# Contemporary Surgical Approaches and Outcomes in Adults With Kommerell Diverticulum

Karen M. Kim, MD, Richard P. Cambria, MD, Eric M. Isselbacher, MD, Joshua N. Baker, MD, Glenn M. LaMuraglia, MD, James R. Stone, MD, PhD, and Thomas E. MacGillivray, MD

Divisions of General Surgery, Vascular Surgery, and Cardiac Surgery, Department of Surgery, Division of Cardiology, Department of Medicine, and Department of Pathology and Center for Systems Biology, Massachusetts General Hospital, Boston, Massachusetts



*Background.* **Surgery in patients with Kommerell diverticulum (KD) is controversial. Although the presence of symptoms is an accepted indication, the KD itself may be a risk factor for dissection and rupture, although size criteria for operation are undefined.**

*Methods.* **A retrospective review of 19 adult patients who underwent surgical treatment of KD between March 2004 and June 2013 was performed. Mean age was 48 years (range, 32 to 68 years). Fifteen patients were female, 15 were symptomatic, and 13 had a right aortic arch. Sixteen patients with aberrant subclavian artery underwent a two-stage procedure involving subclavian–common carotid artery transposition or bypass followed by aortic resection, including origin of the KD, with interposition graft reconstruction. Aortic resection was performed with left heart bypass (n = 10) or deep hypothermic circulatory arrest (n = 9).**

*Results.* **There were no deaths or strokes. Complications after aberrant subclavian artery revascularization were transient ptosis (n = 3), graft occlusion (n = 1), recurrent laryngeal nerve injury (n = 1),phrenic nerve injury (n = 1), and reintubation (n = 1). Complications after aortic resection were intraoperative type A dissection (n = 1), phrenic nerve injury (n = 1), chylothorax (n = 1), and transient neurologic dysfunction (n = 1). Mean hospital stay after aberrant subclavian artery revascularization was 2 ± 2 days and after aortic resection, 6.4 ± 2.4 days. Of 18 available pathology specimens, all 18 showed medial degeneration. Mean follow-up was 3.3 years.**

*Conclusions.* **This is the largest reported single-center experience with the surgical management of KD in adults, verifying its safety and efficacy. The high percentage of KD with medial degeneration suggests asymptomatic patients with an enlarged KD also may benefit from resection.**

**(Ann Thorac Surg 2014;98:1347–54)**


Kommerell diverticulum (KD) with or without an associated aberrant subclavian artery (ASA) is an uncommon arch anomaly [1]. Indications and techniques to treat patients with KD continue to be debated. The KD or the ASA can compress the esophagus or the trachea causing dysphagia, stridor, or asthma. Patients with symptoms (ie, dysphagia lusoria) have long been referred for corrective surgery. In the absence of symptoms, KD had been considered to be a benign anatomic variant [2]. However, spontaneous rupture, dissection, and death associated with KD have been reported [3, 4]. The mere presence of KD may be a risk factor for the development of an acute aortic syndrome and therefore an indication for surgical intervention.

Since Robert Gross reported the first surgical treatment for dysphagia lusoria in 1946 [5], the surgical approaches have evolved. Until recently, much of our information was limited to case reports and reviews of the literature. The purpose of this study was to review our institutional experience during the last decade with the surgical management of patients with KD.

## Patients and Methods

Between March 2004 and June 2013, 19 adult patients underwent surgical treatment for KD at Massachusetts General Hospital. These patients were identified by querying the Massachusetts General Hospital cardiac surgery database for patients with the ICD-9 code "anomalies of aortic arch" and selecting those with KD with and without ASA who were 18 years or older. The institutional review board approved this study and waived informed consent.

Mean age at aortic resection was 48 years (range, 32 to 68 years). Fifteen of the patients (79%) were female. Fifteen patients (79%) had symptoms, including dysphagia lusoria (n = 10), respiratory symptoms such as asthma, cough, or stridor (n = 5), or neck, chest, or back pain (n = 3). Four patients were entirely asymptomatic; in

Accepted for publication May 8, 2014.

Presented at the Fiftieth Annual Meeting of The Society of Thoracic Surgeons, Orlando, FL, Jan 25–29, 2014.

Address correspondence to Dr MacGillivray, Massachusetts General Hospital, 55 Fruit St, Cox 650, Boston, MA 02114; e-mail: tmacgillivray@partners.org.



0003-4975/$36.00
http://dx.doi.org/10.1016/j.athoracsur.2014.05.045

**Abbreviations and Acronyms**

ASA = aberrant subclavian artery
DHCA = deep hypothermic circulatory arrest
KD = Kommerell diverticulum
LC = left carotid artery
LSC = left subclavian artery
RC = right carotid artery
RSC = right subclavian artery

3 of them the KD was discovered incidentally, and in 1 it was found on computed tomography scan done for family history of sudden death owing to ruptured type B dissection.

All of the patients underwent preoperative computed tomographic angiography of the aorta. Thirteen patients (68%) had a right-sided aortic arch. Sixteen patients (84%) had an ASA arising from the KD, and 1 had a posteriorly originating nonaberrant subclavian artery arising from the KD. Computed tomographic angiography scans were reviewed again retrospectively to obtain measurements of the KD and ASA. The diameter of the KD ranged from 15 to 45 mm. With respect to the subclavian artery arising from it, the diameter of the KD was 1.8 to 6.7 times larger. The patients' clinical characteristics are summarized in Table 1.

The 16 patients with ASA all underwent revascularization of the subclavian artery, 10 with subclavian–common carotid artery transposition and 6 with common carotid–subclavian artery bypass. Subclavian–common carotid artery transposition was performed through a supraclavicular incision. The ASA was divided in the mediastinum, usually proximal to the takeoff of the vertebral artery, and the proximal stump was oversewn. An end-to-side anastomosis of the subclavian artery onto the common carotid artery was performed, with an effort to preserve the ipsilateral vertebral artery when technically feasible. Common carotid–subclavian artery bypass was similarly performed through a supraclavicular incision using a 6- or 8-mm polytetrafluoroethylene graft to perform end-to-side anastomoses of the graft to the common carotid and subclavian arteries. The patient with a posteriorly originating nonaberrant left subclavian artery arising from a KD was revascularized with an end-to-end aorta–subclavian artery anastomosis using the sidearm of the aortic graft. Two patients had KD from which no subclavian artery arose.

Resection of the KD and adjacent aorta was performed through a posterolateral thoracotomy in the fourth interspace on the side of the arch. Perfusion strategies included left heart bypass or deep hypothermic circulatory arrest (DHCA) with arterial cannulation in the femoral artery or descending aorta and venous cannulation in the inferior pulmonary vein or common femoral vein. An impregnated woven polyester tube graft measuring 16 to 30 mm with a 10-mm sidearm was used to replace the resected aorta. Ten patients underwent aortic resection using left heart bypass with a mean bypass time 60.0 ± 6.7 minutes. In 9 patients DHCA was used; mean bypass time was 183.4 ± 37.9 minutes, and mean circulatory arrest time was 26.6 ± 7.1 minutes.

With respect to timing of subclavian artery revascularization and aortic resection, the 16 patients with ASA

*Table 1. Patient Characteristics*

| Patient | Age (y) | Sex | Symptoms | Side of Arch | Size of KD (mm) | Size of ASA (mm) |
|---|---|---|---|---|---|---|
| 1 | 42 | M | Chest and back pain | L | 35 | 8 |
| 2 | 36 | F | Dysphagia | L | 15 | 7 |
| 3 | 48 | M | Persistent cough | L | 38 | 8[a] |
| 4 | 38 | F | Dysphagia | R | 16 | 7 |
| 5 | 47 | F | Dysphagia, asthma | R | 24 | 6 |
| 6 | 32 | F | Asymptomatic | R | 40 | 6 |
| 7 | 57 | F | Dysphagia | L | 34 | 8 |
| 8 | 68 | M | Asymptomatic | R | 45 | 9 |
| 9 | 68 | F | Neck and back pain | R | 27 | 8 |
| 10 | 44 | F | Dysphagia | R | 19 | 8 |
| 11 | 40 | F | Dysphagia | L | 16 | 9 |
| 12 | 37 | F | Dysphagia | R | 29 | 7 |
| 13 | 58 | F | Dysphagia, stridor | R | 27 | No ASA |
| 14 | 62 | F | Asthma, back pain | R | 23 | No ASA |
| 15 | 51 | M | Asymptomatic | R | 23 | 10 |
| 16 | 52 | F | Asthma | R | 23 | 8 |
| 17 | 41 | F | Dysphagia | R | 17 | 7 |
| 18 | 34 | F | Family history of aortic dissection | R | 23 | 8 |
| 19 | 57 | F | Dysphagia | L | 24 | 7 |

[a] Posteriorly originating nonaberrant left subclavian artery.

ASA = aberrant subclavian artery; KD = Kommerell diverticulum; L = left; R = right.