeding is the only way to rescue; however, as in our second case, bleeding is usually fatal because of the difficulty of securing the

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Fig. 1

A: Sterno-clavicular joint.
B: Sternal notch.
C: Tip of the tracheostomy tube.
The tip of the tracheostomy tube was at the same level as the sternal notch, of which finding suggested that the fistulous lesion should be above the sternal notch.

Fig. 2

A: Sternocleidomastoid muscle interpositioned for mechanical separation.
B: Reconstructed innominate artery.
C: Sternal notch.
airway and maintaining the blood pressure. Grant et al. from U.K. advocated the following 3 emergency steps to control bleeding until the start of the operation. Firstly, flexible bronchoscopy through the tracheostomy tube should be performed to clear and secure the airway. Secondly, the tracheostomy cuff should be over-inflated. Lastly digital compression should be applied around the tracheostomy incision. An attempt to manipulate the tracheostomy tube, like transoral tube intubation, is absolutely contraindicated since it deteriorates the ongoing intratracheal bleeding.2)

Once the patient is successfully taken to the operating room, the operation is usually initiated with median sternotomy. However, our first case was quite an exception due to a high-lying innominate artery, which was confirmed by preoperative CT scan. From our experience, an enhanced CT scan for tracheostomized patients with the above mentioned risk factors for TIF could be very helpful. Sung et al. also advocate the CT surveillance for patients with risk factors of TIF.5) If it can be preoperatively determined whether a patient with TIF has high-lying innominate artery, the causative lesion of bleeding could well be approached quickly through a supra-sternal neck approach. However, patients with risk factors for TIF are chronically hospitalized and usually do not undergo CT scan. Hence, once massive intra-tracheal bleeding is observed in a tracheostomized patient without previous CT scan, the airway should be cleared with bronchoscopy with a hyperinflated cuff, and the patient should be taken to the operating room for median sternotomy without any delay.

Contrary to our first case, most authors advocate resection of the fistulous segment of the innominate artery without a vascular reconstruction.1-4,6) This recommendation is well supported by the reports, which suggest that the rate of lethal rebleeding for TIF was higher in the group with vascular reconstruction than in the group with interruption of blood flow by resection of the fistulous arterial segment.7) The concern for the possibility of rebleeding due to failure of the suture or vascular graft has made the technique of sacrificing the blood flow well employed by surgeons.

Post-operatively, following a rescue operation for TIF, a tracheostomy tube should be carefully monitored. The cuff should not be over-inflated, and the tip of the tube should not be compressed against the tracheal wall.

In conclusion, bleeding from TIF is a surgical emergency, and surgical repair should be immediately performed once temporary hemostasis is secured. It is advisable that a patient with long-standing tracheostomy tube should undergo CT scanning to determine the surgical approach and the risk of developing TIF.

References