The role of Multidetector CT angiography in evaluating stent graft treatment of aortic aneurysms

Essay

Submitted for Partial fulfillment of the Master Degree in Radiodiagnosis

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2012

Acknowledgement

To Allah the all knowing , whose knowledge is beyond all the knowledge and to him I relate any success in my life .

I am honored to have Prof. Dr. Sahar Mohamed El Fiky , Prof. of Radiology, Faculty of Medicine, Ain Shams University, as a supervisor of this work. I am so grateful and most appreciative to her efforts.

I am deeply thankful to Prof. Dr. reem hassan bassiouny, lecturer. of Radiology, Faculty of Medicine, Ain Shams University , not only for her great help and effort to make this work possible, but also for her patience and valuable advices.

I would like to thank my colleagues in the national heart institute for their continous support and encouragement wih special appreciation for Dr. Eman hassan, Prof. of Radiology in national heart institute for her effort and fruitiful help.

I also deeply thank Dr. shreif , hossam elkhabiry ,gehan eldahaby Proffessors of Radiology in national heart institute for their guidance and cooperation throughout the conduction of this work.

I have never forgetten my kind family ; father ,mother , husband , Brother and sisters .No words can make a dedication to match what they deserves.

Marwa adel

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List of abbreviations

3D-------------------------three dimension.

AA-------------------------ascending aorta.

CTA-----------------------computed tomography angiography.

DSA-----------------------digital substraction angiography.

ECG-----------------------electro cardiography.

IMH-----------------------intramural hemorrhage.

IU--------------------------international unit.

LSA-----------------------left subclavian artery.

MDCT--------------------multidetector row computed tomography.

MPR----------------------multiplanar reformation.

MIP-----------------------maximum intensity projection.

MRA---------------------magnetic sesonance angiography.

ROI-----------------------region of interest.

SMA----------------------superior mesenteric artery.

SSD-----------------------shaded surface display.

TAA----------------------thoraco abdominal aorta.

TEE-----------------------trans esophageal echocardiography.

VR-------------------------volume rendering.

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Introduction

Multidetector row computed tomography (MDCT) has modified the imaging approach for the assessment of many diseases. The technique enables the acquisition of a volume of data, rather than slices. **(Avni et al, 2005)**.

The multi-slice CT scanner refers to a special CT system equipped with a multiple-row detector array to simultaneously collect data at different slice locations. The multi-slice CT scanner has the capability of rapidly scanning large longitudinal (z) volume with high z-axis resolution. **(Hu, 1999)**.

The endoluminal repair of aortic aneurysms with stent-grafts is rapidly becoming an important alternative to open repair. Unlike open repair, the success of endoluminal repair cannot be ascertained by means of direct examination and thus relies on imaging results. **(Armerding et al, 2000)**.

Postprocedure multidetector CT is mandatory to assess stent placement, efficacy, and complications. Important factors to document are location of the stent, stent patency, size of the aorta, thrombosis of disease outside the aortic lumen, and any complications. In particular, it is of utmost importance to document any increase or decrease in the size of the aorta, including the proximal and distal aortic necks . ***(Sakai et al, 1999& Resch et al, 2001).***

Potential complications of endovascular stents include endoleaks, stent migration, pseudoaneurysm formation, dissection, aortic perforation, kinking, thrombosis, and coverage of vital branch vessels with spinal cord ischemia . ***(Bent et al, 2007- Mita et al, 2000&Amabile et al, 2008).***

Aim of the work

This Essay is designed to overview the role of multidetector CT angiography in evaluation of stent graft treatment of aortic aneurysms.

ANATOMY OF THE AORTA

The aorta is the main systemic artery of the body (Fig1). It arises from the aortic orifice of the left ventricle behind the third left intercostal space at the margin of the sternum. It ends on the anterior surface of the fourth lumbar vertebra by dividing into right and left common iliac arteries. It is divided into thoracic and abdominal portions ***(Romanes, 1997)***.

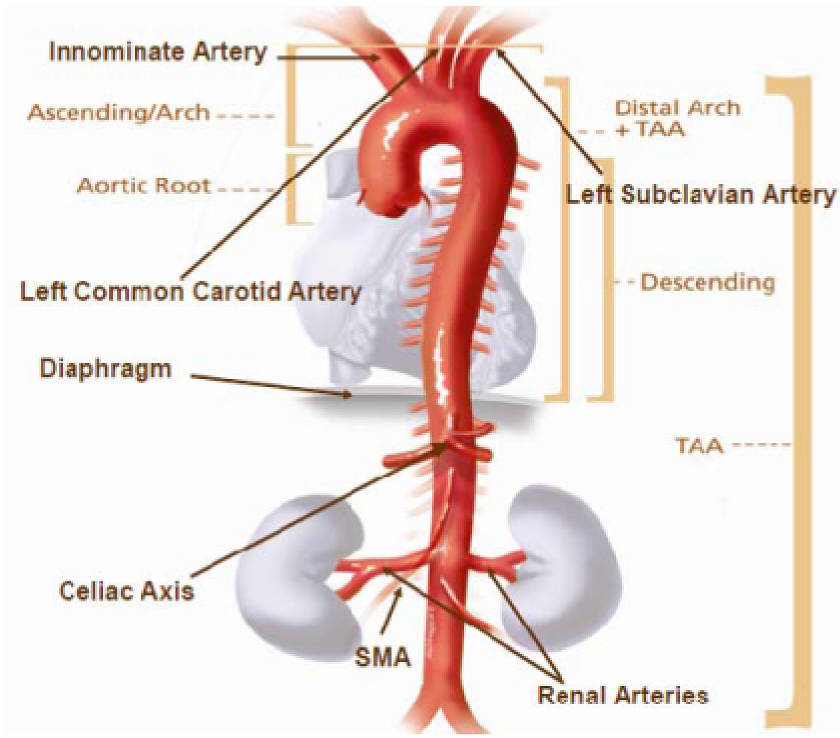

Fig.1: The aorta, and its branches.TAA represent thoracoabdomial aorta ,SMA represent superior mesenteric artery ***(Standring et al, 2005)***.

The thoracic portion of the aorta can be divided into ascending aorta, arc of the aorta and descending thoracic aorta ***(Drake et al, 2005)***.

From a surgical perspective, the thoracic aorta is divided into four anatomic segments the aortic root, the ascending aorta (tubular portion), the transverse aorta (aortic arch), and the descending thoracic aorta ***(Fleischmann and Miller, 2007)***.

The aortic root is the short segment of the aorta arising from the base of the heart and containing the aortic valve, the annulus, and the sinuses of Valsalva ***(Gotway, 2000)***.

The ascending aorta runs upwards, forwards and to the right, behind the left half of the sternum to the level of the upper border of the second left costal cartilage where it ends before the origin of the brachiocephalic artery ***(Naidich, 1999)***.

The ascending aorta is 5 cm long and is about 3 cm in diameter ***(Standring et al, 2005)***.

It has four dilatations of its wall:

1) Three aortic sinuses at its root corresponding to the cusps of the aortic valve.
2) The bulb of the aorta is a swelling of the right border which receives the full thrust of the blood ejected from the left ventricle ***(Romanes, 1997)***.

Relations:

The ascending aorta is contained within the pericardial sac and is covered by a visceral layer of serous pericardium, which also surrounds the pulmonary trunk ***(Standring et al, 2005).***

Anteriorly : it is related to lower part, 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, anterior margin of the right lung, loose areolar tissue and the remains of the thymus gland.

Posteriorly : the left atrium, right pulmonary artery and principal bronchus .

Right laterally : the superior vena cava and right atrium.

Left laterally : the left atrium and at a higher level the pulmonary trunk.

Branches:

The branches of the ascending aorta are the right and left coronary arteries, which arise from the right and left aortic sinuses respectively. They supply the heart itself ***(Romanes, 1997)***.

The posteriorly located sinus of Valsalva is termed the non-coronary sinus ***(Gotway, 2000)***.

Blood supply:

The vasa vasorum of the ascending aorta arise principally from a branch of the left coronary artery which ascends on the left side of the aorta and sends circumferential branches at regular intervals. The right coronary artery may also send a branch ***(Romanes, 1997)***.

Ascending Aorta:

The AA begins at the base of the left ventricle at the level of the lower border of the third left costal cartilage ***(Standring et al, 2005)***.

Aortic Arch:

It begins posterior to the sternal end of the second right costal cartilage as a continuation of the ascending aorta. The arch first passes posteriorly with a slight inclination and convexity to the left over the anterior surface of the trachea, then back across its left side and finally descends to the left of the 4th thoracic vertebral body, continuing as the descending thoracic aorta. It ends at the level of the sternal end of the second left costal cartilage, in the same horizontal plane as its origin ***(Standring et al, 2005)***.

It is about 4.5 cm in length and its diameter ranges from 28 mm at its origin to 20 mm at its end. There is a small stricture (aortic isthmus) at its border with the thoracic aorta, followed by a dilatation. In fetal life the isthmus lies between the origin of the left subclavian artery and the opening of the ductus arteriosus ***(Standring et al, 2005)***.

Relations:

Anteriorly :it is in contact with remnants of the thymus and with the left brachiocephalic vein which crosses its upper part ***(Romanes, 1997)***.

Posteriorly : the left surface of the arch is crossed by the phrenic nerve, the cervical cardiac branches of the left vagus (inferior) and sympathetic trunk (superior), the left vagus, and the left superior intercostal vein ***(Romanes, 1997)***.

Inferiorly : the structures passing to the root of the left lung, the bifurcation of the pulmonary trunk, the left pulmonary artery and the left bronchus ***(Romanes, 1997)***.

The ligamentum arteriosum joins the inferior surface of the arch of the aorta to the superior surface of the root of the left pulmonary artery, with the left recurrent laryngeal nerve passing posterior to the ligament to the groove between the trachea and esophagus, medial to the arch.***(Romanes, 1997)***.

Branches :

1) Brachiocephalic trunk:

This is the first and largest of the three branches. It arises behind the center of the manubrium sterni and ends posterior to the upper margin of the right sternoclavicular joint by dividing into right subclavian and right common carotid arteries anterior to the dome of the pleura ***(Romanes, 1997)***.

2) left common carotid artery:

It arises immediately to the left of the brachiocephalic trunk, and ascends through the superior mediastinum along the left side of the trachea. It enters the neck posterior to the left sternoclavicular joint ***(Romanes, 1997)***.

3) The left subclavian artery:

It arises from the arch further to the left, and more posterior than the other branches. It enters the neck some distance posterior to the left sternoclavicular joint ***(Romanes, 1997)***.

It is generally accepted that this “normal” configuration occurs in approximately 70% of patients (**Kadir , 1991)**.

Descending Thoracic Aorta:

It is the segment of the descending aorta confined to the posterior mediastinum. It begins at the level of the lower border of the fourth thoracic vertebra, as the continuation of the aortic arch, and ends at lower border of the 12 th thoracic vertebra in the diaphragmatic aortic aperture ***(Standring et al, 2005)***.

At its beginning it lies to the left of the vertebral column, and then as it descends it approaches the midline to lie directly in front of the vertebral column at its termination ***(Standring et al, 2005)***.

The descending thoracic aorta is about 20 cm in length. At any level the normal descending aorta is never larger than the ascending aorta. ***(Posniak et al, 1990)***.

Relations:

Anteriorly : The left pulmonary hilum, the pericardium separating it from the left atrium, esophagus and diaphragm.

Posteriorly: The vertebral column and hemiazygos veins.

Right laterally: The azygos and thoracic duct and below, the right pleura and lung.

Left laterally: The pleura and lung ***(Standring et al, 2005)***.

Branches:

From the anterior surface:

1. Two left bronchial arteries. The superior of these may give rise to the right bronchial artery.

2. Several esophageal branches.

3. Small branches to the fat and lymph nodes of the mediastinum, the pericardium, and the diaphragm ***(Romanes, 1997)***.

From the posterior surface:

Nine pairs of posterior intercostal arteries and one pair of subcostal arteries ***(Romanes, 1997).***

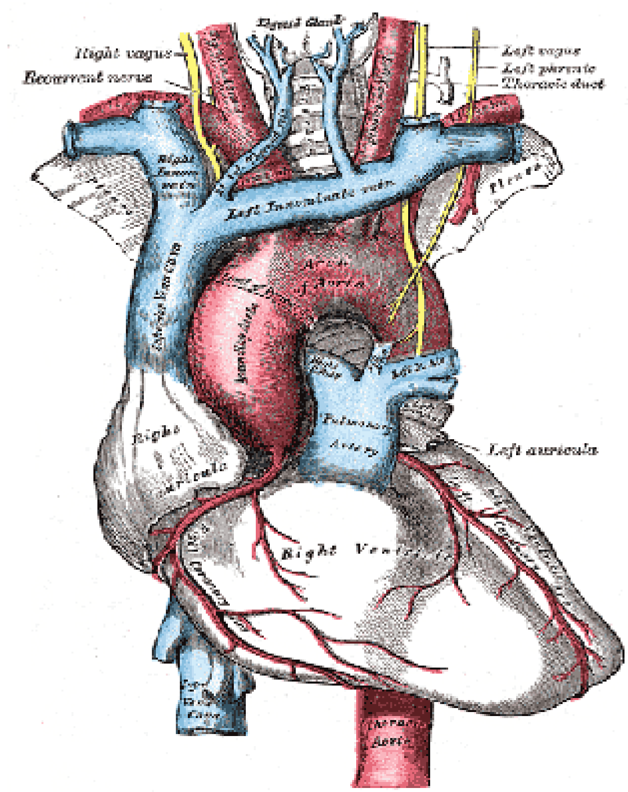

Fig.2: Ascending and arch of the aorta ***(Williams et al., 1995).***