

CASE REPORT

Unusual complication of perioperative internal jugular venous cannulation

S. Akunuri¹, A. Sapare¹, R. Hegde¹, C. Reddy²

¹Department of Paediatric Intensive Care, Narayana Health, Bangalore, India

²Department of Cardiothoracic Surgery, Narayana Health, Bangalore, India

Correspondence

S. Akunuri - akunurishalini@gmail.com

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Abstract

Central venous lines are commonly inserted in cardiac surgery for haemodynamic monitoring as well as administration of fluids and vasoactive drugs. A rare and potentially serious complication of central venous access is development of pseudoaneurysms after inadvertent puncture of the artery. We present a case of right subclavian artery pseudoaneurysm after internal jugular vein access for perioperative management of congenital heart disease, which presented late with a mass effect over the trachea, leading to difficulty in mechanical ventilation and multiple failed extubation attempts.

Introduction

Central venous cannulation is performed for haemodynamic monitoring and rapid administration of drugs and fluids. However, serious adverse events can occur such as haemorrhage, arterial injury, pneumothorax and nerve injury. Here we report a case of subclavian artery pseudoaneurysm that followed right internal jugular vein cannulation for perioperative management, which caused a mass effect over the trachea leading to respiratory distress, difficult ventilation and extubation failure.

Case report

An 8-month-old female infant weighing 3.2 kg with an interrupted aortic arch, large patent ductus arteriosus continuing as descending aorta and aorto-pulmonary window underwent successful surgical correction. She was extubated the following day and was haemodynamically stable. She was transferred to the ward after vasopressors were weaned. However, on the 14th postoperative day, she developed severe respiratory distress for which she was intubated and transferred back to intensive care unit. Chest X-ray was obtained which showed haziness in the right upper zone and was interpreted as collapse due to aspiration (*figure 1A*).

Four days later she was extubated, but she developed severe

respiratory distress with marked suprasternal and chest recessions. The respiratory distress was akin to gasping breath without audible stridor. She was intubated immediately and ventilated. She was extubated twice thereafter with a 2-3 day interval between each extubation. Each time she developed respiratory distress and gasping breath within minutes of extubation. The following differentials for the failed extubation were considered: diaphragm palsy, subglottic stenosis, tracheobronchomalacia, severe pulmonary arterial hypertension and extrinsic airway compression. Two-dimensional echocardiography showed normal pulmonary artery pressures and fluoroscopy showed normal diaphragmatic movements. Laryngoscopy showed a normal glottic opening without any oedema and there was no difficulty in intubation. Bronchoscopy was planned for airway assessment. Meanwhile, ventilating the baby posed a challenge. In view of repeated extubation failure, tracheostomy was performed to facilitate weaning from the ventilator. However, she developed severe respiratory acidosis and hypoxaemia a few hours later and it was noticed that there were no chest excursions despite manual ventilation. The tracheostomy tube was changed, taking due care to avoid false track formation. As ventilation was ineffective in all possible ways, she was intubated orally and the tracheostomy

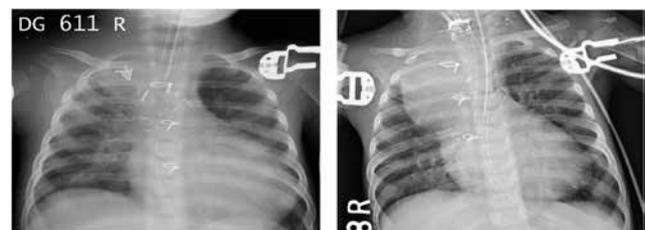


Figure 1A. Chest X-ray showing right upper zone haziness

Figure 1B. Chest X-ray showing haziness with round contour in right upper zone

site was closed. However, the problem of ineffective ventilation persisted as intermittently she would develop wheezing along with severe respiratory acidosis, and an increase in peak pressure and airway resistance. Initially tube block was suspected. However despite suctioning, nebulisation and subsequently changing the endotracheal tube, there was no improvement in ventilation. Later she was observed to have chest rise only with the neck abnormally flexed in a particular position, while in all other positions the symptoms of airway obstruction would manifest. Her serial chest X-rays showed persistent haziness in the right upper zone and in due course, the haziness increased in size and developed a rounded contour (figure 1B). Inability to ventilate even via an artificial airway decreased the likelihood of tracheomalacia. Also the rounded opacity in the chest favoured the possibility of a mass lesion causing dynamic external airway compression, which made ventilation possible only in a particular position. Hence contrast enhanced computed tomography of the chest was performed which showed a large haematoma with a pseudoaneurysm in the right upper thoracic cavity measuring 4 x 3.3 x 4.3 cm with active contrast leak from the proximal right subclavian artery and a mass effect on the trachea (figure 2A, 2B, 2C). The three-dimensional reconstruction image (figure 2D) confirmed the same. She underwent open surgical repair via a right thoracolateral approach. The pulsatile haematoma was evacuated and the rent in the subclavian artery was closed. She was finally extubated.

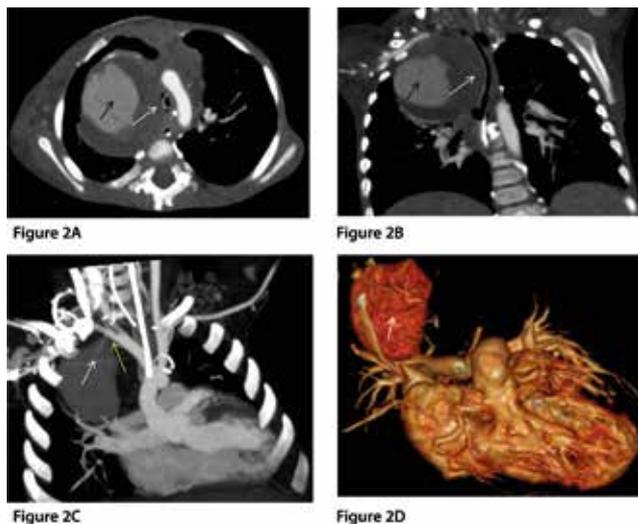


Figure 2A and 2B. Intravenous contrast enhanced computed tomography shows large right subclavian artery pseudoaneurysm (black arrow) in the right upper hemithorax causing compression over trachea (white arrow)

Figure 2C. CT chest with intravenous contrast shows large acute haematoma with pseudoaneurysm in right upper thoracic cavity with active contrast leak (white arrow) from proximal right subclavian artery (yellow arrow)

Figure 2D. 3D CT scan reconstruction shows large pseudoaneurysm (arrow) and the relationship with other anatomic structures

Possible causes for pseudoaneurysm formation were evaluated. Review of the case records revealed that she did not undergo cardiac catheterisation prior to surgery. The likelihood of cardiac surgery itself leading to this complication was remote as the surgery was performed via a sternotomy and the subclavian artery, being a lateral structure, was never exposed or mobilised. However, insertion of the line in the internal jugular vein for cardiac surgery was difficult, requiring three attempts, which were not ultrasonography guided. The arterial injury could have been minor, leading to a gradual leak of blood into the false lumen, causing progressive enlargement of the haematoma and dynamic compression of the trachea. The lower tracheal compression was responsible for difficult ventilation, when the endotracheal tube tip was above the site of obstruction. This airway compression was responsible for the airway resistance leading to gasping breaths soon after extubation.

Discussion

Pseudoaneurysms are localised arterial disruptions or pulsatile haematoma that communicate with an artery through a disruption in the arterial wall and are caused by trauma, iatrogenic interventions and anastomotic disruption.

Right internal jugular vein cannulation is commonly used in cardiac surgery for haemodynamic monitoring and administration of drugs. The incidence of serious complications from venous access varies from 0.4% to 9.9%.^[1] Inadvertent arterial puncture occurs in about 5% of all central venous catheter placements.^[2] Pseudoaneurysm formation post accidental arterial puncture has an incidence rate of 0.05% to 2%.^[3] Ultrasound guidance for central line placement is associated with fewer attempts and fewer complications.^[4] It can differentiate between the venous and arterial anatomy through its ability to display arterial pulsatility, venous compressibility, and venous engorgement. Real-time ultrasound decreases thrombotic, infectious, and mechanical complications associated with central venous cannulation.^[5] A new device – a compact, sterile, single-use transducer with a display (mean pressure and pressure waveform on a small LCD screen) and sealed guidewire port – is now available (Compass, Mirador Biomedical). It provides protection against inadvertent insertion of the needle into the artery during guidewire placement. An analysis found that the device functioned properly and it was suggested that routine use of the Compass for the placement of central venous catheters would be cost-effective.^[6]

During internal jugular vein access, the carotid artery is most susceptible to arterial injury^[7,8] due to its proximity to the vein. However, rarely subclavian artery injury has also been described.^[9-11] Symptoms of subclavian artery aneurysm are determined by its site and size. Extrathoracic aneurysms usually present with a pulsatile lump over the supraclavicular fossa and flow murmurs, while intrathoracic aneurysms compress the brachial plexus or upper limb vessels leading to ischaemia

of the limb, recurrent laryngeal nerve resulting in hoarseness, and erosion of the lung apex causing haemoptysis. In addition, there are reports about dysphagia and Horner's syndrome.^[12] Identifying pseudoaneurysm as the cause of multiple extubation failure and difficult ventilation was a diagnostic challenge in this case. Pseudoaneurysms of the subclavian artery usually occur immediately after iatrogenic injury. This patient presented a fortnight after the initial injury, probably because of minor trauma.

As spontaneous rupture and thrombosis are common risks associated with subclavian artery aneurysm, it is highly recommended to correct the aneurysm, especially in patients with compressive symptoms.^[13,14] Treatment options include ultrasonography guided compression, ultrasound guided thrombin injection, coil embolisation, balloon occlusion, endovascular stents and open surgical repair.^[15] Ultrasonography guided compression involves locating the aneurysm sac using the ultrasound transducer and applying enough pressure to stop flow within the sac, but maintain flow in the affected artery. Flow within the sac is reassessed at 10-20 minute intervals until thrombosis is achieved.^[16] Ultrasound guided thrombin injection involves needle infiltration of the aneurysm sac using ultrasound guidance and injection of thrombin to induce thrombosis of the cavity;^[17] this could not be undertaken due to the risk of vertebral artery thrombosis. Endovascular exclusion with covered stents may be an option for treatment of distal subclavian artery pseudoaneurysm if coverage of the vertebral origin can be avoided. Endovascular repair was deferred due to the large aneurysmal size and mass effect. Open surgical repair is reserved for rapidly expanding or ruptured pseudoaneurysms, pseudoaneurysms causing a mass effect or when other treatment options have failed.^[18]

While prevention of inadvertent arterial puncture is paramount, a protocol for treatment may be needed. Guilbert et al. proposed a management algorithm for inadvertent arterial puncture and cannulations.^[19] If the catheter is in situ, the catheter should be kept in place rather than using the pull pressure technique, which has a high complication rate. Open exploration and direct arterial repair must be contemplated. Alternatively, if arterial injury is suspected in a surgically inaccessible area, percutaneous treatment with covered stent or closure device must be considered. In cases of arterial puncture by a needle or guidewire, immediate imaging and neurological examination must be performed and patients must be clinically followed up for airway and neurological complications.^[19]

Conclusion

Although a common procedure, insertion of a central venous line is not without complications. Pseudoaneurysms usually occur immediately after an iatrogenic injury. However, delayed manifestations can occur which require a high index of suspicion. Also the presentation may be unusual. The use

of ultrasonography or a novel compass device during central line cannulations limits the incidence of complications. Any inadvertent arterial puncture during central line placements requires close follow-up for airway and neurological complications with clinical examination and imaging.

Disclosures

All authors declare no conflicts of interest. No funding or financial support was received.

Consent

Written informed consent was obtained from the baby's parents for publication of this case report and any accompanying images.

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