

 **Case Report** 

Single-Stage Surgical Repair of Kommerell Diverticulum with Annuloaortic Ectasia via a Median Sternotomy: Frozen Elephant Trunk Technique with an Antler-Like Shape Reconstruction of Arch Branches

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We present here a case of Kommerell diverticulum (KD) with annuloaortic ectasia, in which single-stage surgical repair was performed via a median sternotomy using frozen elephant trunk (FET) technique. We used this technique for the following reasons: firstly, we could perform surgery only via a median sternotomy without thoracotomy; secondly, we were able to deliver the FET using a guidewire through the severely angulated aortic arch. We here investigate this technique as it could potentially be a good treatment option of KD.

Keywords: frozen elephant trunk, Kommerell diverticulum

Introduction

Kommerell diverticulum (KD) is a rare congenital anomaly at the origin of an aberrant subclavian artery which is described as aneurismal dilatation. Various surgical techniques have been reported for repair of KD, including open surgical repair with thoracotomy, endovascular repair, and hybrid repair.^{1–6} We present a case of KD with annuloaortic ectasia (AAE) in which single-stage surgical

repair was performed via a median sternotomy using frozen elephant trunk (FET) technique.

Case Report


A 38-year-old man was found to have aortic root dilatation and moderate aortic valve stenosis with bicuspid valve by transthoracic echocardiography. Enhanced computed tomography (Fig. 1) showed aortic root dilatation (55 mm), right aortic arch, and an abnormality at the origin of the left subclavian artery (LSCA), which were diagnosed as KD. The diameter of KD including the aorta was 40 mm, longitudinal diameter of KD was 16 mm, diameter of the ascending aorta was 40 mm, aortic arch had severe angulation, and arch vessels measured 6 to 7 mm. We therefore decided to perform aortic root reconstruction and total arch replacement (TAR) using FET technique for KD.

With the patient in supine position, a horizontal incision was made below the bilateral clavicle to expose the axillary arteries, and both were connected to an 8-mm graft. The mediastinum was accessed via a median sternotomy. An arterial cannula was inserted into the artificial blood vessel connected to the right axillary artery and the right common femoral artery. A cannula for venous drainage was inserted into both the superior and inferior vena cava from the right atrium, and total extracorporeal circulation was established. A left ventricular vent tube was inserted from the right superior pulmonary vein, and a guidewire was inserted through the femoral artery and advanced to the ascending aorta.

We used a knitted quadrifurcated graft (InterGard™ Quadrifurcated, MAQUET Cardiovascular, La Ciotat, France) to reconstruct the four cervical branches. After the rectal temperature decreased to 28°C, the left common carotid artery (LCCA) was ligated and transected, and an end-to-end anastomosis was performed using the inner leg of the quadrifurcated graft. The right common carotid

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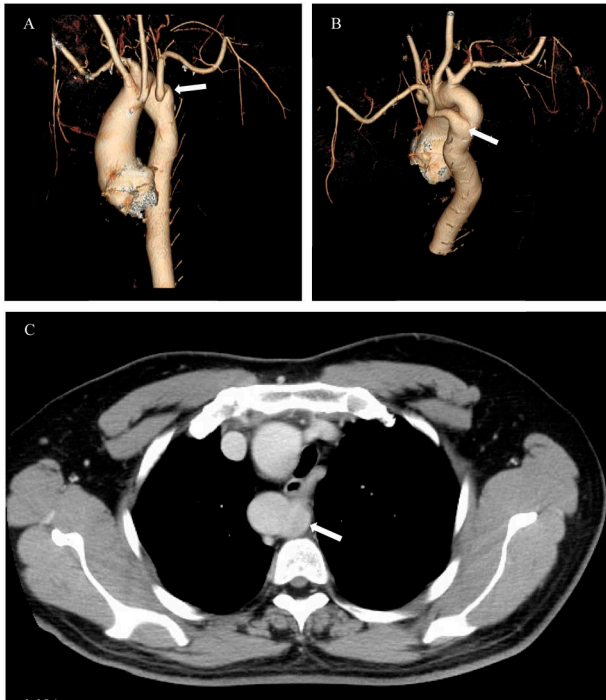


Fig. 1 Preoperative enhanced computed tomography showed aortic root dilatation (55mm), right aortic arch, and abnormality at the origin of the left subclavian artery (LSCA), which is called KD (A, B: white arrows). The diameter of the KD including the aorta was 40mm, longitudinal diameter of the KD was 16 mm (C), the diameter of the ascending aorta was 40 mm and the aortic arch had severe angulation. KD: Kommerell diverticulum

artery was anastomosed in the same way. The LSCA was ligated and clipped, and cerebral perfusion was initiated through the artificial blood vessel connected to the left axillary artery. After the ascending aorta was opened, cardiac arrest was obtained by retrograde cardioplegia. Then, the ascending aorta was incised longitudinally to the origin of the LCCA, and the proximal part of the aortic arch was transversely dissected. We inserted the device for the FET (Frozenix®, Japan Lifeline, Tokyo, Japan) using a guidewire under trans esophageal echocardiography (TEE) guidance. A synthetic graft with one branch (which was part of the valsalva graft) was anastomosed end-to-end to the stump of the distal aortic arch before antegrade systemic perfusion was begun. A composite graft consisting of valsalva graft and mechanical valve was used to replace the aortic root. Then, the proximal and distal valsalva grafts were sutured in an end-to-end fashion. The main body of the quadrifurcated graft was sutured to the valsalva graft in an end-to-side fashion. Finally, the outer legs of the quadrifurcated graft were anastomosed to the grafts that were connected to the axillary arteries in an end-to-side fashion. Surgical time was 655 min, cardiopulmonary bypass time was 379 min, cardiac arrest time was

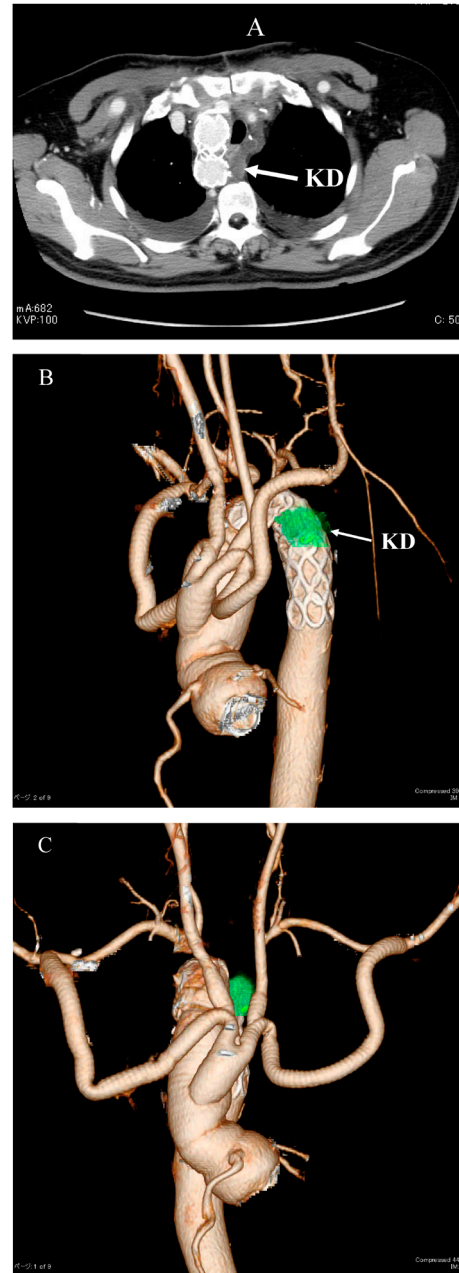


Fig. 2 Postoperative CT (A, B) showed good exclusion of the Kommerell diverticulum (white arrows), and the arch branches were reconstructed in the shape of an antler (C). KD: Kommerell diverticulum

245 min, and rectal temperature was 27.5°C. Postoperative computed tomography (CT) showed good exclusion of the KD, and the arch branches were reconstructed in the shape of an antler (Fig. 2). The postoperative course of the patient was uneventful and he had no complications at the time of discharge.

Discussion

KD carries a risk of rupture or dissection if left untreated.

Indications for surgical repair have not previously been established because the number of patients with KD has been small, and the size of KD cannot be used to predict rupture.^{1,7)} In this case, the patient needed a median sternotomy because he had AAE. The diameter of KD including the aorta was 40 mm, the longitudinal diameter of KD was 16 mm. Thus we planned to perform single-stage repair of KD with AAE. Various methods of repair have been described, such as open surgical repair via thoracotomy or sternotomy, or endovascular repair.¹⁻⁶⁾ In their study, Motoki et al.⁴⁾ reported endovascular repair of a ruptured KD, concluding that this endovascular repair is a valuable alternative approach for ruptured KD. However, they pointed out that it is difficult to deliver the stent grafts through the aortic arch because of the severe angulation of the aortic arch. The proximal landing zone of the stent graft was in most cases the aortic arch, so there is still a risk of possible endoleak or migration due to the sharp angulation of the aortic arch. In addition, KD patients are generally younger, and there is the possibility of retrograde type A aortic dissection during long-term follow-up. Rosu et al.⁵⁾ reported hybrid repair of KD. They concluded that in cases of severe arch angulation and short inner curve of the arch, proximal landing in the ascending aorta with total debranching of the neck vessels was a good procedure.

In this case, the patient needed a median sternotomy because he had AAE. The aortic arch was severely angulated and the diameter of the ascending aorta was over 40 mm. Thus a zone 0 landing was not feasible. To perform single-stage repair of KD and AAE, we selected, for the following reasons, total arch replacement with FET technique and aortic root replacement. This was because, firstly, we could perform single-stage surgery only through a median sternotomy without thoracotomy, and secondly, for the fact that our FET device, which is approved for use in Japan, could be inserted using a guidewire, we could deliver the device easily through the severely angulated aortic arch to the descending aorta. In this case, the common carotid artery had a small diameter (6 mm), and we could reconstruct the carotid arteries without size mismatch using the inner legs of the quadrifurcated graft.

Conclusion

We think that treatment of KD using TAR with the FET technique could be used as a good option in treatment of similar cases of KD.

Disclosure Statement

None declared.

Author Contributions

Study conception: YY

Writing: YY

Critical review and revision: all authors

Final approval of the article: all authors

Accountability for all aspects of the work: all authors

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