BRIEF COMMUNICATIONS

TRAUMATIC RUPTURE OF THE AORTIC ISTHMUS IN A PATIENT WITH AN ABERRANT RIGHT SUBCLAVIAN ARTERY: THERAPEUTIC IMPLICATIONS

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Acute traumatic injury to the thoracic aorta resulting from blunt chest trauma may also occur in patients with an aberrant right subclavian artery (ARSA). If this vascular anomaly is unknown at the time of surgery, a straightforward surgical repair of such ruptures—usually double clamping and direct suture—may lead to brain damage. We describe here the case of an acute rupture of the aortic isthmus in a patient with an ARSA and discuss preoperative work-up and surgical management.

Clinical summary. A 20-year-old white man wearing a seat belt had a violent car crash while driving (the passenger died). On arrival at the local hospital 30 minutes after the crash, the patient was conscious, with a blood pressure of 15/9 mm Hg in the left arm, and a pulse rate of 100 beats/min. He had an open wound of the right knee. The chest x-ray film showed a widened mediastinum with displacement of the trachea to the right. A computed tomographic (CT) scan demonstrated rupture of the isthmus and the presence of an ARSA, but no other injuries (Fig 1, A and B). The patient was transferred to Geneva University Hospital 2 hours later in stable condition. The blood pressure was then 8/5 mm Hg and the pulse rate 110 beats/min (both probably because of the left hemothorax and insufficient fluid replacement). He was taken to the operating room immediately. A femoro-femoral bypass was put in place and heparin administered (3 U/kg). A Bio-Medicus venous cannula (Medtronic Bio-Medicus, Eden Prairie, Minn) was introduced in the left femoral vein up to the right atrium and its position was checked by transesophageal endoscopy (TEE) (this examination confirmed the isthmic rupture but not the ARSA). The femoral artery was cannulated and a Y connection added to the arterial and venous lines. A posterolateral thoracotomy in the 4th intercostal space disclosed a hemothorax of 1.5 L but no active

Fig 1. A, CT scan of the chest with ARSA (*single arrow*) in its posterior position and the left subclavian artery (*double arrows*). B, CT scan of the chest showing the isthmus rupture (*arrow*).

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bleeding from the aorta or elsewhere. Hypothermia was set at 30°C with ventricular fibrillation occurring at this temperature. The left ventricle was not distended and its venting proved unnecessary. Body temperature (rectal) was lowered further to 19°C. The patient was placed in the Trendelenburg position and the cardiopulmonary bypass output was maintained at 1.5 L/min. The aortic hematoma was then opened. The aortic rupture was circumferential and precisely located at the isthmus. Both subclavian arteries were identified 1 cm

proximal to the isthmus. The distal aorta was clamped and bypass output increased to 2.5 L/min to maintain some degree of splanchnic blood supply. An end-to-end anastomosis was done with a running suture of 4-0 polypropylene. Partial circulatory arrest lasted 30 minutes. Body temperature was gradually raised to 37°C and cardiac defibrillation was obtained spontaneously. Cardiopulmonary bypass lasted 2 hours 30 minutes. The knee wound was explored: both menisci were sutured, as well as the anterior cruciatum ligamentum. During the immediate postoperative period, the patient had slight paresis of the right arm and decreased visual acuity. Both cerebral CT and magnetic resonance imaging scans showed a left frontal contusion and a small hemorrhagic zone in the cortex. Evolution was quickly favorable, thereafter, and the patient was transferred on the 14th postoperative day to a regional hospital.

Discussion. ARSA (which originates from the aorta distal to the departure of the left subclavian artery and crosses the superior mediastinum behind the esophagus, an anomaly also termed *arteria lusoria*, is the most frequent anatomic variation of the aortic arch (incidence 0.5%-2%). Rupture of the aortic isthmus, on the other hand, was described by Vesalius in 1557 and its first successful repair achieved by Parmley in 1958. The combination of the 2 conditions is rare indeed and has been published in only 1 case of aortic dissection¹⁻⁴ and 1 case of chronic aortic rupture.

When a patient with chronic aortic rupture and ARSA is operated on electively, the operation can be carried out in 2 steps: first, the ARSA is reimplanted on the right carotid artery and, second, the aorta is either sutured or replaced with a Dacron patch. In the emergency setting, however, rupture of the aortic isthmus can usually be repaired in a straightforward fashion, by direct suture, after opening the pericardium and clamping the aortic arch proximal and distal to the vascular tear (the proximal clamp is placed between the left carotid and the left subclavian arteries). Should an ARSA be present, however, placing the proximal clamp at the same spot will deprive both vertebral arteries (which originate from the subclavian arteries) (Fig 2) and may lead to disastrous brain stem ischemia.³ It is therefore of utmost importance to diagnose the ARSA before the operation. In this exceptional setting, cardiopulmonary bypass and circulatory arrest under deep hypothermia probably are the safest steps preceding vascular repair. A Y-shaped arterial tube should be readily available in case the aortic rupture is complete, to rapidly cannulate the proximal aorta.

Isthmic rupture is usually first suggested on a plain chest x-ray film, but it needs to be confirmed by a CT scan and/or an aortogram. TEE is being resorted to more and more often, because it is minimally invasive and can be performed in the emergency department; its sensitivity and specificity exceed 80%.⁵ However, the sole recourse to TEE to confirm suspected isthmic ruptures should be discouraged, precisely because TEE is usually unable to visualize an ARSA.⁵ Initial TEE should therefore be followed by a CT scan or aortogram to

Fig 2. Schematic diagram showing the isthmic tear and the origins of both subclavian arteries. Without cardiopulmonary bypass, placing the proximal clamp on the aorta as shown may lead to brain-stem ischemia, because both vertebral arteries are excluded.

rule out this anatomic variation, since the presence of an ARSA implies a different and somewhat more sophisticated surgical strategy.

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