Aortic aneurysm: What do surgeons should know before the surgery?

Poster No.: C-2489
Congress: ECR 2015
Type: Educational Exhibit
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Keywords: Arteries / Aorta, Emergency, Abdomen, Ultrasound, CT, CT-Angiography, Education, Image compression, Aneurysms

DOI: 10.1594/ecr2015/C-2489

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Learning objectives

• Describe abdominal aortic aneurysms (AAA) and its clinic.

• To show how to recognize it, to classify and to know the critical information that radiologist prior to surgery should give.

• Explain the radiological findings on ultrasound, CT and CT-angiography.
Background

AAA is the dilation of the abdominal aorta greater than 3 cm in its transverse axis. The estimated frequency is 15 to 37 per 100,000 patients/year and increases with age. In population older than 50 years is found in 2-4%.

A ruptures AAA is the cause of death of 15,000 people a year worldwide. Many patients die before reaching the hospital and postoperative mortality after rupture is 50-60%.

Most abdominal aortic aneurysms are true aneurysms, because it involves all three layers (intima, media and adventicia) of the arterial wall.

The most common site is infrarenal, between the renal arteries and aorto-iliac bifurcation, and there are two morphologies of aneurysms: saccular and fusiform aneurysms.

Regarding the etiology, the most important is the atherosclerotic cause. Other causes are: trauma, vasculitis and infection. The latter is known as mycotic aneurysms occurs classically adjacent artery bifurcations, in immunosuppressed patients and intravenous drug users. Germs are described fungal or syphilis.

Between the risk factors are: tobacco use, male gender, hypertension, hypercholesterolemia and family history.

Most are asymptomatic (75%) and represent a finding. By increasing its size, can trigger hypotension, abdominal, back or groin pain, palpable and pulsatile mass or puffs appear. If it is a mycotic aneurysm presented with fever.

Within complications include rupture of the aneurysm. Aortic aneurysm rupture is the most important diagnosis, that radiologist must be able to exclude in patients with acute abdominal pain especially when they present with back or flank pain. There are some risk factors present with ruptures aneurysm: aneurysm diameter of greater than 5 cm, degree of expansion and female gender. This is how the risk rupture in an aneurysm measuring 5.0 to 5.9 cm amounts 3-15%. The classical findings in aortic aneurysm rupture are well known.

There is a great advantage in the early management of aneurysm, this because, in the management of a ruptured aneurysm, mortality exceeds 75%.
The increased frequency of AAA and accepted use of *Endovascular Aneurysm Aortic Repair* (EVAR) as first line therapy or as an alternative to conventional surgery, is necessary to know the pre- and post-treatment findings.
Findings and procedure details

Ultrasonography is used as a diagnostic and also in monitoring aneurysms. It is an economical technique, non invasive, without using ionizing radiation or iodinated contrast, so it is useful in patients with chronic renal failure or allergy to iodinated contrast. It has an acceptable sensitivity and specificity, identifies diameters, mural thrombosis and arterial dissection. However, identification of the origin of the renal arteries and iliac arteries commitment may be poor. Also another disadvantage is that it is very dependent on the observer exploration, and therefore measurements may vary. For detection of endoleaks is useful to use the Doppler color or power Doppler.

In ultrasound thrombi are displayed moderately echogenic, which varies with the age of the thrombus. The calcified plaques in artery walls can cause acoustic shadowing.

Computed tomography is best for symptomatic patients and for preoperative assessment. It allows better definition of the shape, extent of the lesion, most accurate tool for serial monitoring of AAA size and provides greater detail suprarenal AAA. It has the disadvantage of using intravenous contrast and ionizing radiation.

The Angio-CT and 3D reconstruction achieves adequate description of renal, mesenteric and iliac arteries and is an important part of the preoperative evaluation.

In general, the parameters to be studied with CT for preoperative planning are:

1. **Shape of the aneurysm**: saccular or fusiform.
2. **Characteristics of calcifications and mural thrombi**. If they exist, the placement of the prosthesis is more difficult and the possibility of leakage increases proximal. No circumferential calcification and thrombus not contraindicate the placement of a prosthesis.
3. **Dimensions of aneurysm**: Is important to consider the outer anteroposterior diameter and the length of the aneurysm.
4. **Dimensions and characteristics of the neck**: Consider the outer anteroposterior diameter and the length.
5. **Position of the time origin of the visceral vessels in the axial reconstructions**. This is necessary when the aneurysm involves some visceral branch, where it is relevant to establish that position to determine the orientation of fenestration of the prosthesis.
6. **Shape of the neck:** Conical shape can generate displacement of the prosthesis.

7. **Neck angulation:** This is determined by the axis line of the neck and suprarenal aorta. The ideal is that there is no angle between the neck and the aneurysm by the possibility of displacement of the prosthesis. It is recommended that the angle is less than 60º.

8. **Diameter** of the right and left common iliac arteries and the **length** from the **infrarenal** line to the bifurcation of the iliac arteries.

9. **Associated findings:** highly developed lumbar arteries and patency of the inferior mesenteric artery, which can generate endoleaks.

10. **Anatomic variants:** polar renal arteries, ectopic kidney or fibrous tissue in the case of inflammatory AAA.

CT is also used in the post-treatment follow-up. It is important to control the diameter of the aneurysm and the aneurysm neck. Display the position, shape of the prosthesis and identify possible complications of this. There are 5 types of endoleaks:

- **Type I:** Sealing defect in the anchor points of prostheses.
- **Type II:** Dependent retrograde flow arteries of the aorta (lumbar arteries or inferior mesenteric artery). This is the most common (8-45%).
- **Type III:** Failure of the prosthesis structure.
- **Type IV:** Porosity of the prosthesis.
- **Type V or endotension:** Increase the aneurysmal sac without an obvious source.

CT also helps determine if there are complications after the procedure. Within these are:

1. **Prosthesis thrombosis.**
2. **Kinking or migration of the prosthesis.**
3. **Hematomas and other collections.**
4. **Prosthetic infection:** Gas is observed inside the prosthesis as a result of the third fistula duodenum.
5. **Embolic infarcts.**
6. **Intestinal ischemia.**
7. **Arterio-venous fistula:** For example, fill in the arterial phase of the inferior vena cava and femoral veins.
8. **Aorto-enteric fistula:** Rare, may occur as upper gastrointestinal bleeding, abdominal pain and sepsis. On CT extravasation of contrast medium is displayed to the digestive tract. There may also be ectopic gas, focal thickening of the bowel wall, aortic wall disruption, loss of fat plane interlaced aorta and bowel loop or a pseudoaneurysm.
In symptomatic patients presenting with an aortic aneurysmal rupture, findings on CT are:

- Periaortic stranding.
- Retropreritoneal hematoma.

There are also signs of impending rupture:

- **High-attenuating crescent sign**: Represents an acute hematoma within either the mural thrombus or the aneurysmal wall.
- **Focal discontinuity of intimal calcification** (tangential calcium).
- **Draped aorta sign**: Draping of posterior wall of aorta over adjacent vertebra (contained rupture).
Fig. 1: Abdominal aortic aneurysm with a calcified wall, about 4.5 cm in diameter. With mural thrombus of about 2 cm.

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Fig. 2: Axial CECT. Abdominal aortic aneurysm with a calcified wall, about 4.5 cm in diameter. With mural thrombus of about 2 cm.
**Fig. 3:** Axial CT. Abdominal aortic aneurysm with a calcified wall, about 4.5 cm in diameter.

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Fig. 4: Axial CT. Abdominal aortic aneurysm about 10cm in diameter. Signs of anterior wall rupture with active bleeding, pelvic and abdominal large retroperitoneal hematoma, which moves forward the kidney and colon.

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**Fig. 5:** Reconstruction. Infrarenal abdominal aortic aneurysm which starts immediately below the renal artery and output extends to aorto iliac bifurcation showing a maximum diameter of 8.5 cm. Active bleeding area dependent the anterior wall of the aneurysm.

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Fig. 6: Reconstruction. Infrarenal abdominal aortic aneurysm which starts immediately below the renal artery and output extends to aorto iliac bifurcation showing a maximum diameter of 8.5 cm. Active bleeding area dependent the anterior wall of the aneurysm.

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Fig. 7: Coronal CT with intravenous contrast. Infrarenal abdominal aortic aneurysm which starts immediately below the renal artery and output extends to aorto iliac bifurcation showing a maximum diameter of 8.5 cm.

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Fig. 8: Sagittal CT with intravenous contrast. Infrarenal abdominal aortic aneurysm which starts immediately below the renal artery and output extends to aorto iliac bifurcation showing a maximum diameter of 8.5 cm. Active bleeding area dependent the anterior wall of the aneurysm.

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Conclusion

- AAA are most asymptomatic and represent an incidental finding.
- Ultrasonography is the initial screening method and study.
- CT allows the complete pre- and postoperative study of the AAA. The Angio-CT and 3D reconstruction achieves adequate description of the arteries and important information for the surgeons.
- Depending on the diameter and condition of the aneurysm, treatment may be medical or surgical. There are an accepted use of *Endovascular Aneurysm Aortic Repair* (EVAR) as first line therapy or as an alternative to conventional surgery.
References