

Case Report

Surgical Management of Tracheal Compression Caused by Mediastinal Goiter: Is Extracorporeal Circulation Requisite?

Guangsuo Wang*, MD, Shaolin Lin*, MD, Lin Yang, MD, Zheng Wang, MD, Zongquan Sun, MD.

From Department of General Thoracic Surgery (Drs Wang, Lin, Yang and Wang), Second Affiliated Hospital, Medical College of Ji'nan University, Shenzhen People's Hospital, Shenzhen 518020, Guangdong Province, China; Department of Cardiovascular Surgery (Dr Sun), Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, Hubei Province, China

ABSTRACT Objective: To investigate the surgical and anesthetic management strategy of tracheal compression caused by mediastinal goiter.

Methods: We retrospectively analyzed a patient with an anterior mediastinal mass in whom cardiopulmonary bypass was kept on standby via femoral vessels before induction of anesthesia. Bronchoscope guided tracheal intubation was done and tumor was removed via a cervical approach. Relative literature was reviewed.

Results: CPB via femoral vessels before induction of anesthesia help the patient recover from the perioperative period safely. While bronchoscope slipped beyond the obstruction smoothly and spent less time. The apparently narrow trachea easily distended and did not impair passage of the tube into the trachea opposed to being predicted preoperatively. The histopathological diagnosis confirmed the tumor as a nodular goiter with the formation of hematoma.

Conclusions: CPB via femoral vessels before induction of anesthesia during surgical management of tracheal compression caused by mediastinal goiter is justified while bronchoscope guided tracheal intubation to establish the tracheal patency is a safe and feasible alternative.

KeyWords: mediastinal tumor; substernal goiter; tracheal compression; extracorporeal circulation

J Thorac Dis 2009; 1: 48–50.

It has been known that total occlusion of the airway leading to cardiopulmonary arrest is a fatal complication in patients with tracheal compression caused by mediastinal tumors (1, 2). The airway occlusion can occur during induction of anesthesia, extubation, surgical resection, or simply by a change of posture. How to establish a patent airway in the shortest possible time and allow good surgical access is what we should consider. However, it remains a challenge and a controversy. Cardiopulmonary bypass (CPB) via femoral vessels can be kept ready before induction of anesthesia so that oxygenation can be maintained by initiation of CPB, if irreversible airway obstruction occurs (2, 3). A patient with an anterior cervical-mediastinal mass confirmed pathologically as substernal goiter postoperatively in whom CPB was kept on standby before induction of anesthesia is described. We reviewed the principles of

airway management in patients with mediastinal masses and characteristics of substernal goiter and discussed the importance of CPB in such patients.

Case report

A 72-year-old man with past medical history of hypertension, asthma, chronic bronchitis, bronchiectasis, prostatectomy for prostate cancer and cholecystectomy presented in the hospital with chief complaint of shortness of breath from one day. Treatment in other hospital with aminophylline and oxygen failed to relieve his symptoms. He had difficulty in lying supine which is more severe when his head turned right and he was unable to lie in the left lateral position at all. Physical examination on admission showed no palpable mass in his neck. Lung auscultation revealed moist crackles in bilateral lower lung fields. All preoperative checkup was accomplished with an appointed resident accompanying the patient. CT scan of the neck demonstrated a 5x7 cm right upper cervical-mediastinal mass and compressing the trachea to the left in a diameter of 3 mm at the narrowest point with a radiologic diagnosis as bronchogenic cyst or thyroid origination (Fig 1). Radio-isotope thyroid uptake scan was performed. No radioiodine uptake was found in the mediastinal region and thyroid imaging was not clear. Blood gas analysis demonstrated that PCO₂ was 42 mmHg, PO₂ 80 mmHg, and HCO₃ 25.0 mmol/L. Color Doppler ultrasonog-

The authors have no commercial, proprietary, or financial interest in the products or companies described in this article.

*These authors contributed equally to this paper.

Corresponding author: Zheng Wang, MD. Department of General Thoracic Surgery, Second Affiliated Hospital, Medical College of Ji'nan University, Shenzhen People's Hospital, Shenzhen 518020, Guangdong Province, China. Tel: +86-755-25533018 ext 2555, Fax: +86-755-25533497. Email: wgsy01@163.com.

Submitted November 6, 2009. Accepted for publication November 20, 2009.

Available at www.jthoracdis.com

raphy showed atherosclerotic plaque of the internal carotid artery and normal heart. Cranial MRI showed multiple ischemic lesions. Laboratory data showed TSH level was 0.080 uIU/ml. The peripheral blood and liver and renal function tests were within normal limits.

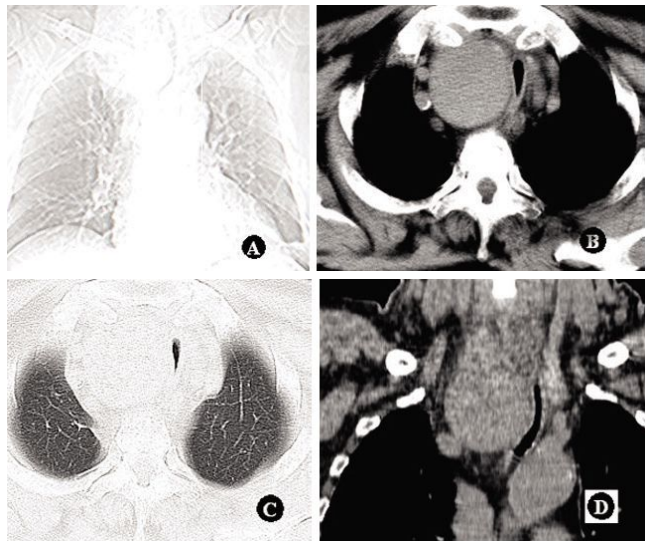


Fig.1 (A) Chest radiograph shows a large mediastinal mass with severe tracheal compression. (B, C and D) Chest CT scans show apparent tracheal deviation and compression and the mass. Arrows indicating the tumor.

After team consultation among thoracic, cardiovascular, thyroid, ear, nose and throat (ENT) surgeons, pulmonologists and anesthesiologist, a final scheduled operation was decided to be carried out under partial CPB followed by fiberoptic bronchoscope guided tracheal intubation. An exploration via a cervical approach was performed first and a median sternotomy was done when needed.

Cannulas for cardiopulmonary support were placed in the femoral vessels using local anesthesia before the induction of general anesthesia. The extracorporeal circuit was primed with balance rate throughout bypass of (43-58)ml.Kg-1.min-1. A normal nasopharyngeal temperature was maintained at 36.5°C in order to avoid arrhythmia. A 22-gauge catheter was inserted into a radial artery to permit continuous recording of systolic and diastolic arterial blood pressures and blood gas analysis. Blood oxygen saturation and oxygen partial pressure remained at a normal level.

After the induction anesthesia, the respiratory physician and the anesthesiologist inserted the bronchoscope (Olympus BFP30) into a single lumen endotracheal tube (Tyco, No.7) and then managed to introduce them from the mouth to the trachea and further beyond the inferior edge of the narrow site with the bronchoscope as the guide wire. Bronchoscope revealed severe outer compression 2-3cm below glottis with a diameter of 3mm at the narrowest point. The mucosa was smooth and no neoplasm was found. After that the bronchoscope was withdrawn and tracheal tube was connected to the ventilator. The elapsed time measured was 4 minutes from

the start.

After 22 minutes bypass, CPB discontinued and conventional mechanical ventilation was given. An incision was made via a cervical approach. The strap muscles were cut, and the middle thyroid vein was cut after ligation. The inferior thyroid artery was ligated in continuity, the superior pole was cut after double ligation, and the recurrent laryngeal nerve was exposed and dissected away. Careful dissection was done to ensure mobilization in the right tissue plane, with care to identify and secure the parathyroid glands. Upward delivery of the gland was done using the index and middle finger. The fingers were rotated in all directions to reach the lower end of the gland to aid delivery. A 4× 5× 7cm tumor was found located in the middle and lower pole of right thyroid with smooth margin and filled with coffee-like liquid. It was wholly excised. We didn't resort to median sternotomy.

The postoperative recovery was uneventful, with no bleeding problem or other CPB-related complications. The patient was monitored in our intensive care unit and extubated after ventilation for 17 hours. Post-thyroidectomy airway compromise due to tracheomalacia and laryngeal oedema didn't occur. He was discharged at 7th post operative day without any difficulty in breathing. The histopathological diagnosis confirmed the tumor as a nodular goiter with the formation of hematoma.

Discussion

In 1970s the risk of fatal airway obstruction or cardiovascular collapse during induction of anesthesia in patients with large anterior mediastinal masses was first time recognized (1). Hypoxia, carbon dioxide accumulation, asphyxia, cardiopulmonary arrest, cerebral edema or hemorrhage can occur due to failed intubation or dysfunction of ventilation following intubation. This situation can be fatal. It will require at least 5-10 min (much more time spent in our patient) to cannulate and establish adequate circulation and oxygenation (4), even with a primed pump and a prepared team. CPB via femoral vessels before induction of anesthesia is a good option. It can allow gas exchange, avoiding hypoxia and hypercapnea which can lead to cardiac arrest and safeguard smooth intubation. Meanwhile, it can give good surgical access for the mass operations. Though thyroidectomy can safely be performed via cervical incisions and without the CPB support in 94% to 98% substernal goiters (5), it's difficult to differentiate definitely the extent of mass preoperatively. Median sternotomy may be indicated following the cervical exploration, the management of which might have required CPB support. In this patient the establishment of CPB was necessary mainly for respiratory, not hemodynamic reasons confirmed intraoperatively. Regarding CPB (esp. shortened duration) related complications; they can be minimized where cardiac surgery is routinely performed. CPB is now considered a safe and acceptable everyday clinical tool.

We finally chose to cannulate the femoral vessels under local anesthesia and to keep the circuit ready to initiate CPB followed by

bronchoscope guided tracheal intubation based on the patient's baseline and consensus between medical staffs and patient.

Traumatic intubation may precipitate postoperative laryngeal edema when blind intubation is usually performed even by a senior anaesthetist (6). In the absence of a 2mm in outer diameter flexible fiberoptic bronchoscope in our hospital, we used a 5.5mm alternative to guide the tracheal intubation after the induction of anesthesia. Flexible bronchoscopy can be useful intraoperatively to exclude an invasion of the tracheal wall by a neoplasm and evaluate the tracheal compression as well as the risk of tracheomalacia. More importantly it can help to guide the endotracheal cannula passing beyond the site of obstruction and the distal margins of the stenotic process could be visualized (6). Our patient's tracheal mucosa was smooth. The performer turned the bronchoscope gently and slowly which slipped beyond the obstruction smoothly. The time spent may be less than what it was because several colleagues browsed what the bronchoscope displayed in turn. Hence, the apparently narrow trachea easily distended and did not impair passage of the tube into the trachea opposed to being predicted preoperatively, a finding ever noted by Shen and Kebebew and was confirmed in our study (7). In a recent study, Mackle compared the subjective tracheoesophageal pressure symptoms associated with substernal goitres with objective cross-sectional radiographic measurements and found tracheal deviation on radiographic imaging did not appear to affect airway symptoms (8). We speculate this is probably due to the cystic and parenchymatous nature of the benign goiter that allowed the bronchoscope squeezing into the distal trachea. It may also explain the present patient's symptom doesn't appear as severe as that we can see on the radiological images.

Mediastinal mass may be benign or malignant tumors or cysts or aneurysms and may arise from the lung, pleura or any of the components of the anterior mediastinum. The anesthetic considerations for patients with an anterior mediastinal mass will vary according to the individual anatomy, pathology and the proposed surgical procedure (2). Thus, although there are general principles of safe anesthesia for these patients, there is the need to individualize management on a case-by-case basis. As mentioned above, fiberoptic bronchoscope guided tracheal intubation appears to be possible and feasible in such patients. Some author proficient in bronchoscopy even raised a suspicion of "why use an ox-cleaver to kill a chicken". CPB might not have been requisite in this patient.

An alternative method of securing the airway is the use of emergency attempts at tracheostomy in the event of total airway obstruction occurring during waiting for operation or induction of anesthesia (9). This method was ever considered in the present case

on emergency admission because of unprepared systemic checkup. However, prophylactic tracheostomy still present a likewise challenge for establishment of the tracheal patency because operation under local anesthesia may cause the process to be time-consuming and dangerous due to deviation of normal tracheal anatomy and tube failing to pass beyond the narrowest part (combination of too short tube and tracheal stricture may contribute to the situation). Tracheostomy itself poses a risk as high as excision of the tumor. A same catastrophic situation may arise during induction of anesthesia and at that time relaxation of airway smooth muscle by anesthetic agents makes the airways more compressible followed by inability to ventilate patients with mediastinal tumors. Tracheostomy in a hurry is extremely hazardous and even fatal.

Fortunately, we succeeded in alleviating the tracheal obstruction without any anesthetic complication in this patient. But what if CPB is not required at all? Medical staffs are fully prepared to deal with a respiratory and hemodynamic catastrophe, fully communicate with the patient and his/her relatives and finally reach a consensus on treatment strategy and risks. That is perhaps an optimal choice at present. We believe that CPB via femoral vessels before induction of anesthesia in such patients is justified while bronchoscope guided tracheal intubation to establish the tracheal patency is a safe and feasible alternative.

References

1. Bittar D. Respiratory obstruction associated with induction of general anesthesia in a patient with mediastinal Hodgkin's disease. *Anesth Analg* 1975; 54: 399-403.
2. Slinger P, Karsli C. Management of the patient with a large anterior mediastinal mass: recurring myths. *Current Opinion in Anaesthesiology* 2007; 20:1-3.
3. Tempe DK, Arya R, Dubey S, Khanna S, Tomar AS, Grover V, et al. Mediastinal mass resection: femorofemoral cardiopulmonary bypass before induction of anesthesia in the management of airway obstruction. *J Cardiothorac Vasc Anesth* 2001; 15: 233-6.
4. Takeda S, Miyoshi S, Omori K, Okumura M, Matsuda H. Surgical rescue for life-threatening hypoxemia caused by a mediastinal tumor. *Ann Thorac Surg* 1999; 68: 2324-6.
5. Wheeler MH. Clinical dilemma: retrosternal goitre. *Br J Surg* 1999; 86: 1235-6.
6. Shaha AR, Alfonso AE, Jaffe BM. Acute airway distress due to thyroid pathology. *Surgery* 1987; 102: 1068-74.
7. Shen WT, Kebebew E. Predictors of airway complications after thyroidectomy for substernal goitre. *Arch Surg* 2004; 139: 656-60.
8. Mackle T, Meaney J, Timon C. Tracheoesophageal compression associated with substernal goitre. Correlation of symptoms with cross-sectional imaging findings. *J Laryngol Otol* 2007; 121: 358-61.
9. ul Huda A, Siddiqui KM, Khan FH. Emergency airway management of a patient with mediastinal mass. *J Pak Med Assoc* 2007; 57: 152-4.