The left anterior extrapleural approach for innominate artery transection in a patient with tracheostomy and a neurological disorder

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INTRODUCTION

Our recent study demonstrated that preventive elective surgery for innominate artery compression of the trachea (IACT) is effective in preventing life-threatening complications (e.g. massive bleeding and obstructive apnoea) in patients with neurological disorders, pre-existing tracheostomy poses a risk of mediastinal infection with sternotomy. We successfully performed innominate artery transection on such a patient via the left anterior extrapleural approach without sternotomy after confirming the anatomical configuration on three-dimensional multidetector row computed tomography angiography.

CASE REPORT

A male patient was born via emergency caesarean section because of umbilical cord prolapse and foetal distress. The diagnosis was hypoxic-ischaemic encephalopathy with multicystic encephalomalacia. He required long-term mechanical ventilator support with tracheostomy, and severe scoliosis developed gradually. Since the age of 7, the patient has occasionally experienced minor tracheal bleeding. Bronchoscopy revealed pulsatile extrinsic compression of the anterior wall in the lower trachea and granulation with ulcer formation at the tracheostomy tube tip. IACT was confirmed on chest computed tomography (CT). We adjusted the tracheostomy tube tip proximally to prevent excessive irritation of the trachea. At 9 years of age, the patient was brought to our hospital by ambulance because of sudden respiratory failure. Emergency bronchoscopy showed severe tracheal luminal stenosis by granulation. Tracheal bougie dilatation was performed with incremental sizes, and a tracheostomy tube (5.5 mm internal diameter) was inserted for internal stenting. We planned innominate artery transection to prevent fatal airway obstruction. Three-dimensional multidetector row CT angiography (3D-MDCTA) showed the trachea quite close to the manubrium and IACT just below the sternum’s left side (Fig. 1). Brain magnetic resonance angiography showed an incomplete circle of Willis with an anterior communicating artery missing.

The operation was performed through a small skin incision (4.5 cm) in the second left intercostal space from the sternal border laterally. After incising the perichondrium on the mid-pectoral surface, we resected the second left costal cartilage to the costochondral junction subperichondrially. The posterior perichondrium was released, and the innominate artery was exposed carefully. After temporary clamping of the innominate artery, systemic blood pressure in the radial artery was 70 mmHg without changes in regional cerebral tissue oxygen saturation from baseline. The innominate artery was ligated and transected (Fig. 2), and its proximal arterial stump was closed with a continuous 5-0 polypropylene suture. The proximal and distal arterial stumps were pulled away from the underlying trachea. The dissected costal cartilage was reattached to the costochondral junction, and the opened perichondrium was resutured. Flexible bronchoscopy showed complete resolution of pulsatile extrinsic compression of the tracheal wall. The postoperative course was uneventful without respiratory failure, infection or neurological complications. There were no episodes of right upper-extremity ischaemia or subclavian steal syndrome. CT showed sufficient spacing between the sternum and the trachea. The patient was discharged on postoperative day 21.
Our major concern with the innominate artery transection was the risk of mediastinal infection in the patient with tracheostomy. The tracheostomy stoma site was approximately 1 cm above the suprasternal notch, and the trachea was close to the manubrium in this case. If we performed the operation via a small cervical collar incision without sternotomy or I-shaped skin incision with upper partial median sternotomy, the operative field may have been connected to the tracheostomy stoma subcutaneously. Wound contamination by tracheostomy stoma exposes a patient to the risk of mediastinitis and sternal wound infections. Sternotomy itself is associated with postoperative mediastinal infections [2]. The important procedural factors that minimized the risk of infection included the avoidance of sternotomy and the small skin incision at an adequate distance from the tracheostomy stoma [3].

Figure 1: Preoperative CT assessment. (A) Sagittal CT image shows the trachea (Tr) close to the manubrium (M), and extrinsic compression of the trachea (red arrow) by the innominate artery (red asterisk). (B) 3D-MDCTA image, anterior view. The first branch of the left aortic arch is a common trunk of the innominate artery and the left common carotid artery (LCCA). The second branch is the left subclavian artery (LSCA). The innominate artery (red asterisk) originates from the common trunk near to the left edge of the sternum (S).

Figure 2: Intraoperative photograph of the innominate artery transection via the left anterior extrapleural approach. The second left costal cartilage (LCCII) was resected to the costochondral junction. Tr: trachea; LCCIII: third left costal cartilage; stumps of the transected innominate artery (yellow asterisk); cephalad (black arrow).

The left anterior extrapleural approach through the second left intercostal space was first introduced as a surgical approach to the heart by Yao and Mustard in 1969 [4], in conjunction with pulmonary artery banding and innominate artery suspension, and has often been used in cardiac surgery. Excision of costal cartilage is also known as Chamberlain’s procedure for an incision biopsy of a mediastinal tumour [5]. Because IACT was detected just below the sternum’s left side on 3D-MDCTA assessment, we applied the above technique to innominate artery transection. It ensured adequate separation of the tracheostomy stoma from the operative field, and yielded excellent results without infection. Preoperative 3D-MDCTA was very useful to determine the optimal surgical procedure. Current advent of the state-of-the-art endovascular modalities allows an innominate artery embozilization to be a therapeutic option as a less invasive approach. However, progressive thoracic deformity and long-term placement of a tracheostomy tube in patients with neurological disorders may exacerbate IACT because of an innominate artery remnant after endovascular embolization; thus, we recommend innominate artery transection as preventive elective surgery for patients with neurological disorders.

In summary, we used the left anterior extrapleural approach for innominate artery transection in a patient with tracheostomy and a neurological disorder. This approach allowed easy access and adequate exposure of the innominate artery without sternotomy, and prevented postoperative mediastinal infections.

Conflict of interest: none declared.

REFERENCES