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# Reoperation after Vascular Ring Repair

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**The majority of patients having surgical intervention for a vascular ring have resolution of their symptoms. However, 5% to 10% of these patients develop recurrent symptoms related either to airway or esophageal compression and may require reoperation. In our series of 300 patients with vascular rings, we performed a reoperation on 26 patients, not all of whom were originally operated on at our institution. The four primary indications for reoperation were Kommerell diverticulum (n = 18), circumflex aorta (n = 2), residual scarring (n = 2), and tracheobronchomalacia requiring aortopexy (n = 4). All patients undergoing reoperation have had preoperative evaluation with bronchoscopy and computed tomographic scanning (CT) with 3-dimensional reconstruction. Patients with dysphagia have had a barium esophagram and esophagoscopy. Patients with a Kommerell diverticulum have undergone resection of the diverticulum and transfer of the left subclavian artery to the left carotid artery. The aortic uncrossing procedure has been used in patients with a circumflex aorta. Aortopexy has been used to treat anterior compression of the trachea by the aorta. Results of these reinterventions have been successful in nearly all cases. Lessons learned from these reoperations can be applied to prevent the need for reoperation by properly selecting the correct initial operation. A dedicated team caring for these children consisting of medical imaging, otolaryngology, cardiovascular-thoracic surgery, and critical care is imperative.**
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The two main types of true vascular rings are double aortic arch and right aortic arch with left ligamentum.[1] Following standard surgical repair of these two congenital lesions, 92% of patients have nearly complete resolution of their symptoms at 1 year following the operation.[2] However, for various reasons, some patients develop recurrent symptoms related to either airway or esophageal compression. It is these patients who may require a reoperation. The four primary indications for reoperation (n=26) in our series of vascular ring patients (n = 300) are: 1) Kommerell diverticulum, 2) circumflex aorta, 3) residual scarring, and 4) tracheobronchomalacia requiring aortopexy.

Patients who presents with recurrent symptoms following vascular ring surgery must be carefully investigated with noninvasive imaging. Typical symptoms are recurrent stridor, cough, frequent upper respiratory tract infections, dyspnea on exertion, and dysphagia for solid foods. The main test we have used to evaluate these patients is computed tomographic scanning (CT) with 3-dimensional (3D) reconstruction.[3] The use of CT scanning has also been recommended by other centers.[4,5] Careful preoperative imaging with 3D reconstruction will usually reveal the source of the recurrent tracheal or esophageal compression. Patients with dysphagia have a barium esophagram. To complete the evaluation patients undergo rigid bronchoscopy/esophagoscopy, performed either before the operation or at the time of the planned reintervention.

## Kommerell Diverticulum

A Kommerell diverticulum is a remnant of the left fourth aortic arch that serves as the origin of the left subclavian artery in a

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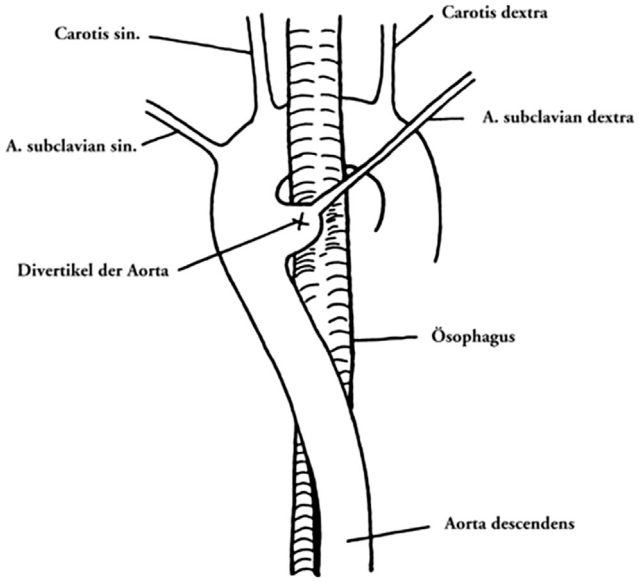


**Figure 1** This image is taken from Kommerell's original paper. Kommerell described a pulsating mass behind the esophagus consisting of an aortic diverticulum from which the right subclavian artery originates. His original description of course was of a patient with a left aortic arch. This is a remnant of the primitive right dorsal aorta (4th aortic arch). (Reprinted with permission from Thieme Publishers.[6])

patient with a right aortic arch. Burckhard F. Kommerell, MD, who first described this entity, was a German radiologist (1901–1990). He practiced radiology for 30 years and was also an accomplished pianist and composer. He first described the aortic diverticulum in 1936 (Fig. 1).[6] His original description was in a patient with a left aortic arch and aberrant origin of the right subclavian artery from the descending thoracic aorta. We now use the "mirror image" of this when describing a patient with a right aortic arch and retroesophageal origin of the left subclavian artery from the descending thoracic aorta. A common presentation of this is a patient who has had a previous ligamentum division through a left thoracotomy and now presents with recurrent upper respiratory tract symptoms and/or dysphagia years after the initial procedure (Fig. 2 A and B). In our series of patients (n = 18) the mean age at initial operation for the left ligamentum division was 8.4 ± 7.1 years (median, 7.7 years) and mean age at reoperation was 13.7 ± 11.6 years (median, 10.3 years).[7] All but one of the reoperations were performed through a left thoracotomy (Fig. 3). After administering 100 units/kg of heparin, the base of the Kommerell diverticulum is occluded with a vascular clamp. The left subclavian artery is controlled with a small vascular hemoclip. The Kommerell diverticulum is resected. The median size of the resected diverticulum was 1.5 × 2 cm. The aortic stump is oversewn with running prolene suture in

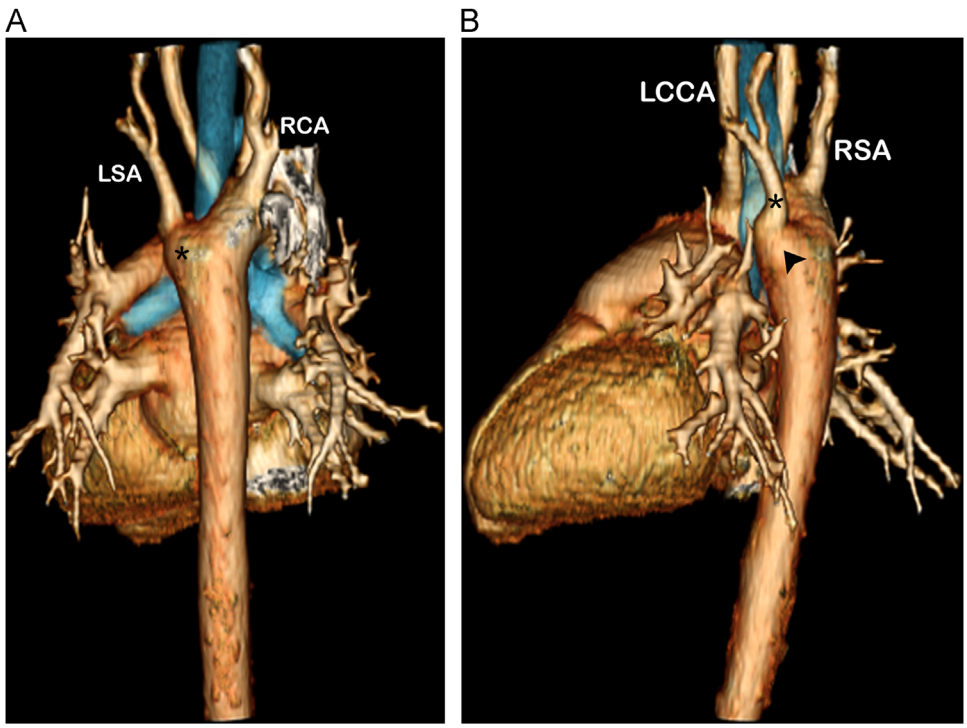


**Figure 2** CT images from an 8-year-old boy who presented with recurrent dyspnea on exertion and a chronic cough. He has a right aortic arch, retroesophageal left subclavian artery, and a Kommerell diverticulum (*). The patient underwent left ligamentum division 18 months earlier at another institution. CT images show a large Kommerell diverticulum serving as the origin of the left subclavian artery (A). This is compressing his esophagus and trachea independently, despite prior ligamentum ligation and division (B). LCCA, left common carotid artery; LSA, left subclavian artery; RCA, right carotid artery; RSA, right subclavian artery.