A new concept in management

of

Thoracic aortic aneurysm

Essay submitted for the partial fullfilment of Master Degree in General Surgery

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بسم الله الرحمن الرحيم

"قل أن صلاتى و نسكى ومحياي و مماتى لله رب العالمين . لا شريك له و بذلك أمرت و أنا أول المسلمين "

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LIST OF ABBREVIATIONS

AA	Aortic Arch
AAA	Abdominal Aortic Aneurysm
AR	Aortic Regurge
CAD	Coronary Artery Disease
CPAP	Continuous positive airway pressure
CPB	Cardio-Pulmonary Bypass
CSF	Cerebrospinal fluid
CT	Computed tomography
CTA	Computed tomography angiography
EDS	Ehlers-Danlos syndrome
GRF	gelatin resorcinol formaldehyde
HCA	Hypothermic Circulatory Arrest
IRAD	International Registry of Aortic Dissection
IVUS	Intravascular ultrasound
LDS	Loeys-Dietz syndrome
LVA	Left Vertebral artery
MEP	Motor Evoked Potential
MFS	Marfan syndrome
MRA	Magnetic resonance angiography
MRI	Magnetic resonance imaging
PEEP	Positive end expiratory pressure
PTFE	Polytetrafluoroethylene
RCP	Retrograde cerebral perfusion
RVA	Right Vertebral Artery
SACP	selective antegrade cerebral perfusion
SCPP	Spinal cord perfusion pressure
SSEP	Somato-sensory Effoked Potential

STJ	Sino-Tubular Junction
TAA	Thoracic aortic aneurysm
TAAA	Thoracoabdominal aortic aneurysm
TEVAR	Thoracic Endovascular Aortic Repair
TGFBR1	Transforming Growth Factor ß Receptor 1
TGFBR2	Transforming Growth Factor ß Receptor 2
TGF-ß	Transforming Growth Factor ß

AIM OF THE WORK

- Aim of the work is to review the literature concerning the modalities of management of thoracic aortic aneurysm, and to outline a frame for perioperative management of these patients.

INTRODUCTION

- Aneurysmal dilatation is the most common indication for thoracic aortic surgery. Aneurysm is defined as a permanent localized dilatation of the aorta that results in a diameter that is at least 50% greater than normal **(Johnston etal.,1991)**
- Thoracic aortic aneurysms are subdivided into 3 groups depending on location: ascending aortic, aortic arch, and descending thoracic aneurysms or thoracoabdominal aneurysms. Aneurysms involving the ascending aorta may extend as proximally as the aortic annulus and as distally as the innominate artery, whereas descending thoracic aneurysms begin beyond the left subclavian artery. **(seng,2008)**
- Before the development of penicillin, syphilis was the major cause for thoracic aneurysm development. Today cystic medial necrosis, genetic conditions such as Marfan disease and Ehlers –Danlos syndrome, chronic dissection and bicuspid aortic valve are important contributing factors in the development of an ascending aortic aneurysm. **(Coady etal.,1999)**
- Most patients with thoracic aortic aneurysms are asymptomatic at the time of presentation , and aneurysms of the ascending aorta usually are detected as incidental findings during testing for other disorders (i.e., widening of the mediastinum or prominence of the aortic knob on routine chest radiography or aortic enlargement on

echocardiography, thoracic computed tomography, or magnetic resonance imaging).in contrast, aneurysms of the aortic arch, because of their location and the space occupying nature of the aneurysm, may impinge on the important mediastinal structures and are therefore symptomatic more often than are aneurysms of the ascending or descending aorta. **(Caffarelli; 2007).**

- Degenerative TAAA is asymptomatic at the time of diagnosis in roughly 43% of patients. TAAAs remain asymptomatic for prolonged periods of time; however, most ultimately produce a variety of symptoms prior to rupture and inevitable death. **(Coselli and Moreno; 2003).**
- Computed tomography scanning (CT) gives the best determination of the proximal and distal end of the aneurysm. In addition, the CT scan is the definitive study for measuring the size of the aneurysm. **(Lecumberri et al; 1996).**
- Ten years ago surgical results of TAA repair were less satisfactory than they are today .downward trend of complication rates and mortality is generally observed**. (Schepens etal.,2004)**
- Factor associated with mortality following TAA include age,acute presentation,preoperative renal insufficiency,hemorrhagic shock,cardiac arrest,muliorgan system failure and paraplegia. **(Gloviczki,2002)**
- Over the last 15 years, the management of aortic aneurysms has changed dramatically because of the development of the technique of endovascular aneurysm repair. Patients and physicians have embraced endovascular aneurysm repair as the method of choice to treat high risk patients with aortic aneurysms. (**Greenberg at al;2004)**

CONTENTS

ANATOMY OF THE AORTA

The Aorta

The aorta is the main trunk of a series of vessels which convey the oxygenated blood to the tissues of the body for their nutrition. It commences at the upper part of the left ventricle, where it is about 3cm in diameter, and after ascending for a short distance, it arches backward and to the left side, over the root of the left lung ; it then descends within the thorax on the left side of the vertebral column, passes into the abdominal cavity through the aortic hiatus in the diaphragm, and ends, considerably diminished in size (about 1.75 cm. in diameter), opposite the lower border of the fourth lumbar vertebra, by dividing into the right and left common iliac arteries. Hence it is described in several portions, the ascending aorta, the arch of the aorta, and the descending aorta, which is lastly divided again into the thoracic and abdominal aorta (**Gray et al; 2000**).

Aortic valve , Aortic root & The Ascending Aorta

The aortic orifice is guarded by the aortic valve, at the entrance to the ascending aorta. It lies at a lower level than the pulmonary orifice, rather to its right side, and is more obliquely placed. It has three semilunar cusps named right, left, and posterior (**McMinn; 2000)**.

Immediately above the aortic orifice the wall of the ascending aorta bulges to make the aortic sinuses, one above each cusp and similarly named. From the right sinus the right coronary artery emerges, from the left sinus the left coronary artery emerges. Above these sinuses, the aorta runs to the right of the pulmonary trunk and as it passes upward it slants a little forward towards the manubrium before curving backwards at the commencement of the arch. Here the fibrous pericardium is blended with its wall. The ascending aorta 5cm long makes a gentle spiral with the

pulmonary trunk on its left side, both within the common sleeve of serous pericardium (**McMinn; 2000**).

The aortic root has four anatomical components :the aortic annulus , the aortic cusps ,the aortic sinuses & sinotubular junction .

The aortic root and the ascending aorta as part of a common truncus arteriosus that partitions it self into the ascending aorta and the aortic root and the pulmonary artery at approximately the fifth and sixth weeks of development. The aortic root is a tripartite structure owing to the presence of coronary sinuses. The aortic valve proper has no true fibrous annulus, also the surgeon use the term aortic annulus to describe the junction of the aorta and the ventricle. The non coronary sinus of the aortic valve tend to be the largest of the three sinuses , and therefore the size of the aortic valve leaflets reflect this, with the non coronary leaflets generally being the largest. The length of the distance from the basal attachment of each aortic valve leaflets to the aorta is approximately 1.5 times the length of the free margin of the leaflets. The commissures of each of the aortic valves extend right to or just below the sinotubular junction, which marks the anatomic ridge between the end of the aortic root and the beginning of the ascending aorta. In general, the sinotubular ridge is approximately 10 to 15 percent smaller in diameter than the aortic annulus. Anatomic disease states that cause dilatation of the sinotubular junction or dilatation of the aortic annulus will cause insufficiency of the aortic valve. There is an aortic mitral continuity, which is a fibrous tissue attachment between the aorta and the mitral valves that constitute approximately 55 percent of the circumference of the aortic root. The left side of the aortic root toward the pulmonary artery is attached to the ventricular muscle, corresponding to approximately 45 percent of the circumference **(David; 2005)**

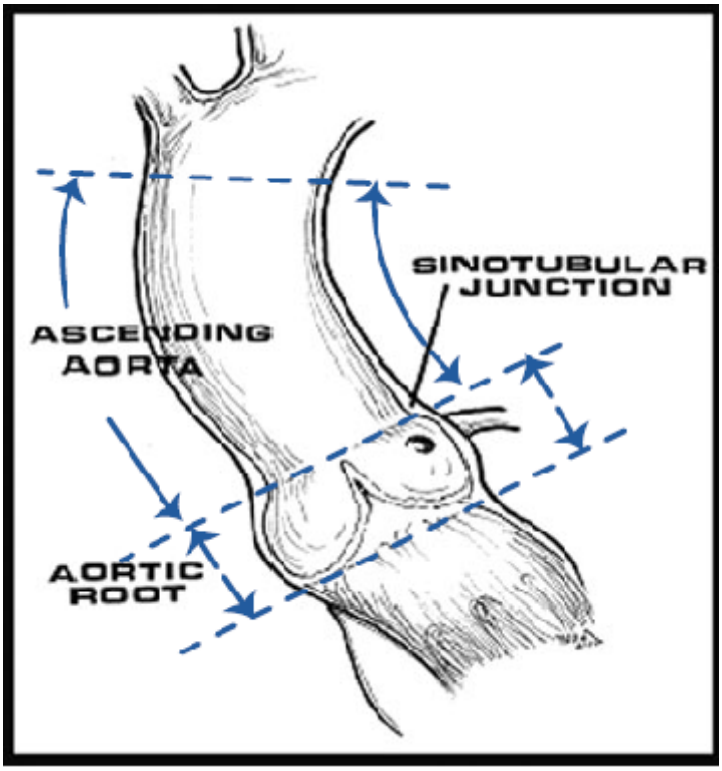

Figure (1): the relationship of the aortic root ,sinotubular junction and ascending aorta

Relations of the Ascending Aorta

The ascending aorta is within the fibrous pericardium, enclosed in a tube of serosal pericardium with the pulmonary trunk, anterior to its lower part are the infundibulum. The initial segment of the pulmonary trunk and the right auricle; superiorly, it is separated from the sternum by the pericardium, right pleura, the anterior margin of the right lung, loose areolar tissue and thymic remains; posteriorly are the left atrium, right pulmonary artery and principal bronchus; right lateral are the superior vena cava, the right pulmonary artery and the right atrium; left lateral are the left atrium and at a higher level, the pulmonary trunk (**Gray et al; 2000**).

The Aortic Arch

The arch of the aorta (Transverse Aorta) begins at the level of the upper border of the second sternocostal articulation of the right side, and runs at first upward, backward, and to the left in front of the trachea; it is then directed backward on the left side of the trachea and finally passes downward on the left side of the body of the fourth thoracic vertebra, at the lower border of which it becomes continuous with the descending aorta. It thus forms two curvatures: one with its convexity upward, the other with its convexity forward and to the left. Its upper border is usually about 2.5 cm below the superior border to the manubrium sterni (**Gray et al; 2000**).

Relations of the Aortic Arch

To the left of the aortic arch are the left phrenic nerve, the left vagus nerve, the left superior intercostal vein, the cardiac branches of the left vagus and sympathetic trunk. Caudally it is in intimate relation to the pericardium, and cranially it gives off its major branches; the innominate, the left carotid, the left subclavian arteries, and occasionally the thyroidea ima artery. Below the arch are the root of the left lung and the bifurcation of the pulmonary artery. Anteromedially and near its posterior end, it is fixed at the transition point to the left of the pulmonary artery by the ligamentum arteriosum **(Najafi; 1992).**