Indications for Aortic Surgery

- Ascending aortic aneurysm
  - With > 6 cm aneurysm: 14% risk of rupture/death
  - Elective surgery for aneurysm > 5.5 cm
  - Surgery if ascending aorta > 5 cm
    - Marfan Syndrome
    - Bicuspid AV
    - Surgery advised
  - Rapid aneurysm growth: > 0.5 cm/year
  - Symptomatic patients (regardless of size)
- Ascending aortic dissection
- Ascending aortic intramural hematoma


Non-contrast CT is not routinely done for routine exams. However it should be performed with:
- Acute events to evaluate for intramural hematoma
- Stent graft endoleak evaluation
- Arterial phase imaging with contrast dose (70-100 ml) at high flow rate (3-4 ml/s).
- EKG gating (prospective preferred)
- Reduce aortic root motion
- Slice thickness

Reliable and accurate modality in the identification of aortic pathology (dissection, intramural hematoma, aneurysm, coarctation) and for post-operative follow-up.

Pros:
- No ionizing radiation (surveillance)
- No iodonated contrast
- Dynamic and functional information

Cons:
- Cautous use of gadolinium in renal failure patients
- Metallic implants/ICD
- Surgical material related artifact
- Longer scanning time (>20-30 minutes).
**MR Evaluation of Post-operative Aorta**

- **Spin Echo (SE)**
  - EKG gated, breath hold
  - Long acquisition time (8-10 min)
  - Aneurysm, intra-mural hematoma, dissection

- **SSFP/GRE (cine)**
  - EKG gated, breath hold
  - Prone to artifact
  - Aneurysm (aortic root), dissection

- **Post-contrast 3D MRA**
  - Breath hold, Non EKG-gated

  - Phase contrast (PC) imaging
  - Can quantify aortic regurgitation
  - Identify false lumen thrombois (risk factor)

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**OPEN AORTIC SURGERY: TWO BASIC TECHNIQUES**

- **Interposition technique:**
  - Resection of diseased aorta
  - Synthetic graft placement (Dacron, DuPont)
  - Preferred method

- **Inclusion technique**
  - Native aorta is left in situ and surrounded by synthetic graft
  - Higher incidence of post-operative complications

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**SURGICAL TECHNIQUES**

- Ascending aortic reconstruction with composite artificial graft
- Bentall procedure
- Cabrol procedure
- Reconstruction with composite biologic graft
- Ross procedure
- Reconstruction with an ascending aortic graft with preservation of the native aortic valve
- David valve-sparing technique
- Aortic arch reconstruction
- Elephant trunk
Dacron synthetic graft is gelatine-sealed woven polyester.

On CTA
- Synthetic graft is hypodense relative to aortic lumen
- Felt ring is hyperdense
Graft may be obscured but signs of location include identification of the
- Felt rings
- Abrupt change in aortic caliber

Choice of surgical procedure varies depending on location and extent of disease and whether the surgery will involve:
- Coronary arteries
- Aortic valve
- Aortic Arch
- Great arch vessels

Ostial buttons:
- Coronary ostia are dissected with rim of surrounding aorta and reanastomosed individually to composite graft

Developed in 1968
Native aortic root and aortic valve replaced by composite graft with re-implantation of the coronaries
Bioprosthetic AV
- Do not require life-long anticoagulation.
- Preferred for younger patients (<60 y/o).
- Increased risk of structural failure and re-operation.

Mechanical AV
- Requires life-long anticoagulation.
- Less risk of structural failure and re-operation.

Bioprosthesis vs Mechanical

Cabrol Procedure
- Developed in 1981.
- A composite aortic root and aortic valve graft and a prosthetic conduit anastomose the coronary ostia to the aortic graft.
- Alternative to Bentall.
  - Severe atherosclerosis of aortic root precluding ostial buttons.
  - Severe proximal coronary divisions.
  - Annuloaortic ectasia.
Cabrol Procedure

- Developed in 1967
- Performed in young patients with dilated aortic root and abnormal aortic valve.
- Replace aortic valve and possibly aortic root with patient’s own proximal pulmonary artery and pulmonary valve. Pulmonary synthetic/biologic may also be placed.
- Advantages:
  - Lower risk of endocarditis, clot
  - Decreased need for anticoagulation
  - Allowance for growth

Ross Procedure

- Developed in 1967
- Performed in young patients with dilated aortic root and abnormal aortic valve.
- Replace aortic valve and possibly aortic root with patient’s own proximal pulmonary artery and pulmonary valve. Pulmonary synthetic/biologic may also be placed.
- Advantages:
  - Lower risk of endocarditis, clot
  - Decreased need for anticoagulation
  - Allowance for growth

Elephant Trunk Procedure

- First described in 1983
- Indications:
  - Atherosclerotic or inflammatory aortic aneurysms involving the arch and descending aorta
  - Postdissection aneurysms
  - Acute type A aortic dissection
- Classically 2 stages:
  - Stage I: The ascending aorta and aortic arch are repaired and the native aorta is removed and a graft is placed into the ascending aorta and proximal descending aorta.
  - Stage 2: A second graft is placed within the descending thoracoabdominal aorta and anastomosed with the distal graft from stage I.
- "Arch-first" technique:
  - The arch vessels are removed from the native aortic arch and reanastomosed to a tubular graft

Pitfalls

- At the conclusion of stage I of the Elephant trunk, the distal end of the graft is left unattached and floats freely in the native descending aorta mimicking a dissection flap.

Postoperative Complications

- Infection
- Hematoma
- Aortic pseudoaneurysm
- True aortic aneurysm and dissection
- Coronary ostial aneurysm

- Low attenuation material surrounding aortic graft
- May be normal within months of surgery
- Infection/perigraft abscess
- Perigraft enhancement
- Perigraft air (should resolve by 6 wks)
- Increasing fluid collection
- Leak/dehiscence
- Inflammatory collection

POSTOPERATIVE COMPLICATIONS: PSEUDOANEURYSM
- Rare complication (<0.5%)
- Mediastinitis and graft infection are most common risk factors
- Other risk factors related to progressive aortic wall disease.
- Marfan Syndrome, Takayasu’s
- Most common locations:
  - Graft anastomosis site
  - Coronary anastomosis site
  - Aortotomy site
  - Aortic cannulation site


POSTOPERATIVE COMPLICATIONS: PSEUDOANEURYSM

POSTOPERATIVE COMPLICATIONS: DISSECTION

POSTOPERATIVE COMPLICATIONS: CORONARY OSTIAL ANEURYSMS
- Develop at coronary reimplantation site
- Increased risk with underlying connective tissue disease
- Can occur in up to 43% of patients with Marfans
- Thought to develop as a result of perioperative stretch of the weakened coronary ostial wall.
- Questionable need to treat

Knowledge of the open aortic surgical techniques is crucial for post-operative imaging interpretation.

Normal post-operative findings/surgical material should not be mistaken for true pathology.

CTA is the modality of choice in post-operative aortic repair, however MRI should be considered for routine follow up studies.