Post-Op Aorta: Differentiating Normal Post-Op vs. Complications

Linda C. Chu, MD
Assistant Professor of Radiology
Johns Hopkins University
Disclosures

• No disclosures
Goals and Objectives

• To review CT technique in post-operative evaluation following aortic root replacement

• To provide a systematic approach in the evaluation of post-op aorta

• To emphasize features helpful in differentiating normal post-op vs. complications
Introduction

• Composite aortic valve conduit replacement was first introduced in 1968

• Surgical modifications and technical improvements during past 4 decades have made aortic root replacement safe and reproducible

• Expected mortality in elective aortic root repair < 5%

• Patients are still at risk of developing early and late term complications

Aortic Root Replacement Procedures

• Interposition graft:
  – Excision of native aorta
  – End-to-end anastomosis with biological or synthetic graft
  – Composite graft – Includes artificial valve
  – Valve sparing – Keeps native aortic valve

• Inclusion graft:
  – Native aorta is wrapped around synthetic graft
Not So Normal Post-Op
CT Technique – Choices

- CT without intravenous contrast
- CT with intravenous contrast
  - Arterial phase
  - Arterial phase and delayed phase
  - ECG-gating
CT Technique – IV Contrast

- IV contrast is critical in detection of postop complications such as pseudoaneurysm or dissection.

**Images:**
- **Retrosternal fluid collection**
- **Pseudoaneurysm**
CT Technique – IV Contrast

• At our institution, non-contrast CT is not performed for routine surveillance of post-op aorta patients
• Non-contrast CT can be helpful in certain situations:
  – Stent grafts (r/o endoleak)
  – Acute chest pain (r/o intramural hematoma)
  – Differentiating surgical hardware from leak

![Image of CT scan]

Pseudoaneurysm? Hyperdense surgical material
CT Technique – ECG-Gating

• Important to perform ECG-gating to minimize motion at the aortic root

Motion artifact on a normal study

Subtle pseudoaneurysm on a non-ECG gated study

Clear depiction of pseudoaneurysm on ECG-gated study
CT Technique – ECG-Gating

- Subtle pseudoaneurysm missed on non-ECG gated study

Pseudoaneurysm missed on outside non-ECG gated study

Clear depiction of pseudoaneurysm on ECG-gated study
Post-Op Aorta Check List

- Aorta and graft
- Coronary arteries
- Aortic valve
- Mediastinum and pericardium
- Lungs and pleura
- Sternum and soft tissues
- Support devices
Aorta and Graft

- Vessel diameter
- Vessel contour
- Anastomosis and cannulation sites
Vessel Diameter and Contour

- Patients with history of aortic root replacement may develop progressive aortic aneurysm or dissection
- Patients with underlying connective tissue disorders are at increased risk for progression

Marfan pt with residual aortic dissection following aortic root replacement

Worsening dissection and aneurysm on 1 year f/u exam
Vessel Diameter and Contour

- Monitor for progressive vessel enlargement
  - Measure on comparable levels
  - Double oblique MPR reformats
  - Compare to more remote exams
    - Slow growth over time → May appear stable compared to most recent exam

- Monitor vessel contour
  - New dissection
  - Extension of preexisting dissection flap
Anastomosis and Cannulation Sites

- Carefully evaluate all anastomosis and cannulation sites to exclude pseudoaneurysm
  - Abnormal outpouching of contrast at the anastomosis site
  - MPR and 3D reconstructions
Pseudoaneurysms

- Pseudoaneurysms (PSA) tend to occur at anastomosis or cannulation sites
  - A. Graft anastomosis
  - B. Coronary artery anastomosis
  - C. Aortotomy site
  - D. Aortic cannulation site
  - E. Needle vent site

Pseudoaneurysm with Aortotracheal Fistula

- Rare and potentially fatal complication
- Effacement of fat plane with trachea
- Tend not to see active contrast extravasation

PSA near graft anastomosis, dx as “tracheal polyp”

Irregular contour of tracheal wall
Pseudoaneurysms

- Specify location of pseudoaneurysm with respect to aortic root and coronary arteries
- Provide size and number of pseudoaneurysms
- Indicators of acute hemorrhage
- Presence of additional aortic abnormality that require intervention
- Distance of pseudoaneurysm from sternum
  - Helps assess risk for resternotomy
Risk of Pseudoaneurysm Rupture

• Higher risk for reentry:
  – Anterior pseudoaneurysm < 2 cm from sternum
  – Need to establish cardiopulmonary bypass before resternotomy

Risk of Pseudoaneurysm Rupture

• Lower risk for reentry:
  - Anterior pseudoaneurysm > 2 cm from sternum OR
  - Posterior pseudoaneurysm
  - Cardiopulmonary bypass before resternotomy is optional

Coronary Arteries

- Evaluate morphology of coronary ostia
- Evaluate coronary arteries on axial, MPR, and MIP
- If patient has coronary artery graft → Assess patency of graft
Coronary Ostial Aneurysm

- Dilatation of coronary artery reimplantation site > 10 mm
- Perioperative stretch of weakened ostial wall
- Increased risk in patients with connective tissue disorders
- Long-term consequences unknown
- Probably low risk finding

Aortic Valve

- MPR reformat to evaluate valve leaflet thickness and morphology
- Aortic valve function (retrospective gating)
Aortic Valve Endocarditis

- CT with ECG gating can reliably detect valvular vegetations > 1 cm

- Valvular thickening and nodular excrescence

- Evaluate associated findings:
  - Perivalvular pseudoaneurysm
  - Septic emboli

Aortic Valve Malfunction

- Prosthetic valve obstruction due to thrombus or pannus is a serious and occasionally fatal complication
- Incidence of prosthetic valve obstruction ~ 0.1% to 0.6% per patient-year

Thrombi on “stuck” valve

Anterior leaflet “stuck” in semi-open position, posterior leaflet with limited excursion

Mediastinum and Pericardium

- Amount and density of fluid
- Amount of gas

- Small amount of fluid or gas may persist for days or weeks
- Suspicious CT findings:
  - Large amount of hypodense fluid
  - Increasing fluid and soft tissue on serial scans
  - Increasing gas

Mediastinitis

- Difficult to differentiate between “normal post-op” vs. mediastinitis
- **Most helpful clue:** Increase in size or complexity on serial exams

1 week post-op: Small amount of fluid and air, expected post-op change

2 week post-op: Increased size of fluid collection and density → Mediastinitis
Mediastinal “Fluid Collection”

- Beware of pseudoaneurysm masquerading as mediastinal “fluid collection”
- **IV contrast is critical for thorough evaluation of post-op complications**

“Retrosternal fluid collection”  Pseudoaneurysm
Perigraft Seroma

- Rare, late complication of polytetrafluoroethylene and Dacron grafts
- Failure of graft incorporation into native vessel wall and increased graft porosity
- After 3 months, any perigraft hematoma or fluid should have resolved
- May recur following simple aspiration and drainage

Lungs and Pleura

- Amount and density of pleural fluid
  - CT with IV contrast may be able to identify source of bleeding in hemothorax

- Pneumothorax

- Lung consolidation
Sternum and Soft Tissues

- Integrity of sternal wires
- Alignment of sternum
- Sternal erosion
- Sternal periosteal reaction
- Soft tissue fluid collection
Sternal Dehiscence

- May occur alone or in association with mediastinitis
- Displacement of sternal wires
- Sternal erosion
- Cleft within sternotomy site
- Soft tissue hematoma

Sternal Osteomyelitis

- Complication seen in 2% of patients undergoing sternotomy
- Bone erosion and periosteal reaction
- Associated soft tissue infection

Rim enhancing fluid collection $\rightarrow$ Abscess

Sternal erosion $\rightarrow$ Osteomyelitis

Support Devices

- Check appropriate placement of all support devices
Conclusion

• Multidetector CT with ECG-gating can provide important diagnostic information in the evaluation of post-operative complications following aortic root replacement

• Systematic approach with attention to key CT features can help differentiate normal post-op from pathology
THANK YOU