

Tracheal Compression Caused by a Mediastinal Hematoma After Interrupted Aortic Arch Surgery

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SUMMARY

Congenital abnormalities of the aortic arch include interrupted aortic arch (IAA), coarctation of the aorta (CoA), and double aortic arch (DAA). Aortic arch repair is difficult and postoperative complications are common. However, postoperative tracheobronchial stenosis with respiratory insufficiency is an uncommon complication and is usually caused by increased aortic anastomotic tension. We report here a case of tracheal compression by a mediastinal hematoma following IAA surgery. The patient underwent a repeat operation to remove the hematoma and was successfully weaned off the ventilator.

In cases of tracheobronchial stenosis after aortic arch surgery, airway compression by increased aortic anastomotic tension is usually the first diagnosis considered by clinicians. Other causes, such as mediastinal hematomas, are often ignored. However, the severity of symptoms with mediastinal hematomas makes this an important entity. (*Int Heart J* 2017; 58: 629-632)

Key words: Congenital heart disease, Vascular hemorrhage, Postoperative

Interrupted aortic arch (IAA) one-stage surgical repair has many postoperative complications. The most common one is anastomotic stenosis leading to aortic dysplasia, but tracheal stenosis is a rare complication and has not been reported previously. Herein, we report a novel finding of tracheal stenosis due to mediastinal hematomas. Cardiovascular CTA examination and a second surgery found bleeding from the branches of the descending aorta.

CASE REPORT

A 7-month-old female patient was admitted to our hospital due to persistent coughing, shortness of breath, and wheezing that had lasted for two days. The patient was born full-term at 38 weeks, with no significant medical or family history, except that her mother had diabetes. After a thorough examination, including cardiovascular ultrasound and computed tomography angiogram (CTA) (Figure 1A), the patient was diagnosed with a complex congenital heart disease. She had a type A interrupted aortic arch (IAA) with a ventricular septal defect, patent ductus arteriosus, mitral valve stenosis, and severe pulmonary hypertension. Preoperative plain chest X rays (Figure 1C) and axial view of the CT (Figure 1D) revealed no signs of significant stenosis. After comprehensive preoperative preparation, the patient was placed in deep hypothermic circulatory arrest and selective cerebral perfusion. Using a median

sternotomy incision, one-stage IAA correction surgery was performed. The repair included an artery catheter suture, end-to-side anastomosis of the distal aorta to the aortic arch, ventricular septal defect repair, and mitral supra-valvular stenosis relief (Figure 1B). The patient was kept in the pediatric intensive care unit after the surgery. The patient's vital signs remained stable after dopamine and milrinone were administered to maintain the circulation. No difference in the blood pressures between the upper and lower extremities was identified. The blood pressure increased to 140/85 mmHg or higher occasionally, but returned to normal with drug treatment. After extubation on the 11th postoperative day, the patient developed progressive respiratory difficulty and intercostal retractions. The pO₂ was 103.0 mmHg and pCO₂ was 91.7 mmHg. After re-intubation, the peak inspiratory pressure was 40–45 cmH₂O. The blood pO₂ was normal, but the pCO₂ remained above 60 mmHg. The tracheal tube was pushed 3 cm further, after which the airway pressure decreased to 20 cmH₂O.

The patient displayed signs of airway obstruction after being weaned off the ventilator. The following diagnoses were considered: tracheobronchial compression caused by anastomosis and angioplasty; postoperative tracheal softening; airway foreign body; airway spasm; and over-insertion of the tracheal tube. A thorough examination helped determine the cause of the airway obstruction. Plain chest X rays showed right upper lobe atelectasis and a widened mediastinum (Figure 1E), while a chest CT scan revealed a mass in the right upper

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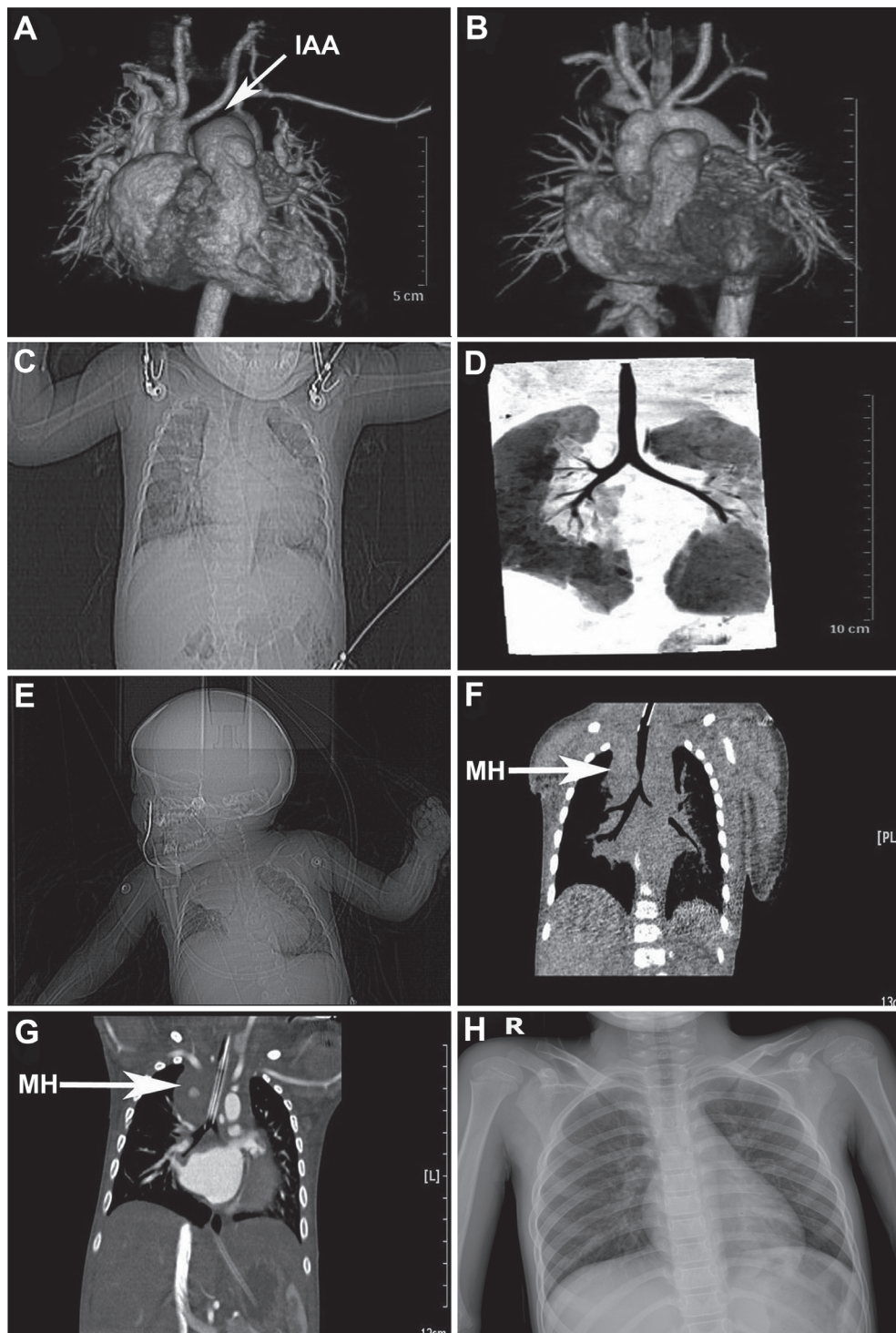


Figure 1. Preoperative and postoperative image data (plain chest X ray, cardiac CTA, and chest CT scan, tracheobronchial reconstruction. **A:** Preoperative image showing interruption in the aorta distal to the origin of left subclavian artery and that distal descending aorta is being supplied by the ductus arteriosus; **B:** Postoperative image showing restored aortic arch continuity; **C:** Preoperative plain chest X ray showing normal mediastinal shadow. **D:** Preoperative image showing no tracheal stenosis; **E:** After the first surgery, plain chest X ray showing the right upper lobe atelectasis and widened mediastinum; **F:** After the first surgery (intubated again after weaning): mediastinal mass compressing the right lower side of trachea; **G:** After the first surgery (intubated again after weaning): MH compressing the right lower side of trachea and contrast agent in the hematoma; **H:** Eighteen months after being discharged: no abnormalities. CTA indicates computed tomography angiography; CT, computed tomography; IAA, interrupted aortic arch; and MH, mediastinal hematoma.

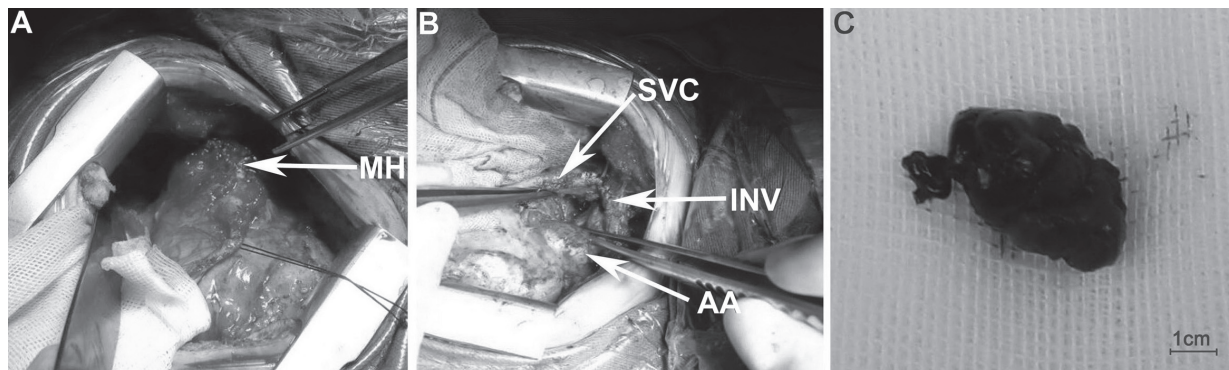


Figure 2. Intraoperative findings of the patient in the second surgery. **A:** The hematoma on the right upper side of the mediastinum; **B:** Gaps between SVC, INV, and AA were opened to remove blood clots and ligate bleeding small vessels; **C:** Hematoma sized 4.5 cm × 3.2 cm × 2.4 cm. IAA indicates interrupted aortic arch; MH, mediastinal hematoma; SVC, superior vena cava; INV, innominate vein; and AA, ascending aorta.

area of the mediastinum that was compressing the lower trachea (Figure 1F). Cardiac CTA examination found a right sided MH compressing the lower tracheal segment close to the carina. Active bleeding was seen in the hematoma (Figure 1G). The aortic anastomosis was found to be patent. Bronchoscopy revealed a compression at the right side of the lower trachea near the carina. A cardiac ultrasound showed successful repair, patent aortic anastomosis, and no signs of tracheal compression.

A repeat thoracotomy was performed to remove the mediastinal hematoma. During the operation, the right side of the lower airway was found to be compressed by the mediastinal hematoma (Figure 2A). The mediastinum was accessed through the superior vena cava, innominate vein, and ascending aorta (Figure 2B). The hematoma was then removed and the bleeding was stopped. During the operation, it was found that the bleeding was derived from the small branches of the descending aorta and the hematoma was about 4.5 cm × 3.2 cm × 2.4 cm in size (Figure 2C).

After the hematoma was removed, the airway pressure decreased significantly and the blood gas analysis returned to normal. The patient was weaned off the ventilator at 10 days after the second operation. She was hemodynamically stable, but had an increased respiratory effort due to tracheal softening. She did not have wheezing or any other symptoms or signs of respiratory difficulty. After using noninvasive ventilation for one week, the patient was switched to oxygen via a nasal catheter. She also recovered from the pneumonia after two weeks of treatment. One month after the second surgery, the patient was discharged. However, one month after the discharge, she was re-admitted with bronchial pneumonia. After two weeks of treatment, the patient recovered. She has not shown any signs of circulatory or respiratory disease since then. A plain chest X ray performed at 18 months after the surgery found no abnormalities (Figure 1H).

DISCUSSION

There are several congenital anomalies of the aortic arch, including IAA, coarctation of the aorta (CoA), and double aortic arch (DAA). A one-stage surgical repair via a median sternotomy is recommended in infants and young children for

anomalies of the aortic arch and other cardiac malformations. Many postoperative complications are associated with one-stage surgical repair, such as ischemic injury of the central nervous system and spinal cord, anastomotic stenosis, tracheal stenosis, recurrent laryngeal and phrenic nerve injury, and renal insufficiency. Our patient developed a mediastinal hematoma due to bleeding from the branches of the descending aorta. The bleeding compressed the trachea and caused tracheal stenosis. Tracheal stenosis is a rare complication and has not been reported previously.

Distal tracheal compression is a rare complication after the surgical repair of deformities of the aortic arch.¹⁾ A previous study reviewed 81 patients younger than 18 years with a double aortic arch and found tracheal stenosis in 14% of the patients and tracheomalacia in 7% of the patients.²⁾ Persistent respiratory symptoms often occur after DAA repair, but a second surgery is rarely required. Previously, 4 cases of severe respiratory disease due to tracheal compression and tracheomalacia have been reported after DAA repair.³⁾ Two patients had extubation failure and the remaining two experienced severe respiratory distress. They were successfully treated with supra-aortic fixation. It is well known that most cases of postoperative tracheal stenosis are due to compression of the trachea due to high anastomotic tension in the aorta. Therefore, sometimes a palliative operation still has an important role in the treatment strategy for severe heart hypoplastic syndrome to avoid postoperative respiratory system complications.⁴⁾ Postoperative endoscopy and chest CT showed compression of the tracheal bifurcation and the right and left main bronchus by the ascending aorta and pulmonary artery. Bronchial stenosis was also seen in that patient, most likely as a result of the extended end-to-end aortic arch anastomosis. In a study conducted on 94 patients after IAA surgery, the reason for a second surgery was mainly due to arch stenosis, bronchial/tracheal compression, or left ventricular outflow tract obstruction.⁵⁾ Many surgeons choose an end-to-side anastomosis⁶⁾ and pulmonary autograft patch⁷⁾ for aortic arch reconstruction in CoA and IAA to reduce aortic anastomotic tension and ensure the patency of the aorta, which could reduce the incidence of postoperative tracheal compression.

Our patient developed signs of airway obstruction after being weaned off the ventilator. The tracheobronchial 3D reconstruction via bronchoscopy and chest CT scan showed tra-

cheal stenosis caused by external compression. Cardiovascular CTA examination excluded aortic anastomosis as the cause of the tracheal compression and confirmed that a mediastinal hematoma was the cause of the compression. Leakage of the contrast agent from the hematoma was seen, which suggested active bleeding. A second surgery was performed to remove the hematoma.

A mediastinal hematoma may be caused by damage to the small branches during separation of the descending aorta during surgery. A mediastinal hematoma may also form in cases of incomplete surgical hemostasis, increased postoperative blood pressure, or rupture of the mediastinal aortic branches. A barrier is formed by the perihematoma adhesive tissue and unbroken mediastinal pleura. The pressure inside the hematoma, therefore, kept rising and caused tracheal compression. Although bronchoscopy plays an important role in evaluating airway stenosis, chest CT scans and cardiovascular imaging are required to evaluate the surrounding structures and vascular distribution of the trachea. A valuable lesson of this case is that minimizing the disruption and complete hemostasis of aortic branches are critical during IAA reconstruction. If bleeding occurs and causes tracheal compression, a timely second surgery is required to remove the hematoma.

DISCLOSURE

Conflict of interest: None.

Patient consent: Consent was obtained from the parents of the patient.

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