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Tracheo-innominate artery fistula: a rare complication in a laryngectomized patient

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Abstract

A tracheo-innominate artery fistula is an uncommon but frequently fatal complication of tracheostomy. Rarely, it can also occur in laryngectomized patients. We report a post-laryngectomy, post-radiotherapy patient using a metal tracheostomy tube, who developed a tracheo-innominate artery fistula about two months after radiotherapy. To our knowledge this is only the second reported case in a laryngectomized patient. The computed tomography (CT) angiography findings helped confirm the diagnosis and the patient was successfully managed by surgical exploration and ligation of the innominate artery. Coagulase negative *Staphylococcus aureus* was cultured from a tracheal swab. The clinical features, CT angiography findings, management protocols and possible aetiological factors are discussed.

Key words: Brachiocephalic Trunk; Fistula; Laryngectomy complications

Introduction

Tracheo-innominate artery fistula (TIAF) is an uncommon but frequently fatal complication of tracheostomy.[1] The medical literature records a few hundred cases of tracheo-innominate artery fistulas as a complication of tracheostomy, but only one other case of a TIAF has been reported in laryngectomized patients.[2] Patients with this complication are subject to sudden haemorrhage and asphyxiation due to aspiration of the blood.[3] The survival rate in patients with a tracheo-innominate artery fistula is about 14.3 per cent and usually only patients who received immediate surgical treatment survive.[4] The successful management of a tracheo-innominate artery fistula requires prompt recognition, a series of specific manoeuvres and early surgical intervention.

Case report

A 56-year-old male presented to the ENT out-patients department with a history of difficulty in swallowing and hoarseness of two months duration and a history of aspiration of two weeks duration. He was diagnosed to have a malignancy of the hypopharynx, involving the posterior pharyngeal wall with extension into both the pyriform fossae with bilateral cervical lymphadenopathy.

He underwent a total laryngopharyngoesophagectomy and gastric pull up and a bilateral modified radical neck dissection at our hospital in February 1999. During the surgery, bilateral paratracheal lymph nodes were found to be involved also. The histopathologist reported it as a case of well-differentiated squamous cell carcinoma. The pathologist also noticed that the upper margin of the specimen and also the underlying muscles were infiltrated by the malignancy.

Post-operatively the tracheal stoma was found to be narrow. The patient was then advised to undergo radiotherapy for a period of six weeks, 60 Gy over 30 fractions, which the patient completed on the 29th of May 1999. In view of the narrow stoma, the patient was aked to use an uncuffed portex tracheostomy tube during radiation. Following radiotherapy the patient was advised to use a metal tracheostomy tube, since the patient did not have access to a suction apparatus to clean the tube at home.

About two months later the patient presented to the casualty with a history of two episodes of profuse bleeding from the tracheostomy site. The patient had lost about 300 ml of blood during each episode, although the bleeding had stopped spontaneously. The patient had another episode of bleeding while in the casualty that was controlled by hyperinflating the tracheostomy cuff. Bleeding from a tracheo-arterial fistula was suspected. CT angiography was performed which revealed a fistula between the trachea and the innominate artery at the level of the clavicle (Figure 1) and revealed good cerebral collateral blood flow.

Emergency surgical exploration was planned by the surgical team headed by the cardiothoracic surgeon. While the patient was being moved to the operation theatre, he had another episode of massive bleeding and had to be resuscitated by the anaesthesiologist. Surgical exploration was undertaken immediately by the surgical team. The sternum was opened partially with a horizontal extension at the fourth intercostal space. The innominate artery and vein were looped. The origin of the innominate artery was dissected and clamped and distally the artery was clamped just before the bifurcation. The TIAF was identified and the innominate artery in between the clamps was resected, leaving behind enough margins for suturing. Both the proximal and the distal ends of the innominate artery were

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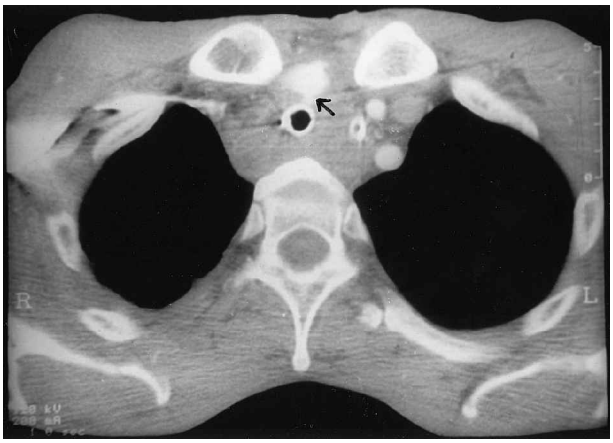

FIG. 1
CT angiogram showing the fistulous communication between the trachea and innominate artery.

double layer sutured with 4° prolene. The stump pressure was measured and found to be adequate (76–80 mmHg). This precluded the need of a shunt as a vascular reconstruction procedure. The defect in the anterior tracheal wall which was about 4 cm from the carina was freshened and the defect was closed with interrupted 4° ethibond sutures with the neck held in flexion. Surrounding muscle, fat and the thymus was used to cover the defect as an additional measure. The entire area was thoroughly cleaned and the sternum closed after placing a drain.

The patient was then moved to the intensive care unit and haemodynamically stabilized. A total of eight units of blood was transfused to the patient intra-operatively and also post-operatively. The post-operative period was uneventful. A culture swab taken from the trachea cultured coagulase negative *Staphylococcus*. The part of the innominate artery that was removed was sent for histopathological examination which showed evidence of atheromatous changes in the arterial wall. There was no evidence of malignancy in the excised specimen.

Discussion

The incidence of trachea-arterial fistula is in the range of 0.5 to 0.6 per cent of all tracheostomies.[5] The innominate (bracheocephalic) artery is the most commonly involved blood vessel followed by the right common carotid artery. Other smaller arteries and even major veins may also be involved.[6] Without prompt surgical intervention the outcome of this complication is grave. Therefore, a high index of suspicion should be maintained in any patient with a tracheostomy and subsequent haemoptysis. Premonitory minimal bleeding (sentinal bleeding) and the pulsation of the tracheostomy tube synchronous with the heartbeat have been reported to be the warning signs of a massive haemorrhage from a TIAF.[4] In the present case also sentinal bleeding was present about 48 hours before the massive bleeding, but the pulsation of the tracheostomy tube was not seen.

The erosion of a major vessel after a tracheostomy is usually caused by pressure necrosis produced by the tracheostomy tube inserted below the fourth tracheal ring. The mechanism of the erosion involves either indirect pressure exerted by the tip of the tube abutting against the anterior tracheal wall or direct pressure relating from that portion of the tube between the skin and the trachea rubbing against an adjacent vessel. Erosion by a direct mechanism is the more common of the two mechanisms.[3] Although the incidence of tracheal damage has lessened with the introduction of the large volume low pressure cuffs it may still occur. The tracheal capillary pressure ranges between 20 to 30 mmHg. In humans, the tracheal capillary perfusion is impaired at 22 mmHg and is totally obstructed at about 37 mmHg.[4] Additional factors that may be responsible for the development of a TIAF are the piston-like movement of the tracheostomy tube connected to a ventilator, the use of excessive and continuous cuff pressure, infection around the stoma and the malignant invasion of a vessel near the trachea.[3] In the present case, following radiotherapy the patient was sent home on a metal tracheostomy tube which may well have been the cause for the TIAF. A tracheal swab taken in the present case cultured coagulase negative *Staphylococcus aureus*, which may have also contributed to the pathogenesis. This finding correlates with the findings of Tungekar[6] who recently reported a case of a tracheocarotid fistula being infected with methicillin resistant *Staphylococcus*. Tungekar[6] also felt that it was a combination of the pressure necrosis leading to inflammation of the tracheal wall and also infection with organisms such as *Staphylococcus aureus* that contributed to the pathogenesis of this condition. In the present case, in addition to the above mentioned factors, the presence of the metastatic paratracheal lymph node, the use of post-operative radiotherapy and the presence of atheromatous changes in the innominate artery, may have all been contributory factors in the aetiopathogenesis of the fistula.

When haemorrhage does occur, rigid restoration of ventilation is mandatory to assure survival. When the erosion is within the trachea, the best approach is to overinflate the tracheostomy tube balloon and ventilate through a smaller endotracheal tube inserted through the lumen of the tracheostomy tube. Bleeding can also be controlled by direct digital pressure or by gauze packing.[7] It could also be controlled by passing a no 5 or 6 Forgarthy catheter through a brachial arteriotomy into the ascending aorta and then withdrawing the inflated balloon until it lodges into the innominate artery.[3] In the present case hyperinflation of the tracheostomy cuff was sufficient to control the bleeding.

After such a limited bleeding episode, even removal of the tracheostomy tube and bronchoscopy may fail to disclose the true source of the bleeding. If the source of the bleeding cannot be positively identified and a TIAF cannot be ruled out, the patient should be taken promptly to the operating theatre for a direct exploration of the neck and upper mediastinum to rule out a TIAF.[1] An angiogram, though not mandatory is sometimes useful in identifying the site of the bleeding and also to know the status of the cerebral blood supply, especially if ligation of the innominate artery is being contemplated. The division of the innominate artery has significant risk of neurological deficit (approximately 10 per cent). Hence, it becomes important to perform a cerebral angiogram, when possible and particularly if there is a history of cerebrovascular disease.[8] In the present case the CT angiography was extremely useful in both identifying the site of the fistula and also in assessing the cerebral vasculature.

Once the diagnosis of the TIAF is confirmed, a partial upper sternotomy with lateral extension into the third intercostal space should be performed.[1] The surgical management of a fistula requires a division of the innominate artery and the separation of the oversewn arterial ends from the trachea.[8] Ligation of the innominate artery proximally and distally appears to be safe and reliable.[7] Ligating only the innominate artery, leaves the subclavian and the carotid circulation in continuity. A vascular reconstruction through the infected field is unwarranted[1] and is usually done in a second sitting if

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deemed necessary. If a carotid artery reconstruction is required in the future a subclavian artery bypass will restore the carotid circulation.[7] Interruption of the innominate artery is reportedly well tolerated by a majority of the patients. However, measurement of the carotid artery stump pressure with the innominate artery clamped is a simple test and should be performed prior to ligation.[7] An autologous vein bypass graft between the aorta and the carotid artery, or between the opposite subclavian artery and the carotid artery, can be employed if the stump pressure is less than 50 mmHg. Delayed reconstruction is carried out through an extra-anatomical route and is indicated in patients with even a minor type of neurological deficit in the post-operative period in spite of satisfactory stump pressure. Reconstruction should also be carried out in a patient who has adequate stump pressure and no neurological deficit but has claudication of the right upper limb either during his normal daily activities or while pursuing his particular occupation. In a young patient with normal stump pressures and no neurological deficits some unusual neurological symptoms have been observed in later life,[9] for prevention of these and for a continued full life, reconstruction is deemed necessary.

A synthetic graft is used in a delayed vascular reconstruction and usually carotid-to-carotid or subclavian-to-subclavian or right axillofemoral arterial bypass grafting is carried out, which brings back normal pulses both in the right innominate and carotid arteries.

In the present case, no vascular reconstruction was done and the patient did not develop any post-operative neurological deficit.

Conclusion

Tracheo-innominate artery fistula is an uncommon, but recognized complication after tracheostomy. It is rarely observed in laryngectomized patients. Pressure necrosis due to a metal tracheostomy tube and local staphylococcal infection and neoplasm are important aetiological factors. A high degree of suspicion of TIAF and early surgical intervention reduces the mortality. A surgical intervention is mandatory, even if investigations are not confirmatory. CT angiography and computerized reconstruction is extremely useful in identifying the bleeding site and also in assessing the vascular status of the brain. An innominate artery ligation is well tolerated by the majority of the patients and a vascular reconstruction can be planned at a later date.

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