Abstract : Double lumen tubes (DLT) are a cornerstone in thoracic anaesthesia to achieve one-lung ventilation. Due to the shape and size of these devices, airway injuries might occur. The reported incidence of tracheobronchial ruptures caused by a DLT is very low (0.005% for single-lumen tubes and 0.05% for double-lumen intubations), but the outcome can be life-threatening (1, 2). In the past, treatment of tracheobronchial ruptures was performed surgically, nowadays conservative treatment can be considered (3, 4). Here, we report a case of tracheobronchial rupture during oesophageal surgery.

Key words : Double lumen tube ; single lung ventilation ; complications.

Case report

A 47-year old man without medical history, was planned for a minimal invasive esophageal resection (MIE) for adenocarcinoma of the distal esophagus, staged cT1N0M0. In our centre, MIE is started with a laparoscopic phase, followed by a right thoracoscopy and cervicotomy. Anesthesia was induced with 200 mg propofol (Diprivan®, AstraZeneca, Cheshire, UK), 50 µg sufentanil (Sufenta®, Janssen-Cilag B.V., Tilburg, The Netherlands) and 16 mg cisatracurium (Nimbex®; GlaxoSmithKline, Stevenage, UK) and maintained with sevoflurane. The patient was intubated with a 39Fr left-sided double lumen tube (DLT) (Sheridan®, Argyle, NY, USA) and it’s position was controlled fiberoptically. During the laparoscopic phase (2.5 hours), both lungs were ventilated and minute ventilation was adjusted to achieve a PaCO2 between 40 and 60 mmHg. For the thoracoscopic phase, the patient was positioned on the left lateral decubitus. The position of the DLT was controlled again fiberoptically. During the laparoscopic phase (2.5 hours), both lungs were ventilated and minute ventilation was adjusted to achieve a PaCO2 between 40 and 60 mmHg. For the thoracoscopic phase, the patient was positioned on the left lateral decubitus. The position of the DLT was controlled again fiberoptically and no reposition was necessary. One-lung ventilation was started on the dependent left lung after insufflation of the bronchial cuff with 2.5 mL of air and opening of the right bronchus. During the whole thoracoscopic phase, oxygenation and ventilation were adequate. At the end of thoracoscopy, the surgeon noticed the bronchial cuff bulging through the mediastinum at the left side, caused by a tear of 1.5 cm in the left mainstem bronchus. Ventilation and oxygenation remained adequate. The decision was made to convert the right thoracoscopy to a left thoracotomy. The laceration at the medial side of the left main stem bronchus was clearly visible, with herniation of the bronchial cuff. The localisation of the tear just beneath the carina and the aspect of the tear raised the suspicion of an injury caused by the placement of the DLT. The DLT was withdrawn in the trachea under fiberoptic control and double lung ventilation was started. The surgeon repaired the laceration by a primary suture. An intercostal bundle was used to cover the left bronchus. During the repair, intermittent apnoeic periods were used to allow surgical exposure. To maintain oxygenation, JET-ventilation of the right lung was started through the right lumen of the DLT. Following the repair, the patient was turned in dorsal decubitus to finalize the surgical procedure through cervicotomy (proximal anastomosis of the gastric conduit). Piperacil- line-Tazobactan, 4 × 4 g/day, was empirically started to prevent infections. The patient was extubated immediately. Afterwards, there was a close follow-up of the patient. The follow-up of the patient by bronchoscopy showed a well-repaired tear of the membranous part of the left main stem bronchus. The patient was discharged from the hospital after 9 days.

Discussion

We described an iatrogenic rupture of the left mainstem bronchus with the use of a left-sided DLT for a MIE.

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Etiology

The incidence of tracheobronchial rupture caused by a DLT is 0.05% (1, 2). Many risk factors and causes of tracheobronchial injury associated with double-lumen tubes have been reported. The most frequent one is hyperinflation of the cuff (5, 6, 7). In addition, in reusable DLTs, the cuff can inflate asymmetrically after multiple uses and can produce very high pressures in the area that is in contact with the cuff (6).

Other causes are positioning and repositioning of the tube. For that reason, the cuffs should be deflated when repositioning the tube (6). Because DLTs are larger and more rigid than single lumen tubes, DLTs are more difficult to place (8). Unskilled anaesthesiologists, multiple attempts, emergency intubations, forceful insertion and the inappropriate use of a stylet, can augment the risk of tracheobronchial damage (3, 5, 7, 9).

Injuries with DLTs are more common in women, especially in small ones, because of the slighter bronchial diameter (10). Therefore, intubation with a tube adapted to the patient physical appearance is necessary (1). Other patient related factors, such as previous radiation therapy, age > 50 years, steroid use, critical illness, hypotension, tracheobronchial malformation and chronic obstructive bronchial diseases have also been reported to increase the risk of injury (5, 7, 9).

Tracheobronchial injury during the use of a DLT occurs most frequently during esophageal surgery. This is related to the dissection of the cervical part of the esophagus near the thin posterior membranaceus trachea or posterior bronchial wall (3, 6, 8). Even during advancement of the tube, injury can already occur, especially in elderly (5, 9). Figure 1 demonstrates the anatomy of the tracheobronchial tree and the position of a left-sided double lumen tube in the left mainstem bronchus.

Another issue to prevent injury is the choice of the appropriate size of the DLT. This can be estimated by measurement of the tracheal diameter at the level of the clavicles on a posterior-anterior chest X-ray. A more accurate evaluation of the left main stem bronchial diameter can be determined by CT scan. Table 1 demonstrates the size of the outer and internal bronchial and tracheal diameter and their corresponding DLT (11, 12). However, the correct size of the devise is still subject of ongoing debate (13).

Diagnosis

As mentioned earlier, symptoms of tracheobronchial rupture are not specific and a high index of suspicion should be maintained. We did not observe any symptoms, the diagnosis was made by direct vision of the surgeon. Signs of tracheobronchial rupture are respiratory distress with desaturation, pneumothorax with haemodynamic instability, air leak, subcutaneous emphysema and haemoptysis (1, 3, 6, 8).

Once suspected, bronchoscopy is the best way to perform the diagnosis intra-operatively (3, 6, 7, 8). Radiology can show emphysema, pneumothorax or sometimes an overinflated cuff (9). It might also be advisable to examine the tracheobronchial tree systematically during the thoracoscopy.

Treatment

Tracheobronchial ruptures can be treated conservative or surgically. Conservative treatment
(no primary repair of the lesion) can be accomplished by chest tube drainage. Spontaneous ventilation might be the better choice to avoid further manipulation of the airways. However, endotracheal intubation or a temporary tracheostomy may be necessary. If mechanical ventilation is necessary, low positive end-expiratory pressures and tidal volumes are desired to reduce the airway pressures (9), because high airway pressures could worsen the subcutaneous emphysema and slow the healing process (2, 8). Criteria for a conservative approach are haemodynamic and respiratory stability, absence of sepsis and non-progressive subcutaneous emphysema or pneumomediastinum. Tears less than 2 cm (2, 3, 4, 7, 9) (some authors describe less than 4 cm (9)), can be treated conservatively because they are generally less deep and not associated with oesophageal lesions. Patients with a poor general condition should be treated conservatively (3, 14).

On the other hand, surgical repair should be considered in patients with haemodynamic and respiratory instability, severe subcutaneous emphysema and sepsis (2, 3, 7, 9). Some authors advocate surgical treatment in every case of a tracheobronchial rupture, since intrapleural suction during chest drainage can convert a tracheobronchial tear in a large bronchopleural fistula. Sometimes, the assessment of the rupture can be impossible and ventilation can be very difficult during the repair of the rupture. In these situations, veno-venous extracorporeal membrane oxygenation or, as in our case, jet ventilation can be instituted. These techniques have the advantage that the surgical area is immobile and surgical exposure is improved (15).

As well as during conservative and surgical treatment, a broad-spectrum antibiotic therapy, chest physiotherapy and anti-inflammatory aerosol therapy should be given (8, 13). The healing process can be evaluated by bronchoscopy at regular intervals.

References