Emergency Bulletin
Hong Kong College of Emergency Medicine

Tracheoinnominate fistula – a patient with massive tracheostomy bleeding

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Patient background

The patient was a 60-year-old woman who suffered from acute subarachnoid hemorrhage due to rupture of bilateral internal carotid artery aneurysms 5 months ago. Despite multiple neurosurgical interventions performed such as craniotomy, insertion of external ventricular drain and coil embolization of aneurysm, her neurological recovery remained poor.

Percutaneous tracheostomy with a cuffed size 7.5 tube was performed two weeks after admission, and subsequently it was downsized to a non-cuffed size 6 tube. After 5 months of hospitalization, she was discharged to an old age home in bedbound status and the last tracheostomy exchange was 1 day before discharge.

Three days later, she presented to the Emergency Department for an estimated 200 ml bleeding from her tracheostomy opening.
She was alert. No stridor was noted. The initial blood pressure was 128/79 mmHg, pulse was 110 bpm, SpO2 was 97% on 5liter/min of oxygen.

There was small amount of blood clots around the tracheostomy opening, and a suction catheter was successfully passed into its opening after removal of inner tube, which yielded small amount of fresh blood.

Intravenous fluid and tranexamic acid were given. Ear nose and throat (ENT) surgeon was consulted for urgent assessment.

What are the probable causes of bleeding tracheostomy?

The incidence of bleeding following tracheostomy placement is around 5.7%[1], in which minor and major bleeding occurs in 4.4% and 1.2% respectively[2].

Early bleeding occurring within 48 hours after procedure is typically caused by skin and mucosal bleeding, local vasculature puncture and systemic coagulopathy. It is more common in patients with risk factors such as treatment with anti-platelet or anticoagulant (40%), thrombocytopenia (29%), short neck (17%) and aberrant blood vessels near tracheostomy site (9%)[3].

Late bleeding occurring days to weeks after procedure is typically caused by mucosal trauma by suction catheter, granulation tissue bleeding, stoma infection, tracheobronchitis, and rarely, erosion into adjacent artery (most often the innominate artery and common carotid artery).

What is the initial approach to bleeding tracheostomy?

Tracheostomy bleeding, albeit minor initially, is a potentially life-threatening condition since 34 to 50% of patients with trachea-innominate fistula present with an initial small sentinel bleed before progression to massive hemorrhage[4].

The main issue is to assess and stabilize patient's airway and breathing. Put the patient in 45-degree prop up position, give supplemental oxygen via face mask and tracheostomy mask. If there is audible stridor and apparent obstruction in the tracheostomy tube, remove the inner tube of tracheostomy cautiously and pass a suction catheter down to remove any obstructing sputum plug or blood clot. Do not deflate tracheostomy cuff or remove the tube entirely until experienced assistance is available because it may precipitate massive hemorrhage when the tamponade effect is released.

Optimize patient's circulation by intravenous fluid resuscitation. Perform blood tests, including type and screen, and consider correcting coagulopathy and initiating packed cell transfusion or activating massive transfusion protocol if necessary.

Early involvement of an ENT or head and neck surgeon for evaluation and definitive management is advised. A flexible bronchoscopy is useful in localizing the source of bleeding, but visualization can be difficult in acute hemorrhage and is only recommended to be performed in an operation theatre[5].

In stable patient a contrast computed tomography (CT) angiogram should be arranged to identify the presence of any trachea-artery fistula and features of arterial fistula bleeding. It also provides anatomical information for endovascular or surgical treatment.

What is the immediate rescue approach if massive tracheostomy bleeding occurs?

If massive hemorrhage occurs, a trachea-innominate fistula (TIF) should be assumed until proven otherwise (Figure 1).

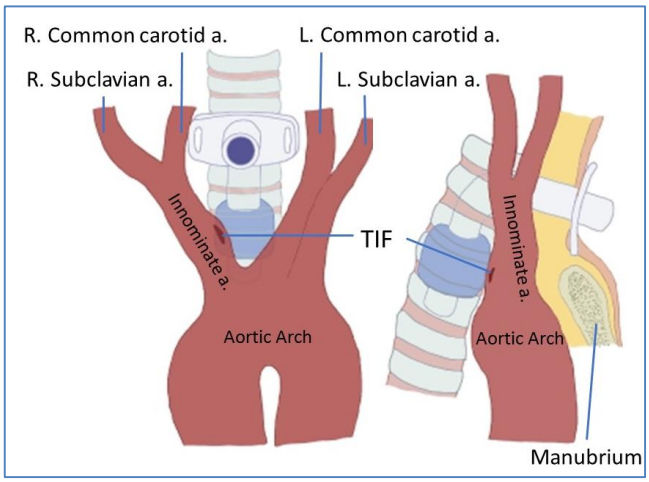

Figure 1: Trachea-innominate fistula (TIF) and its relevant anatomy

Call for help from seniors, nurses and ENT. Immediate reinsertion of tracheostomy with hyperinflation of cuff allows temporary control of bleeding by tamponade effect in 85% of cases[6]. Inflate the cuff with a 50 ml syringe of air slowly and steadily to achieve maximum volume in the balloon without bursting it (Figure 2).

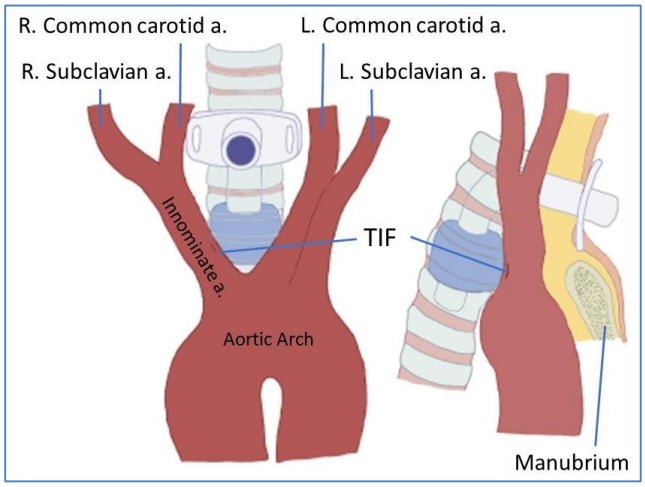

Figure 2: Hyper-inflation of cuff to control bleeding by tamponade effect

In case a cuffed tracheostomy tube is not available or bleeding persist following cuff inflation, insert finger via the tracheostomy stoma 1-2 cm into the pre-tracheal space and apply digital pressure anteriorly against the manubrium to temporarily compress the bleeding artery, also known as the Utley maneuver[7] (Figure 3). The tracheostomy tube should be removed and replaced with a cuffed endotracheal tube which protects the airway and prevents aspiration of blood[7].

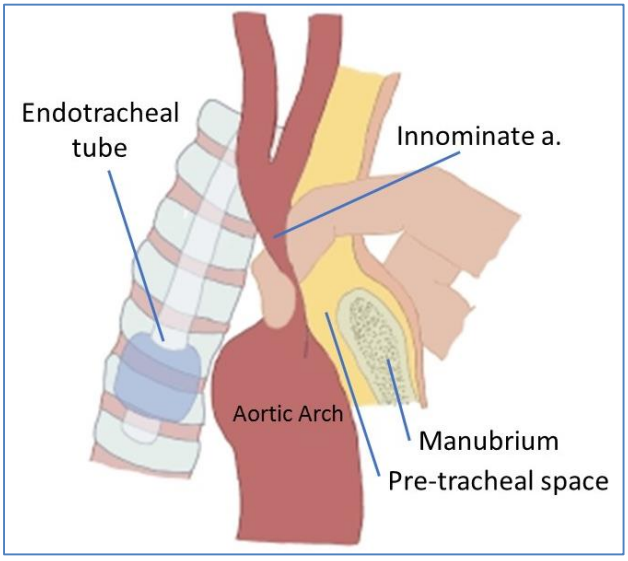

Figure 3: The Utley maneuver: occlusion of bleeding innominate artery by digital pressure against the manubrium

However, this method may be difficult or impossible in children due to their smaller caliber of trachea and thoracic inlet[8]. Alternatively, insert a smaller sized endotracheal tube through the stoma beyond the bleeding site to secure patient's airway and hyperinflate its cuff with up to 50 ml of air.

Progress of our patient

Upon the arrival of ENT surgeon, the tracheostomy was removed for further assessment. A large amount of pulsatile blood immediately spurted out from the stoma. A size 7 Portex cuffed tracheostomy tube was urgently inserted with its cuff inflated for airway protection and attempt for hemostasis. One pint of Hartmann's solution was given at full rate. Unmatched blood transfusion was on standby.

Fortunately, hemostasis was achieved after application of cuffed tracheostomy. Total estimated blood loss was close to 700ml. Blood pressure was 130/60 mmHg; pulse was 90 bpm, saturation was 97% on 5 liters of oxygen/min. TIF was highly suspected at this juncture, thus cardiothoracic surgeon (CTS) was consulted.

Patient was stabilized and CT angiogram was performed to identify the bleeder. CT angiogram showed a pseudoaneurysm at the right innominate artery in close proximity to the inferior margin of tracheostomy (Figure 4).

Based on the clinical context, fistula formation between the pseudoaneurysm and trachea was highly likely. Endovascular stenting of the pseudoaneurysm was offered.

Figure 4 - Coronal view of CT angiogram showing an innominate artery pseudoaneurysm in close proximity to the inferior margin of tracheostomy tube (Arrow)

The patient underwent emergency operation under general anesthesia few hours later. On table angiogram showed a 2mm outpouch at innominate artery consistent with the pseudoaneurysm (Figure 5A). A 14 x19 mm BeGraft cover stent graft is inserted along Terumo guidewire and positioned over the pseudoaneurysm with adequate coverage (Figure 5B).

Fiberoptic laryngoscopy performed by surgeons confirmed no bleeding from the small area of ulceration at right anterior aspect of trachea suspected to be the site of fistulation. An adjustable size 7 tracheostomy tube was reinserted afterwards, and the patient remained hemodynamically stable post operatively.

Patient was started on clopidogrel for 3 months and aspirin for lifelong. No bleeding was reported on subsequent follow up after discharge.

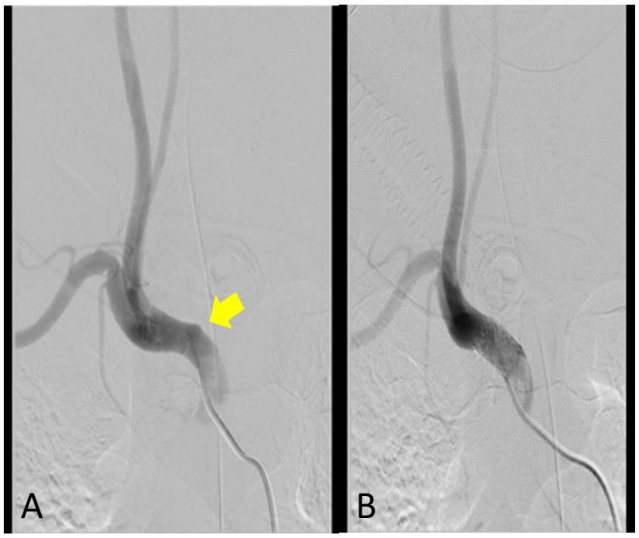

Figure 5A: Angiogram showing an out pouch from innominate artery (Arrow); 5B: Post stenting angiogram of innominate artery

Brief notes on tracheoinnominate fistula (TIF)

TIF is a rare complication after tracheostomy, with an estimated incidence of 0.3% to 0.79%, yet the mortality can approach more than 90% if left untreated[9]. High index of suspicion and prompt action for early surgical intervention reduce mortality. While the usual presentation occurs between 3 days and 6 weeks post tracheostomy, the peak incidence is at 7 to 14 days[10].

Risk factors include placement of tracheostomy below the third tracheal ring as innominate artery traverses the sixth and tenth tracheal rings[10], high riding innominate artery, high pressure tracheostomy cuff, prolonged tracheostomy placement, steroid use, radiotherapy and excessive neck movement[11]. Mechanisms involved in fistula formation are postulated to be related to pressure erosion through the anterior tracheal wall to the artery by different part of the tracheostomy tube: tip, shoulder and cuff erosion[9](Figure 6).

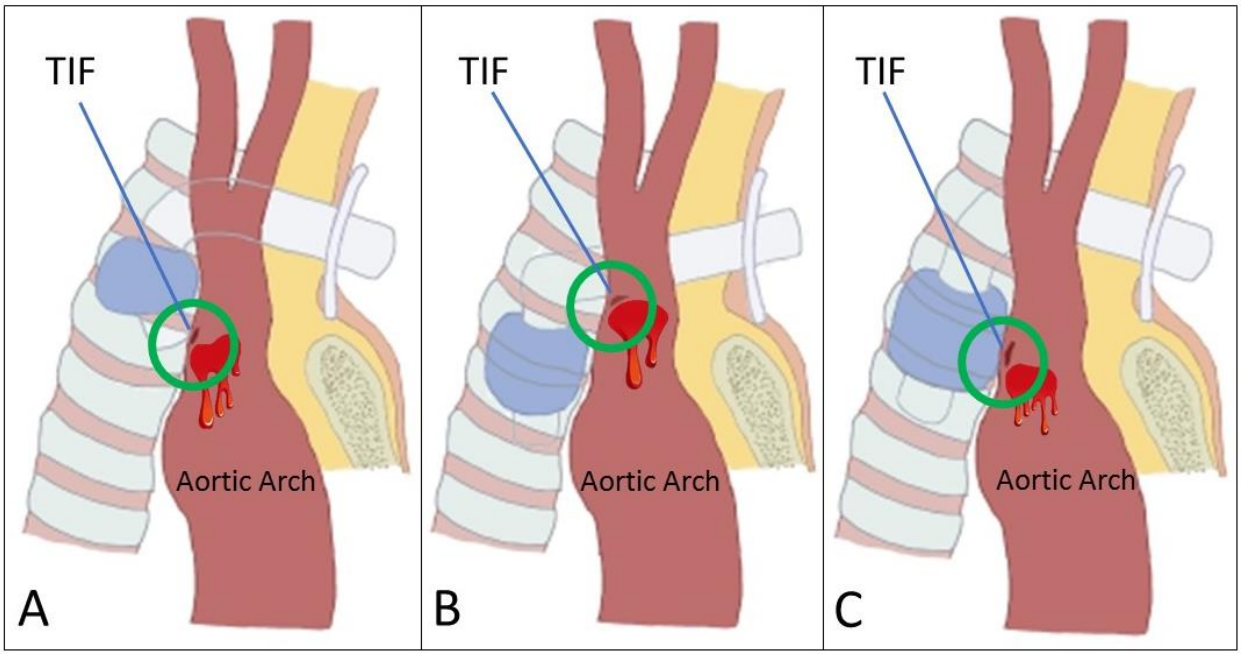

Figure 6: Mechanism involved in fistula formation: Erosion on tracheal wall by A: Tip of tracheostomy tube; B: shoulder of tracheostomy tube; C: Cuff of tracheostomy tube

50% of patients with TIF has a small sentinel bleeding prior to massive hemorrhage. Pulsatile movement of tracheal cannula may be observed[12].

Diagnostic options include CT angiography, bronchoscopy and catheter angiography for bleeder identification, although these can be challenging in unstable patients, and that the reported sensitivity of these studies is only 20-30%[13].

Early control of hemorrhage as described above, and urgent surgical consultation are keys of management. Median sternotomy to identify and ligate the fistula is the most common approach[14], but it is associated with more than 50% mortality due to postoperative hemorrhage and infectious complications[15]. Endovascular stenting is an increasingly popular choice of definitive treatment or bridge to definitive treatment[16].

A cohort analysis found comparable survival but lower complication rates for endovascular treatment when compared to surgical intervention[17].

Possible complications include stent infection, occlusion and rebleeding due to tracheal erosion[18].

Conclusion

Late tracheostomy bleeding, even in small amount, should be taken seriously and carefully assessed. Emergency physicians should be aware of the possibility of tracheoinnominate fistula, arrange relevant consultations and investigations, and be prepared for immediate hemostatic procedure and resuscitation in the event of massive hemorrhage.

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Letter to editor

Re: Emergency Bulletin (Issue 11 July 2022) – Cognitive bias and clinical reasoning

Dear Dr. Editor,

The emergency bulletin is always a delightful read. The present issue is no exception. Concerning the patient described in this issue, I have a few suggestions for your consideration.

1. The patient had a glasgow coma score of 9 which is defined as HI of 'moderate' severity. In the discussion, the injury (TBI) was however repeatedly described as minor.

2. There might be different reasons for missing the dx of cerebral infarct due to L MCA occlusion in the receiving ED. Cognitive bias may be one but failure to appreciate the mismatch of CT findings and clinical signs (R sided cerebral lesion vs R sided deficits) should also be relevant. If so, it suggests inadequate knowledge or vigilance.

3. Cognitive bias is a well-known topic in clinical practice. Our college's simulation training has underlined its importance.

Thank you and please keep up with your excellent works!

Dr. Leung Ling Pong

Reply to letter to editor

Dear Dr. Leung,

Thank you very much for your feedback and comments.

I will reflect your comment to the author.

I agree that the head injury is actually moderate instead of a minor head injury. We would better describe it as TBI instead of minor TBI.

Cognitive bias is not the single reason for missing the initial diagnosis in this case. Inadequate knowledge, inadequate training or lack of supervision all would lead to the diagnostic failure. Learning is a continuous process. We do encounter mistakes of ourselves & others. We must make good use of the occasions to rectify our weaknesses to strengthen our clinical acuity to maximize the patient outcome through timely & precise diagnosis with optimum ensuing management. This is the merit of this case report. The emergency bulletin does provide a platform for sharing of knowledge and experience, both positive and negative. We can learn the good one and avoid the bad one through this platform.

Learning or recognize cognitive bias is one of the topic in our curriculum. Our College has put in great effort in training and providing relevant education to our trainee and fellows. Simulation training is a good way for us to learn.

Once again, thank you very much for your interest in the emergency bulletin.

Dr. Law Ping Keung
Editor-in-chief, Emergency Bulletin, HKCEM