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Review Article

Saccular Kommerell aneurysm, a potential pitfall on MDCT imaging – A review of imaging features and potential mimics

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ABSTRACT

Saccular Kommerell aneurysm represents a potential pitfall on Multidetector CT (MDCT) imaging, mimicking conditions such as saccular aneurysm of the thoracic aorta, ductus diverticulum and dilated Kommerell diverticulum. Accurate diagnosis of this condition is critical in the management of this potentially fatal condition. This paper reviews the MDCT imaging features of Kommerell aneurysms and its mimics and demonstrates how to make an accurate diagnosis through a series of four cases. MDCT features of Kommerell aneurysms, either saccular or fusiform types arising from a Kommerell diverticulum with atherosclerotic plaque and mural thrombus are discussed.

1. Introduction

Aberrant right subclavian artery is encountered in approximately 1% of the population and Kommerell diverticulum is present in about 60% of cases of aberrant subclavian artery, hence both conditions are not rare. Kommerell diverticulum was first eponymously used in 1936 to describe a diverticulum at the origin of an aberrant right subclavian artery in a left-sided aortic arch [1], although it may be used to describe a diverticulum in either an aberrant right or left subclavian artery arising from a left or right-sided aortic arch. Aneurysms of this diverticulum are seen in 3–8% of imaging studies, usually representing fusiform aneurysmal dilation of the diverticulum at the origin of the aberrant subclavian artery or transformation of the diverticulum into a saccular aneurysm [2]. An aneurysm of a Kommerell diverticulum is often abbreviated to the term Kommerell aneurysm.

Occasionally, as depicted in a case below, saccular Kommerell aneurysms may grow to such a size as to completely obliterate the normal appearance of its underlying diverticulum – a configuration easily confused with a saccular aneurysm of the descending thoracic aorta. The importance of making this distinction in the radiology reading room is twofold – Kommerell aneurysms and saccular aneurysms of the descending thoracic aorta are managed differently, and Kommerell aneurysms have a predilection for rupture [3,4]. With this in mind, the objective of this paper is to review the MDCT imaging features of Kommerell aneurysms and its mimics and to demonstrate how to make an accurate diagnosis through a series of cases.

2. Clinical presentation

Most patients with Kommerell aneurysms present with symptoms of dysphagia, followed by dyspnea and chest pain [3,5–7]. A significant proportion of patients are completely asymptomatic. Symptoms are determined by the location of the aneurysm and the course of the aberrant subclavian artery, which has been extensively described in the literature as being retro-esophageal (80%), between the esophagus and trachea (15%), or pre- tracheal (5%). [8–13].

2.1. Management

Kommerell aneurysms and diverticula are normally repaired in a two-staged thoracotomy procedure in which the descending aorta and aberrant subclavian artery are approached separately [14–20] and reconstructed with grafts. On the other hand, saccular aneurysms of the descending thoracic aorta are commonly managed with a one-stage endovascular graft repair [21–23] or open surgery [24–27].

2.2. Prognosis

Kommerell aneurysms are prone to rupture and dissection, an observation not lost on Dr Benjamin Felson, who astutely remarked that a surprisingly high incidence of rupture was noted in aneurysms of an anomalous right subclavian artery in 1989 [4]. Pathological specimens have been observed to contain mural abnormalities such as medial necrosis in up to 50% of cases [28,29], which may account for this

Abbreviations: MDCT, multidetector CT; 3D, three-dimensional

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Table 1
Features of Kommerell aneurysm and mimics on MDCT imaging.

	Origin of the aneurysm/outpouching	Outpouching contents	Morphology
Kommerell aneurysm	Arising from a Kommerell diverticulum	Atherosclerotic plaque, mural thrombus common in saccular form	Saccular or fusiform
Kommerell diverticulum	From the aortic arch	Mural thrombus uncommon	Fusiform
Saccular aneurysm of the aortic arch	May be close to but not involving the origin of the aberrant right subclavian artery	Atherosclerotic plaque always present	Saccular
Ductus diverticulum	Inferior anteromedial aspect of the aorta at site of the ligamentum arteriosum	Mural thrombus usually not present, although atherosclerotic plaque may be seen	Smooth focal bulge with obtuse angles with the aortic wall

predisposition. Rupture of a Kommerell aneurysm occurs in about 19% of affected cases, and is almost universally fatal [3,30]. Hence, it has been suggested that Kommerell diverticula should be removed in children before these undergo aneurysmal transformation. Due to the higher rate of complications in large aneurysms, some authors also advocate operating on those aneurysms larger than 3 cm in size [10].

2.3. Mimics of Kommerell aneurysm

The main task of the radiologist when presented with a case of Kommerell aneurysm is to identify the condition and its potential complications accurately, as well as to exclude other similar aortic conditions which may mimic it. These mimics include the uncomplicated diverticulum of Kommerell, saccular aneurysm of the thoracic aorta, and ductus diverticulum.

Differentiating between these diagnoses is not always an easy process. It requires careful examination of the anatomy of the anomalous vessel and morphology of the outpouching, as well as the relationship of the neck of the aneurysm to the aberrant subclavian artery as summarized in Table 1. Multiplanar reformation and three-dimensional (3D) volume-rendered projections may prove invaluable in these circumstances [31–33].

A useful distinguishing feature between Kommerell aneurysms, Kommerell diverticula and ductus diverticula, is that Kommerell aneurysms have the typical imaging features of atherosclerotic aneurysms, including calcified plaque and mural thrombus, whereas plaque and thrombus is not commonly seen in uncomplicated Kommerell diverticula and ductus diverticula [4,34]. We present four cases below which illustrate the imaging features of Kommerell aneurysm and its imaging mimics.

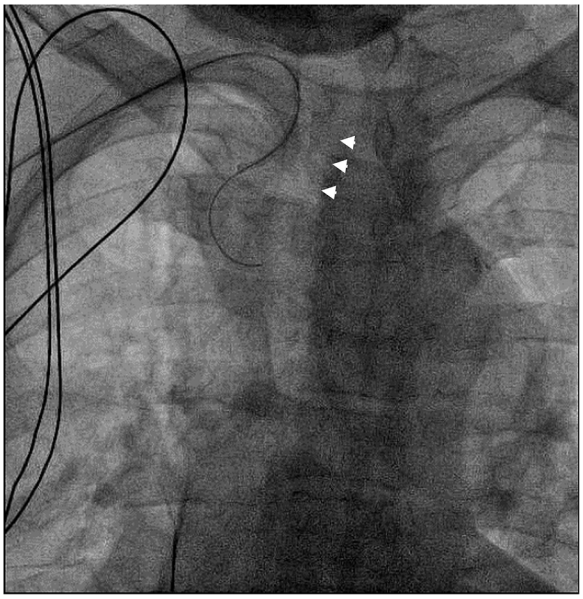

Fig. 1. 78-year-old male with Kommerell aneurysm. Invasive catheter angiogram revealed mediastinal widening during cardiac catheterization. Note the tracheal deviation to the right (*arrowheads*) due to mass effect from the aneurysm.

3. Cases

3.1. Case 1: Kommerell aneurysm

A 78-year-old male ex-smoker presented with chest pain and ST-elevation on electrocardiogram in the anterior and lateral leads to the emergency department. He was reviewed by the cardiology team and diagnosed as having an acute myocardial infarction. Mediastinal widening was noted during cardiac catheterization (Fig. 1) and a gated CT aortogram of the chest was performed using a 320-slice single-source scanner (Aquilion ONE; Toshiba Medical Systems Corporation, Tochigi, Japan) with an injection of 100 ml of a low-osmolar contrast agent, iohexol (Omnipaque 350, GE Healthcare Inc.) at 4 ml/s followed by 50 ml saline bolus.

The study showed a small, hyperdense (38 Hounsfield units) pericardial effusion suggestive of hemopericardium, with a saccular aneurysm measuring 4.1 cm in diameter and 1.7 cm in craniocaudal dimension arising from a Kommerell diverticulum of an anomalous right subclavian artery in a left-sided aortic arch (Fig. 2). The ascending aorta and descending thoracic aorta were normal in caliber. A subsequent chest radiograph was obtained which demonstrated mediastinal widening with bilateral rounded and smooth paratracheal soft-tissue densities (Fig. 2a). The patient was deemed unfit for surgery and died three days later from an unrelated cause. Post-mortem examination confirmed an unruptured aneurysm arising from a diverticulum of Kommerell and left ventricular rupture which was secondary to myocardial infarction.

Radiologic appearance – On frontal chest radiography, the anomalous right subclavian artery has been classically described as an oblique density contiguous with the medial margin of the aortic knuckle, ending as a rounded right paratracheal density [4,35]. On the lateral radiograph, it may appear as a mass in the anteroinferior aspect of Raider's triangle [4,13]. A diverticulum or aneurysm of Kommerell produces a similar appearance, except that the density will appear wider and may cause deviation of the trachea [35,36]. Catheter angiogram may show widening of the mediastinum, and if the aneurysm is large enough, tracheal deviation due to mass effect. On contrast-enhanced MDCT of the chest, Kommerell aneurysms appear as saccular outpouchings from a Kommerell diverticulum if they are atherosclerotic in origin, or they may appear as grossly expanded fusiform Kommerell diverticula [4]. Fusiform aneurysms of Kommerell diverticula are associated with postenotic dilatation of the subclavian artery arising from a punctate opening in the diverticulum [4].

Teaching points – It may be difficult to distinguish a saccular Kommerell aneurysm from a dilated fusiform Kommerell diverticulum; by convention, a dilatation greater than 1.5 times the expected normal diameter of the artery would qualify as an aneurysm [37]. Atherosclerotic plaque and mural thrombi are common in the saccular forms of Kommerell aneurysm [34,38], as these are essentially atherosclerotic in origin [34].

3.2. Case 2: Kommerell diverticulum

A 68-year-old male presented with an incidental lung nodule