Case Report

Successful use of self-expandable metal stents in a case of iatrogenic tracheal rupture

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ARTICLE INFO

ABSTRACT

As an alternative treatment to immediate surgical repair, endotracheal stent placement has been recently proposed in cases of iatrogenic tracheal damages.

We report a case of a 91-year-old male who developed sudden subcutaneous emphysema during a total laryngectomy for laryngeal carcinoma. A tracheal tear at the distal third of the posterior tracheal wall was endoscopically assessed about 2 cm above the carina; CT confirmed the breach approximately 4 cm in length with associated pneumomediastinum and bilateral pneumothorax. Two covered self-expandable metal stents were then coaxially released under fluoroscopic control to cover the defect, restoring the tracheal integrity and leading to a normal thoracic appearance at CT and X-ray after 72 hours.

INTRODUCTION

Tracheal rupture is defined as a complete circumferential injury of the trachea, while tracheal tears stand for longitudinal breaches, generally located at its posterior and more saggy wall, the *pars membranacea*. Both situations represent life-threatening conditions caused by surgical procedures (tracheostomy, esophagectomy, stent placement) or, more frequently, by orotracheal intubation, especially in emergency cases.

Several risk factors have been suggested, such as multiple forced intubation attempts, anesthesiologist's inexperience, overinflation of the tube cuff and its insufficient

deflation in case of tube repositioning [1]. The incidence of postintubation tracheal injury has been recently estimated at 0.05-0.15 per thousand intubation performed [2], although certain postmortem studies indicate an incidence as high as 15% of cases following emergency intubation [3]. Incidence of subcutaneous emphysema, pneumothorax, or hemoptysis should raise the suspicion of a tracheal breach, though CT and tracheoscopy are needed to confirm the diagnosis and precisely assess the exact location and size of the damage.

Immediate surgical repair has been traditionally advocated as the gold standard treatment for both post-traumatic and iatrogenic tracheal breaches [4], while more recently a conservative treatment in selected cases may be just as effective [5].

Fig. 1 – Axial CT scan showing the breach of posterior tracheal wall (arrow). Pneumomediastinum and diffuse emphysema are also evident.

We report a case of iatrogenic tracheal breach during a total laryngectomy for laryngeal carcinoma in an elderly patient, conservatively and effectively managed by placing 2 self-expandable metal stents (SEMS) to cover the tracheal tear.

Fig. 2 – In a sagittal plane the posterior tracheal wall appears interrupted (arrow) 2-3 cm below the tip of the cannula.

CASE REPORT

In July 2017, a 91-year-old Caucasian male in good general condition was admitted to our Department complaining of dysphonia which had presented 15 months earlier as a moderate and worsening dyspnoea without dysphagia.

At endoscopy a lesion involving both vocal cords and the anterior commissure was evident, with impaired laryngeal motility. A CT scan revealed a transglottic extension of the lesion involving the subglottic mucosa up to 1.5 cm below the glottic plane. Neither CT nor ultrasonography of the neck suggested the presence of nodal metastases. Histologic examination of the biopsies revealed the presence of a squamocellular carcinoma, so it was recommended the patient to undergo a total laryngectomy. Surgery started with a tracheotomy under local anesthesia, performed between the 3rd and 4th tracheal ring, a n.8 cuffed tube was then inserted to proceed under general anesthesia. An hour and a half later, due to emerging signs of difficult ventilation, the anesthesiologist asked to halt the surgery; upon removal of surgical drapes, a remarkable subcutaneous thoracic, cervical, and facial emphysema was evident; at endoscopy a posterior tracheal breach was detected, with fat tissue prolapsing within the tracheal lumen at the distal third of the trachea, just above the carina. Once patient's ventilation was stabilized, surgery was completed and a CT scan confirmed the tracheal damage at the distal end of the trachea (Figs. 1 and 2).

Once assessed the stability of vital signs with normal assisted ventilation, the absence of esophageal involvement and/or communication with the mediastinal space and the lack of progression of mediastinal and subcutaneous emphy-

sema, a conservative treatment with covered SEMS (Boston Scientific Ultraflex Tracheobronchial 20×60 mm) to restore the tracheal integrity was planned.

The procedure was performed by 2 interventional radiologists, an anesthesiologist and an ENT surgeon in an angiography room (Philips Integris 3000). The patient laid in supine position to optimize both the interventional maneuvers and the fluoroscopic visualization of the airways. A tracheobronchoscope was inserted through the ventilation tube to precisely assess the site of the rupture. An 0.035 inch guidewire (Amplatzsuperstiff, Boston Scientific) was then advanced over the breach and the prosthesis delivery system was brought over the guidewire under fluoroscopic control until the stent midpoint corresponded to the site of the damaged tracheal wall. After precise evaluation of the position of the stent markers, the prosthesis was released to allow stent expansion and the delivery system was retrieved; yet, the endoscopic control revealed that the caudal end of the stent did not entirely cover the breach, leaving its inferior part uncovered .The procedure was thus repeated and a second prosthesis (Boston Scientific Ultraflex Tracheobronchial 20×40 mm) was coaxially inserted within the previous one, advancing it a few centimeters more inferiorly to fully cover the defect, releasing it just above the carina.

The efficacy of the procedure was confirmed by means of chest X-ray and CT (Fig. 3) and the patient was admitted to ICU.

Forty-eight hours later, a second chest X-ray confirmed the restored tracheal integrity and the complete stent expansion with a normal thoracic appearance, so the patient was sent home advising his caregivers to keep him in a moist environment to avoid crusting secretions.
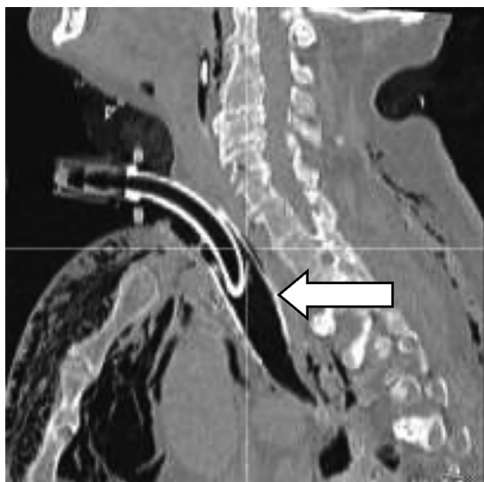
Fig. 3 – Insertion of the stent restoring the integrity of posterior tracheal wall (arrow).
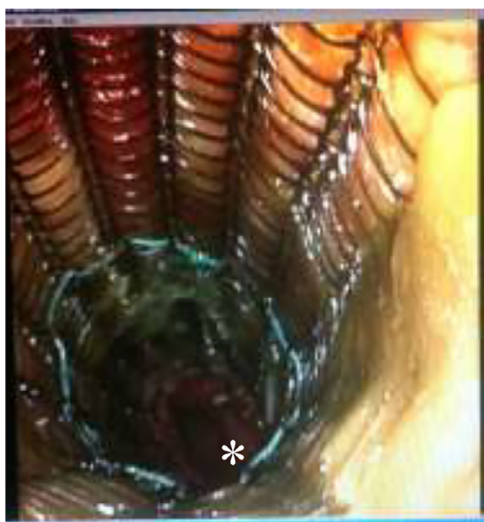

Fig. 4 – Tracheal appearance 14 months after surgery. Caudally (asterisk) carina and left bronchus are visible.

Sixteen months after surgery the patient appears in good general condition with no breathing and/or feeding difficulties, with the prosthesis still in place (Fig. 4) clutched in its inferior end by mucosal ingrowths that would render its removal difficult and, considering the patient's stable status, essentially unadvisable.

DISCUSSION

Tracheal rupture is defined as a complete circumferential interruption of the trachea, while the more common longitudinal injuries of the trachea are referred to as tracheal tears.

Risk factors can be procedure-related or constitutional; the former (also defined as iatrogenic tracheal rupture), are most commonly due to: intubation by inexperienced clinicians, dilative percutaneous tracheotomy, and removal of the tracheal tube without proper deflation, or overinflation, of the cuff [6].

Congenital tracheal abnormalities, tracheomalacia, chronic obstructive pulmonary disease, mediastinal pathologies (tumors, collections) modifying the position of the trachea, and advanced age represent constitutional risk factors. The incidence of tracheal injury has been recently estimated at 0.05-0.15 cases per thousand intubation performed [2], most of which occurring on females over 50 years of age, probably due to the smaller size of their airways.

Tracheoscopy remains the technique of choice for evaluating post-traumatic or iatrogenic tracheal lesions, although preliminary reports of spiral CT with three dimensional reconstruction show promising results [7]. Surgery seems to represent the *gold standard* for the treatment of lesions of the airway [4], through a collar incision with left cervicotomy for tracheal posterior wall injuries and/or partial sternotomy in cases of proximal mediastinal involvement. Reported mortality after surgical treatment varies from 6% to 25% [8]. However, recent reports have shown that especially in iatrogenic tracheal rupture, conservative treatment may also be effective in selected patients [5].

Nonoperative procedures are meant for broad-spectrum antibiotic therapy, clinical and endoscopic observation or tracheotomy, the choice of which depends, respectively, on the width of tracheal laceration (partial, full thickness) and on the stability of vital signs [9] in patients without esophageal injuries or major communication with the mediastinal space [10].

In fact, especially in cases of iatrogenic lesions, usually consisting of simple longitudinal lacerations of the membranous tracheal wall, spontaneous healing can be fostered by surrounding tissues covering the defect.

Most frequently, tracheal breaches, characteristically in a longitudinal fashion [11,10], are observed in mechanically ventilated patients, with the posterior tracheal wall more likely to be the site of rupture.

Ross et al. [5] suggested a conservative policy in cases with stable vital signs, no difficulty in ventilating the patient while intubated or respiratory distress while extubated, absence of esophageal injuries, minimal mediastinal fluid, nonprogressive mediastinal and/or subcutaneous emphysema, no signs of sepsis, endoscopic finding of a lesion <5 cm in length, no gaping of the wound during spontaneous breathing, and no major communication with the mediastinal space.

In their series Cardillo et al. [12] managed tracheal lesions (even ones presenting a complete laceration of the tracheal wall but without oesophageal involvement and mediastinitis) with a conservative approach, by means of bronchoscopic application of 1-2 mL of fibrin sealant onto the lesion.

Conservative treatment is indicated for patients who do not require mechanical ventilation [13] or in cases with mild emphysema and stable ventilation, regardless of the length of the lesion or its proximity to the carina [10,11,13], while others [14] suggest that an alternative treatment to surgery must be considered only in stable patients with small, uncomplicated tears of lengths between 2 and 4 cm.

Finally, conservative management may be facilitated by the insertion of tracheal stents.

These devices can be easily inserted endoscopically, under local anesthesia, even in patients receiving mechanical ventilation without the need of displacing the endotracheal tube.

Tracheal stents adapt without difficulty to tortuous airways and rarely migrate; once deployed, their intrinsic radial force keeps them in position and embeds their ends into the tracheal mucosa. Due to their difficult removal, the main disadvantage of SEMS is tracheal dilation with a potential increase in its diameter, particularly if kept in position for a long time.

In her series (82 patients affected by airways' obstruction caused by malignancies), Saad [15] reported only minor complications such as infectious tracheobronchitis, asymptomatic nonobstructive granulomas, or minor hemoptysis in about 50% of cases, but the actual outcome of the procedure is biased by the obvious short median follow-up duration (42.0 days).

The decision to opt for a conservative treatment in cases of acute lesions should therefore be taken with extreme caution and requires a consolidated experience in the treatment of airway lesions.

Concomitant associated neurologic and respiratory posttraumatic injuries constitute general contraindication to surgery, or, as in our case, when the risks of long-lasting and invasive surgery in an elderly patient would have rendered the surgical option unadvisable.

CONCLUSIONS

Surgery is considered to be the treatment of choice for posttraumatic or iatrogenic tracheal lesions. Accumulating evidence recently challenges this conventional approach, with more surgeons choosing to manage this issue conservatively. Selection criteria for conservative management are a matter of debate: some authors stress the fact that there should be no evidence of respiratory or haemodynamic instability, while others consider the length or depth of the laceration as the most important discriminants.

As of yet, the criteria for guiding which patients will benefit from nonsurgical treatment remain poorly defined, and there is a growing need for clear guidance.

Whether or not a surgical or conservative approach is recommended, prompt treatment is mandatory to prevent septic complications or the creation of adhesions, which could compromise the results of the repair, simple observation should never be an option.

Conservative treatment may thus be a valid alternative to surgery in selected patients, especially in those with iatrogenic lesions, identified according to strict clinical and endoscopic criteria.

Specific experience is however required to select patients for conservative or surgical treatment and to identify a case-specific surgical or conservative therapeutic approach.

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