ENDOVASCULAR REPAIR OF DESCENDING THORACIC AORTIC ANEURYSM

AN ESSAY
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List of Abbreviations

Abbreviation	Meaning
AoD	Aortic Dissection
BSA	Body Surface Area
CT	Computed Tomography
CVA	CerebroVascular Accident
DTA	Descending Thoracic Aorta
EDS	Ehlers-Danlos syndrome
ER	Endoscopic Repair
ERK	Extracellular signal-regulated kinases
FDA	Food and Drug Administration
IMH	IntraMural Hematoma
IVUS	Intravascular ultrasound
LCCA	Left Common Carotid Artery
LSA	Left Subclavian Artery
MDCT	Multi-Detector Computed Tomography
MFS	Marfan syndrome
MIP	Maximum Intensity Projection
MMP	Matrix Metalloproteinases
MR	Magnetic Resonance
MRA	Magnetic Resonance Angiography
MRI	Magnetic Resonance Imaging
OAR	Open Aneurysm Repair
PAU	Penetrating Aortic Ulcer
SCI	Spinal Cord Ischemia
SMA	Superior Mesenteric Artery
SR	Surgical Repair
TA	Thoracic Aneurysm
TAA	Thoracic Aortic Aneurysm
TAAA	Thoraco-Abdominal Aortic Aneurysm
TEE	Trans-Esophageal Echocardiography
TEVAR	Thoracic Endovascular Aortic Repair
TGF	Transforming Growth Factor

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ABSTRACT

Thoracic endovascular aortic repair (TEVAR) represents an attractive alternative to open surgical repair in the treatment of descending thoracic aortic pathologies. Any decision to offer a patient with an aneurysm of the descending thoracic aorta a procedure, either open or endovascular, must balance the patient's expected prognosis and life expectancy without intervention against the risk of undergoing the procedure. At present, for descending thoracic aorta repairs, there is no level A or B evidence (results from prospective, randomized trials) to compare medical therapy with surgical intervention. Furthermore, there is no level A or B evidence comparing the results of open procedures with endovascular stent-graft procedures

Key words: Endovascular, Aneurysms, TEVAR, Descending, Thoracic Aorta, surgery

Introduction

An aneurysm is defined as a permanent dilatation of an artery to at least one and half of its normal diameter at a given location. It is the most common condition of the thoracic aorta that requires surgical treatment ***(Logan and Rice, 1987).***

For the descending thoracic aorta, a significant aneurysmal dilatation is usually defined as an aorta twice the diameter of the patient's contiguous normal aortic caliber. Thus, in an average-height older man with an expected distal aortic arch diameter of 2.8 cm, a proximal descending aortic dilatation measuring 5.6 cm or greater is defined as aneurysmal. ***(Svensson and Crawford, 1997)***.

The prevalence of thoracic aortic aneurysms (TAAs) has appeared to triple in the two most recent decades. Thoracic aortic aneurysms are now estimated to affect 10 of every 100,000 elderly adults, with 30% to 40% of these being descending thoracic aortic aneurysms ***(Bavaria et al., 2007).***

The majority of aneurysms are degenerative; other causes include atherosclerotic, dissecting, genetic causes as in Marfan's syndrome, post inflammatory and pseudo-aneurysms. The mean age of diagnosis is 59–69 year with a male predominance of 2:1–4:1. The 5-year survival rates of patients with thoracic and

abdominal aortic aneurysms not surgically treated is ~20 and 16–19%, respectively ***(Davies et al., 2006).***

Open surgical repair using prosthetic graft interposition is the conventional treatment for TAAs mainly because of its feasibility and effectiveness in excluding the degenerated aorta from the systemic circulation. Open surgical repair of TAAs is associated with significant perioperative complications including 30- day mortality and paraplegia, with rates of 4.8% and 4.6% respectively. Stroke and renal failure are also important complications to be considered ***(Lemaire et al., 2012)***.

Since the introduction of thoracic endovascular aortic repair (TEVAR) using stent grafts for complicated diseases of the descending thoracic aorta, there has been debate regarding the safety, efficacy, and durability of this approach ***(Cheng et al., 2010)***.

As "minimally invasive" endovascular treatment has become technically feasible, initially with homemade first generation grafts and now with commercially available thoracic endografts, it is being offered as an attractive treatment option to patients. Thoracic aortic endografts have been used with early success in small- to moderate-sized, retrospective, single-center series ***(Bavaria et al., 2007)***.

Aim of Work

The aim of the study is to review endovascular repair as a relatively recent modality for the management of descending thoracic aortic aneurysms. It still requires further elaboration of its efficacy, durability and risks. In this essay we are trying to shed light upon its indications, risks and benefits.

Surgical anatomy of the descending thoracic aorta

Course:

The thoracic aorta is the segment of descending aorta confined to the posterior mediastinum. It begins at the level of the lower border of the fourth thoracic vertebra, continuous with the aortic arch, and ends anterior to the lower border of the twelfth thoracic vertebra in the diaphragmatic aortic aperture. At its origin it is left of the vertebral column; as it descends it approaches the midline and at its termination is directly anterior to it ***(Hiratzka et al., 2010)***.

Relations:

Anterior to the descending thoracic aorta, from above down, are the left pulmonary hilum, the pericardium separating it from the left atrium, oesophagus and diaphragm. Posterior are the vertebral column and hemiazygos veins. Right lateral are the azygos and thoracic duct , the right pleura and lung. Left lateral are the pleura and lung. The oesophagus, with its plexus of nerves, is right lateral above, but becomes anterior in the lower thorax, and close to the diaphragm it is left anterolateral. To a limited degree, the descending aorta and oesophagus are mutually spiralized ***(Gray et al., 2008)***.

Branches:

The thoracic aorta provides visceral branches to the pericardium, lungs, bronchi and oesophagus, and parietal branches to the thoracic wall ***(Gray et al., 2008)***.

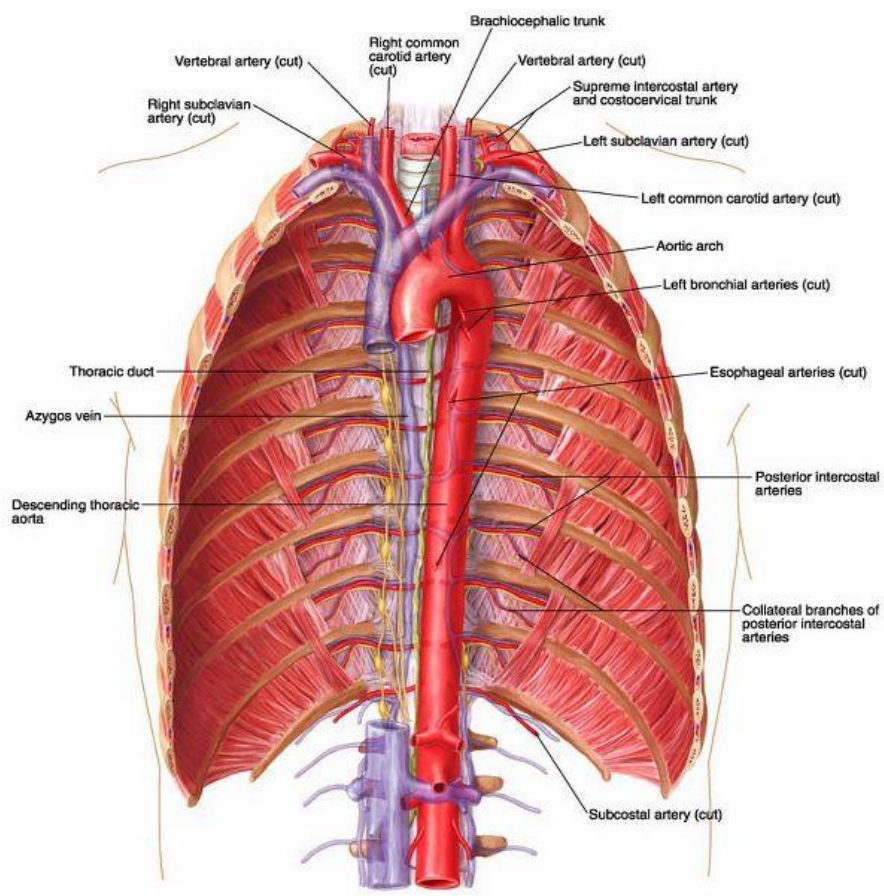

Figure 01: Anatomy of the descending thoracic aorta ***(Patrick and Tomas, 2009).***

Pathophysiological considerations of descending thoracic aortic aneurysm

What is an aortic aneurysm?

The term *aortic aneurysm* refers to a pathological dilatation of the normal aortic lumen involving one or several segments. One useful criterion defines aortic aneurysm as a permanent localized dilatation of the aorta having a diameter at least 1.5 times that of the expected normal diameter of that given aortic segment, although no definition is universally accepted ***(*Johnston KW et al.,** ***1991)***.

A descending thoracic aortic (DTA) aneurysm is defined as aneurysm involving any portion of the thoracic aorta distal to the origin of the left subclavian artery. It can involve varying parts of the DTA and may extend to the abdominal aorta ***(Puchakayala and Lau, 2006).***

Incidence

Aneurysm is the most common condition of the thoracic aorta requiring surgical treatment. During the first half of the 20th century, thoracic aortic aneurysms were far more common than

abdominal aortic aneurysms because of the predominance of infectious aneurysms in the thoracic aorta. In 1952, the ratio of thoracic to abdominal aortic aneurysms was 2 to 1 in autopsy studies. By 1964, this ratio had declined to less than 1 to 1, primarily as a result of the decline in the incidence of syphilitic aneurysms ***(Kouchoukos and Dougenis, 1997).***

Annually, thoracic aortic aneurysms affect approximately 6 persons per 100,000 populations, and the descending thoracic aorta is involved in about 40% of those cases ***(Gowda et al., 2003).***

Overall, men are affected twice as often as women (68% vs. 32%) and are affected at younger ages as well, with male patients having a mean age of 60 years and female patients a mean age of 67 years. However the male predominance is most striking at young ages, with males outnumbering females 4:1 at ages less than 50 years. With increasing age, however, the difference lessens, and among those older than 75 years, males and females are equally represented ***(Isselbacher, 2007).***