FRONTLINE VASCULAR CARE 2025

SPECTRUM VASCULAR & GENERAL SURGERY 光谱外科与血管专科

FARRER PARK HOSPITAL

Abdominal Aortic Aneurysms: Essentials and Advances in Standard of Care

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COMFORT · FAIRNESS · VALUE

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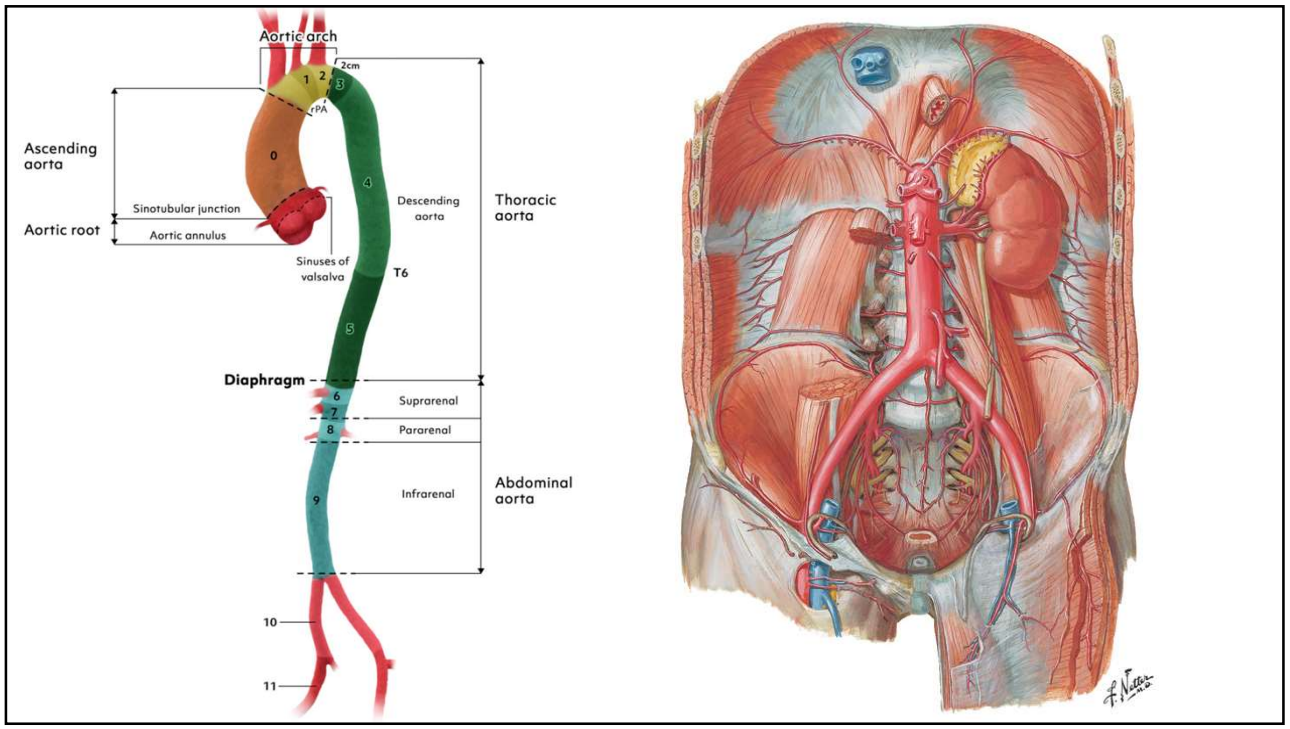

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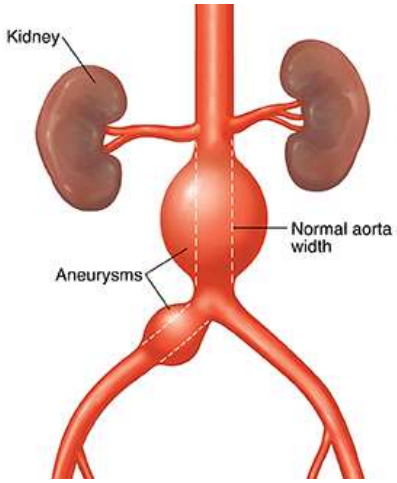
Basics - Definition

- Aortic aneurysm
  - at least 50% increase in local aortic diameter or
  - > 30 mm absolute diameter



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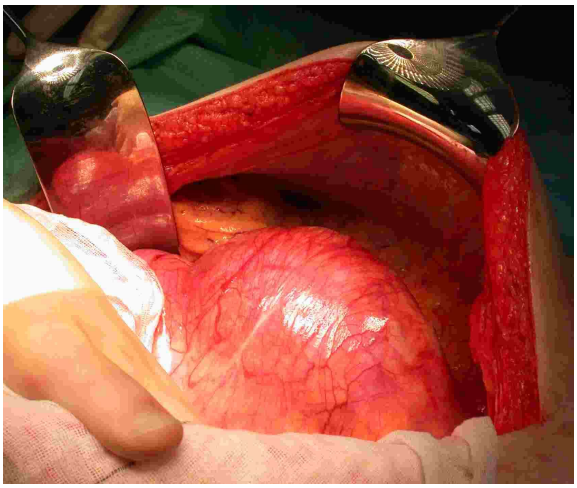
Abdominal aortic aneurysms

- Abdominal aorta aneurysms (AAA) accounts for 90% of all aneurysms
- Aortic arch, thoracic aorta and thoracoabdominal aorta is involved in ~ 10%
- 25% of AAA patients have femoral or popliteal aneurysms



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Etiology

- Unclear – likely multifactorial process with genetic and environmental risk factors
- First-degree relatives of AAA patients have ~ 20% likelihood for development of an AAA
- 90% are thought to be due to a degenerative process
- Other causes:
  - Infection (mycotic aneurysms)
  - Connective tissue disorders → 1. Marfans, 2. Ehlers-Danlos, 3. Loeys-Dietz
  - Arteritis

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Epidemiology

- Aortic aneurysm usually affects elderly men
- 20th century prevalence
  - ~5% in Caucasian men aged > 65 years
  - 1.7% in women (1/3 of men)
- Recent population screening studies
  - 1.71% in men and 1.9% in women
  - Trends in AAA mortality[1]
    - Positively correlated with smoking and hypertension
    - Negatively correlated with obesity
  - Likely due to decline in cigarette consumption and general improvement in management of cardiovascular disease risk factors

1. Png CYM, Wu J, Tang TY, Png IPL, **Tay JS**, Choke E. Decrease in Mortality from Abdominal Aortic Aneurysms (2001 to 2015): Is it Decreasing Even Faster? Eur J Vasc Endovasc Surg. 2021 Jun;61(6):900-907. doi: 10.1016/j.ejvs.2021.02.013. Epub 2021 Mar 24. PMID: 33773903.

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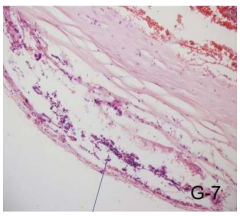
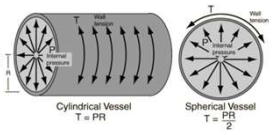
Pathology



- Aortic aneurysmal dilatation is due to
  - reduction in medial and adventitial elastin and collagen
  - thinning of the media
  - Infiltration of lymphocytes and macrophages.
- Proposed mechanisms of aneurysm formation
  - Proteolytic degradation of aortic wall connective tissue
  - Inflammation
  - Biomechanical wall stress
    - Tangential aortic wall stress is proportional to the radius and the systemic blood pressure within the vessel (Laplace's law)
    - Increased stress and rupture risk with enlarging aneurysms



- Turbulent aortic flow due to aneurysmal morphology predisposes to thrombus formation
  - Thrombus becomes laminated against the aortic wall
  - Mural thrombus cause distal embolisation

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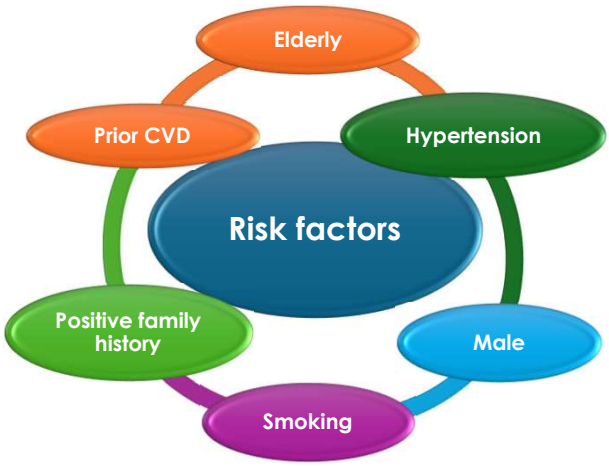
Risk factors for AAA



Diabetes
Negative risk factor

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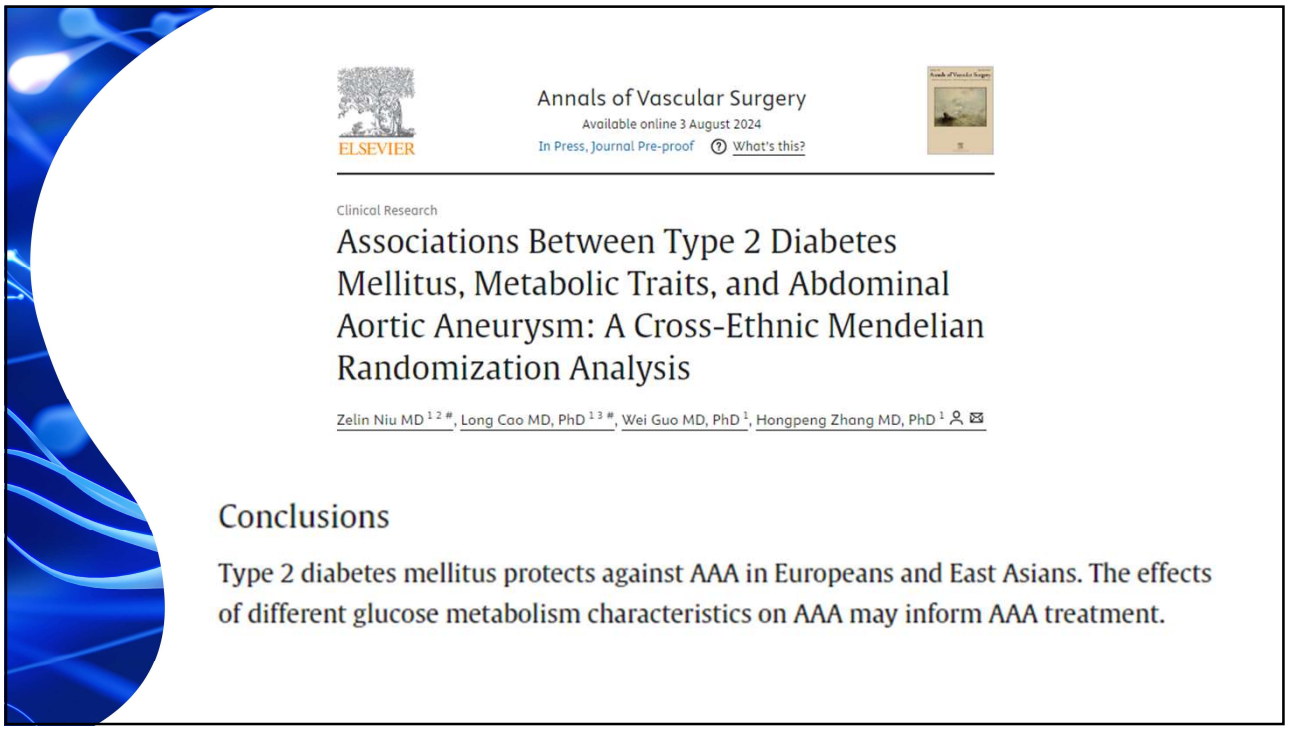

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Risk factors

- Hypertension
- Ethnicity
  - More common in Caucasians
  - Less common in Hispanics (OR, 0.7), African Americans (OR, 0.7), and Asian Americans (OR, 0.7)
- Peripheral arterial disease
- Cerebrovascular disease

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Natural history

- Average growth rate from 0.2 to 0.3 cm per year.
- Larger AAA diameters = higher AAA growth rates.
- A wide variation between patients.
- Smoking cessation to reduce the rate of AAA growth.

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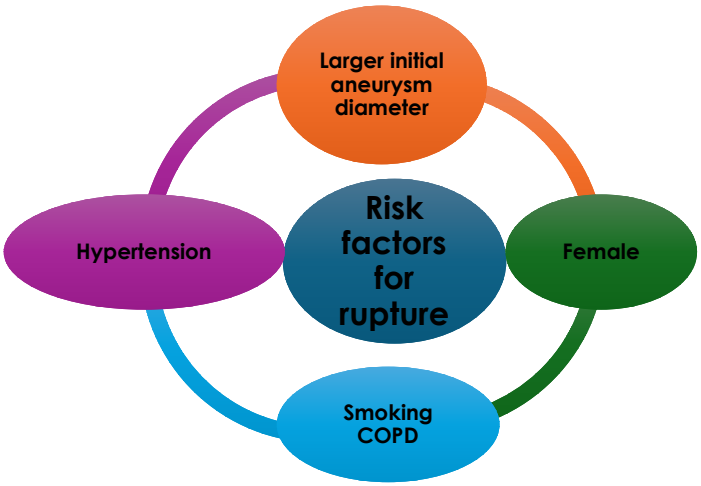
Risk factors for rupture



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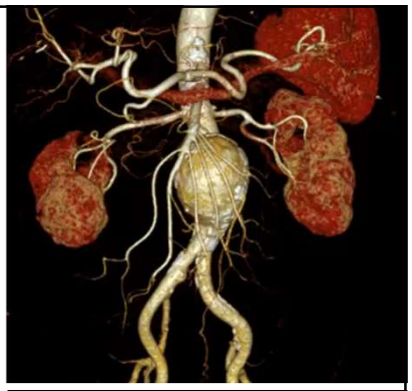
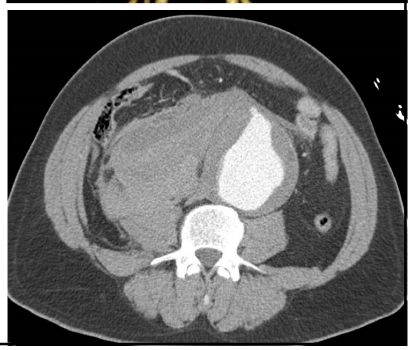
Clinical features

- 75% Asymptomatic/Incidental
- Rupture – few present with triad of
  1. Severe abdominal or back pain
  2. Hypovolaemic shock
  3. Pulsatile abdominal mass





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Clinical features

- Ruptured AAA should be considered in any elderly patient with unexplained hypotension / syncope and abdominal symptoms
  - Overall mortality rate of 80%
    - significant majority do not make it to hospital
  - 50% mortality rate if operated
  - Most who present have a sealed retroperitoneal haematoma with temporary haemodynamic stability.

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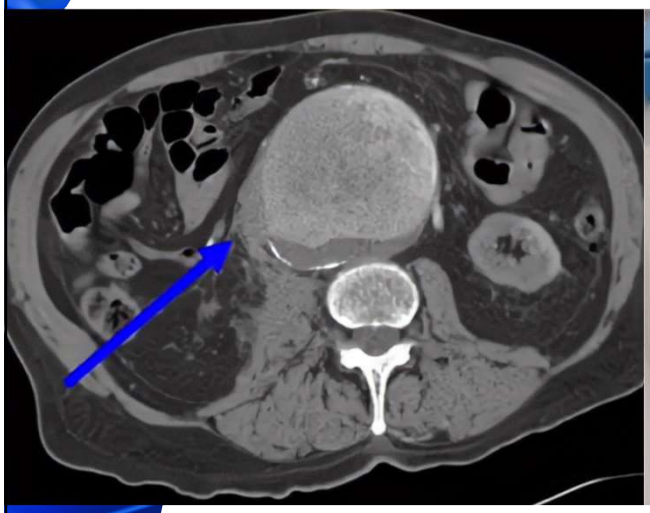

Credit:
NYU LANGONE FEATURING THOMAS MALDONADO

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Clinical features

- Distal embolisation of mural thrombus → Acute limb ischaemia
- Acute thrombotic occlusion of small aortic aneurysms → acute bilateral lower limb ischaemia / paralysis
- Pressure symptoms on adjacent structures
  - Dysphagia
  - Ureteric obstruction
  - Vena caval obstruction

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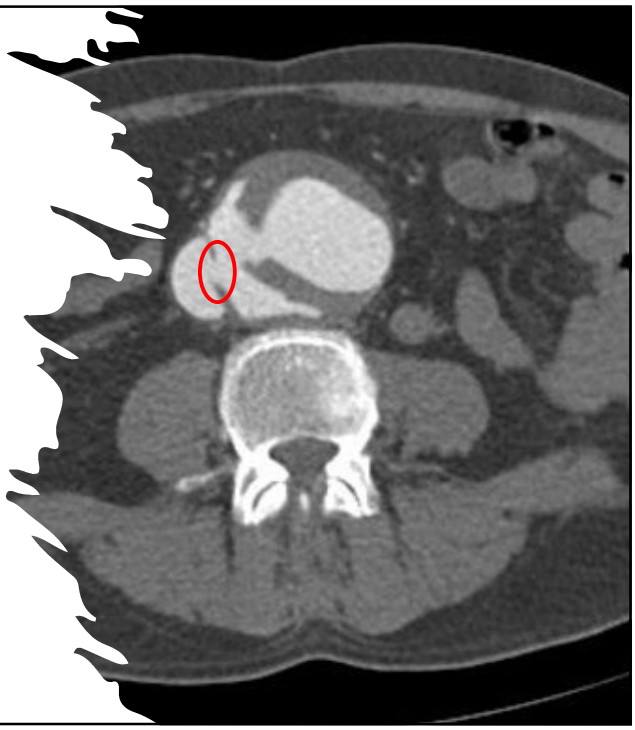
Clinical features

- Rupture into an adjacent structure causing a primary aortic fistula
  - Aortocaval AVF (0.22 – 6%) with tachycardia, congestive heart failure, leg swelling, abdominal thrill, abdominal "machinery" bruit, renal failure and peripheral ischaemia.
  - 4th part of duodenum / aortoenteric fistula - herald upper gastrointestinal bleed followed by massive haemorrhage.



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Management of AAA

- Goals
  - Prevention of rupture = asymptomatic + size criteria
  - Repair of ruptured/symptomatic AAAs
- Best medical therapy
  - Antiplatelets
  - Statins
  - BP Control
- Smoking cessation

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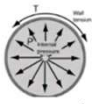
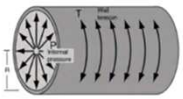
AAA Annual Rupture Rate

Diameter (cm)	Annual rupture rate (%)
4 – 5.4	0.5 – 1.5
5.5 – 6	5 – 15
6 – 6.9	10 – 20
7 – 7.9	20 – 40
≥ 8	30 - 50



T = (P * R)



Laplace's Law: Larger diameter = larger wall tension

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Management of infrarenal AAA using diameter size

- 30 – 39mm → US Aorta 3 year interval
- M: 40 – 49 mm, F: 40 – 44 mm → US Aorta 1 year interval
- M: 50 – 54 mm, F: 45 – 49 mm → US Aorta 6 month interval
- M: ≥ 55 mm, F: ≥ 50 mm
  - Fit → Open or EVAR
  - High risk → 1) Open repair or EVAR if accepts risk 2) Observe until risk of rupture > surgery
  - Unfit → 1) Open repair or EVAR if accepts risk 2) Observe until risk of rupture > surgery

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Indications for Repair

Standard

- Ruptured aneurysm
- Symptomatic aneurysm
  - pain due to acute expansion or imminent rupture
- Asymptomatic fusiform
  - Weigh risk of rupture vs morbidity and mortality with repair
  - Maximum AAA diameter (outer wall to outer wall)
    - Males 5.5 cm
    - Females 5.0 cm
  - Rate of growth
    - > 0.5 cm / 6 mths
    - > 1 cm / 12 mths

Glass fusiform bottle

Roman

4th century CE

On view at The Met Fifth Avenue in Gallery 171

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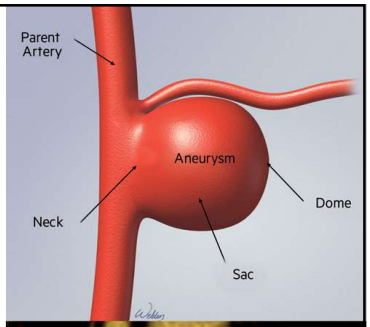
Indications for Repair

Atypical

- Mycotic → Saccular aneurysm
- Penetrating aortic ulcer → Saccular aneurysm
- Recurrent aneurysm/endoleaks
- Pseudoaneurysm
- Dissection with malperfusion



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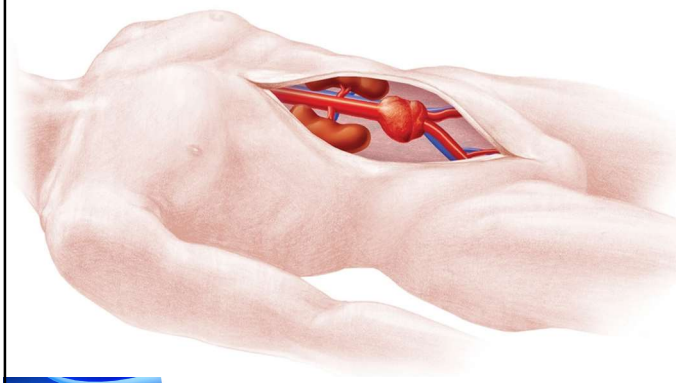
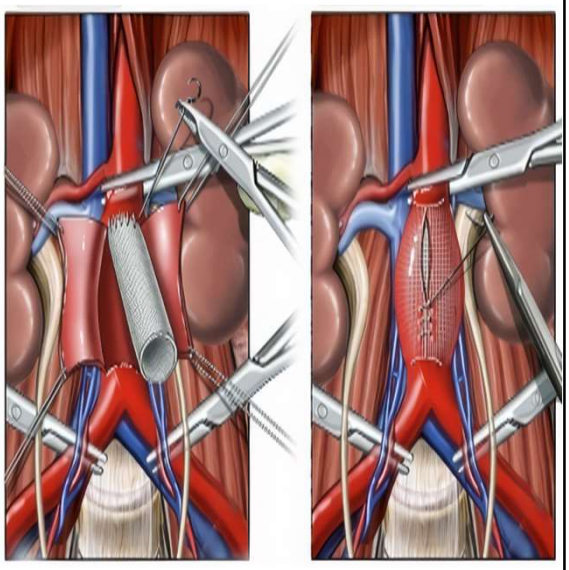
Open Repair





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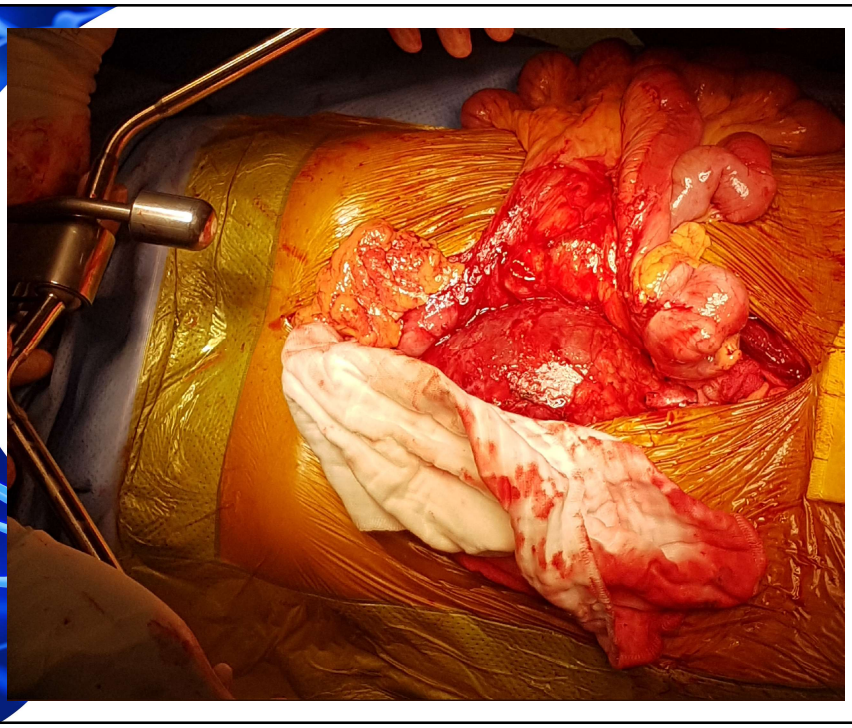

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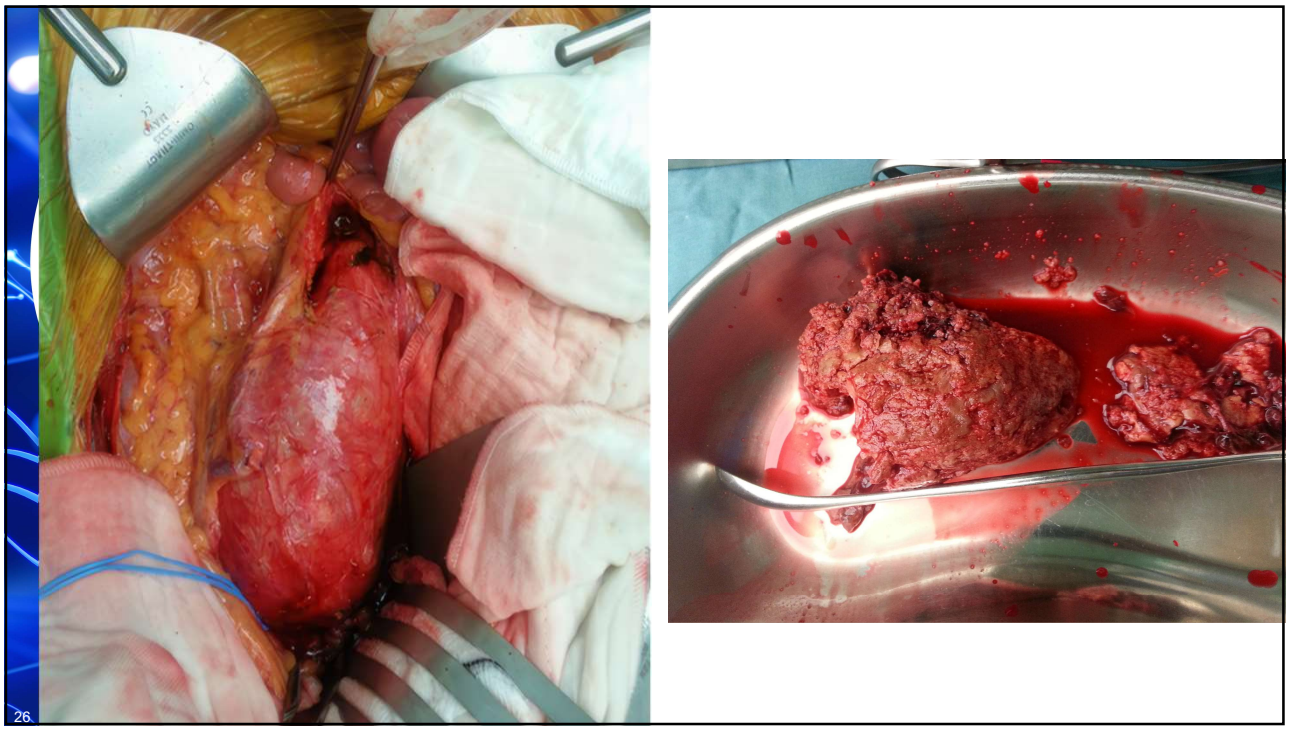

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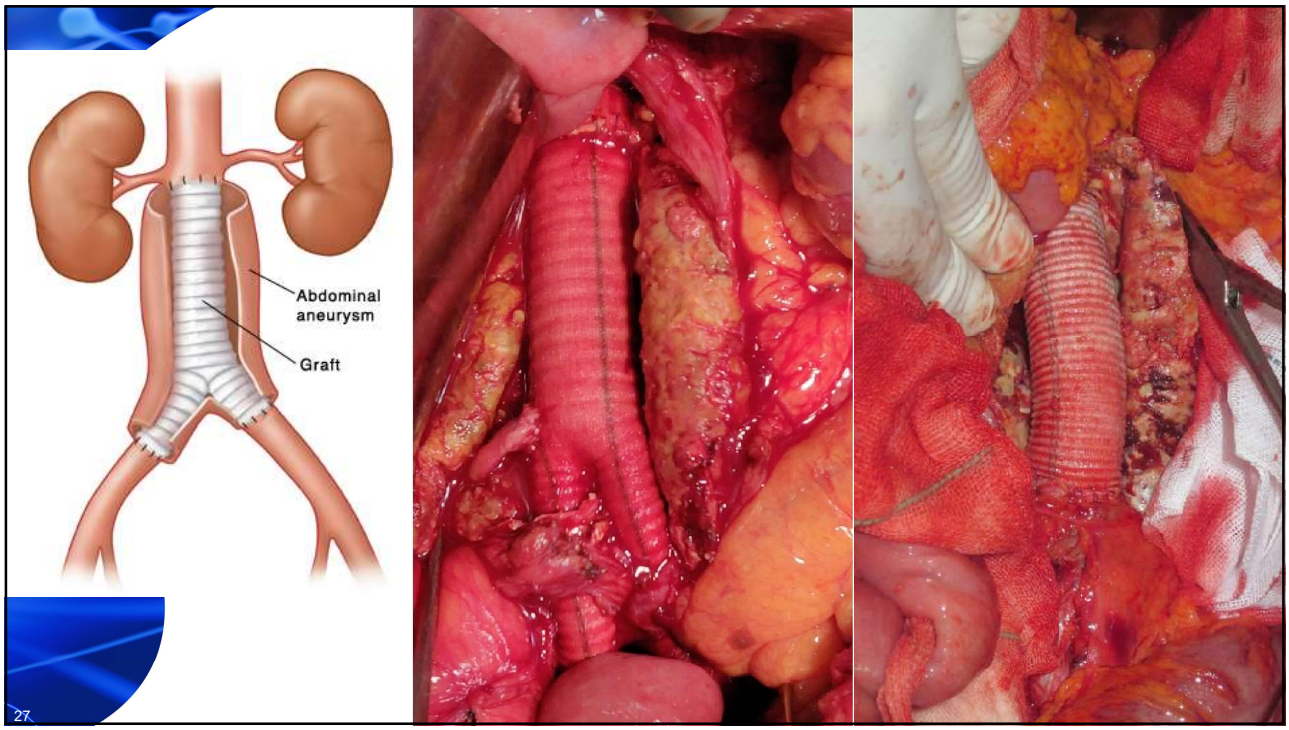

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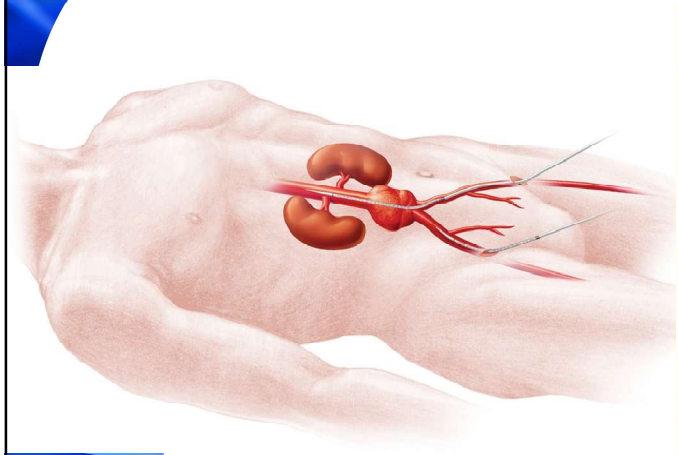
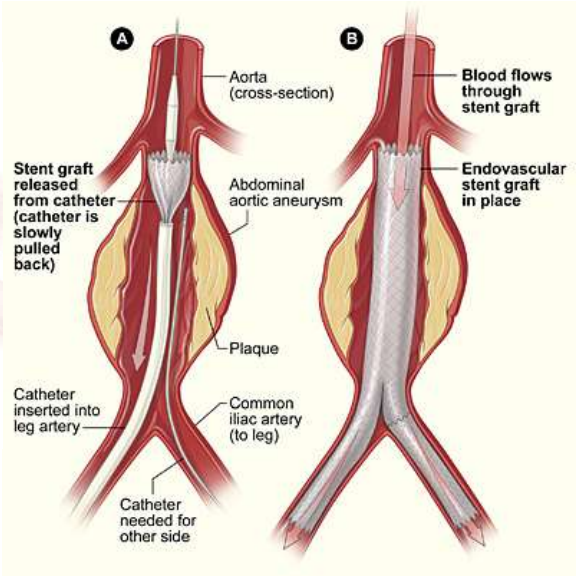
EVAR(Endovascular Aneurysm Repair)





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Feasibility for EVAR

- Neck
  - Length > 15 mm
  - Angulation < 60 degrees
  - Diameter < 28 mm
  - Not conical
  - No excessive thrombus
- Iliac artery
  - Common iliac artery length > 10 mm
  - Diameter > 7 mm
  - Not too tortuous

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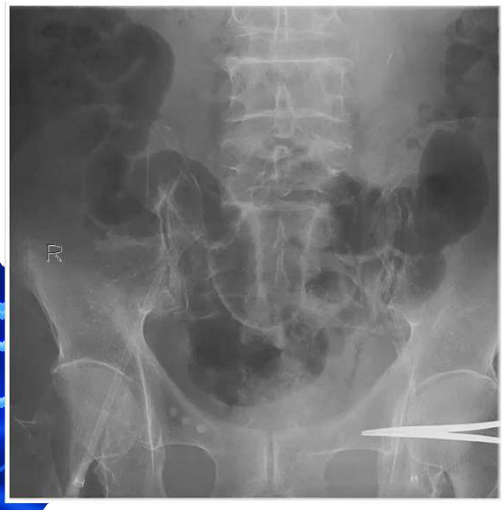
EVAR(Endovascular Aneurysm Repair)



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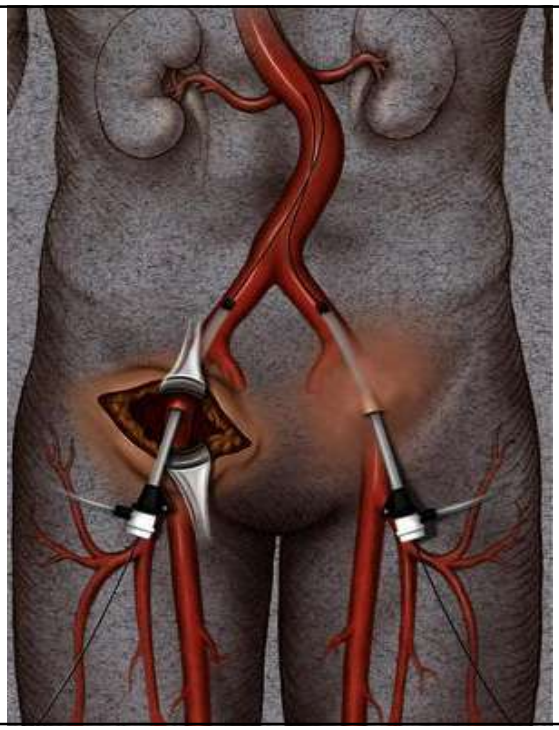
Femoral access:
- Surgical cutdown
- Percutaneous



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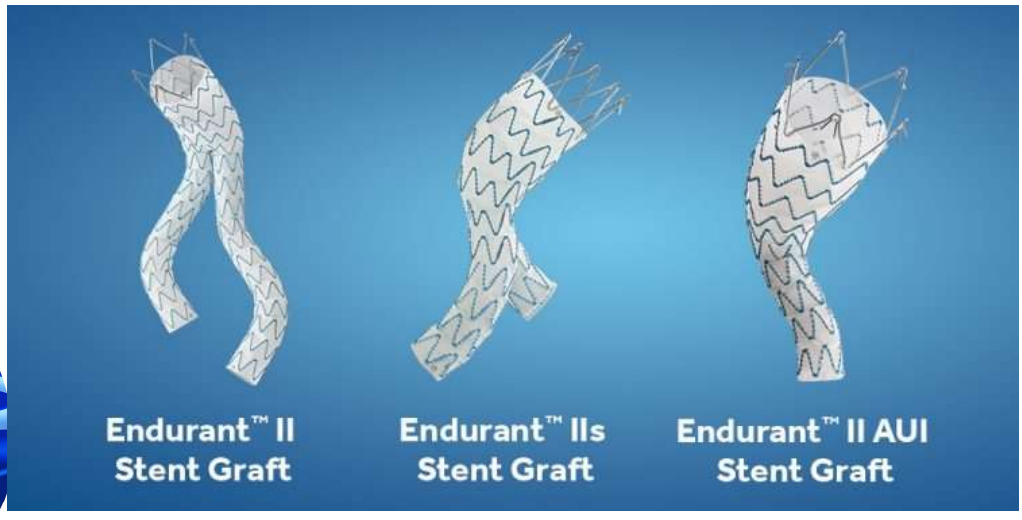
Medtronic



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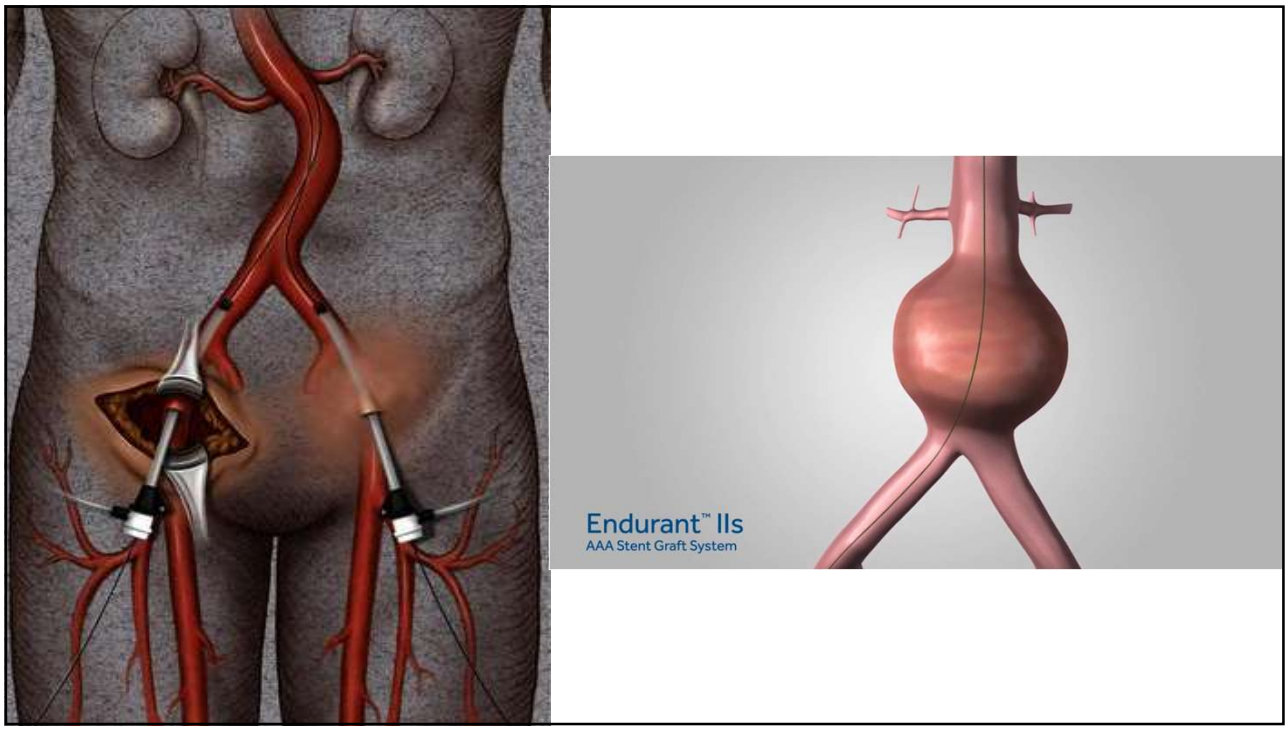

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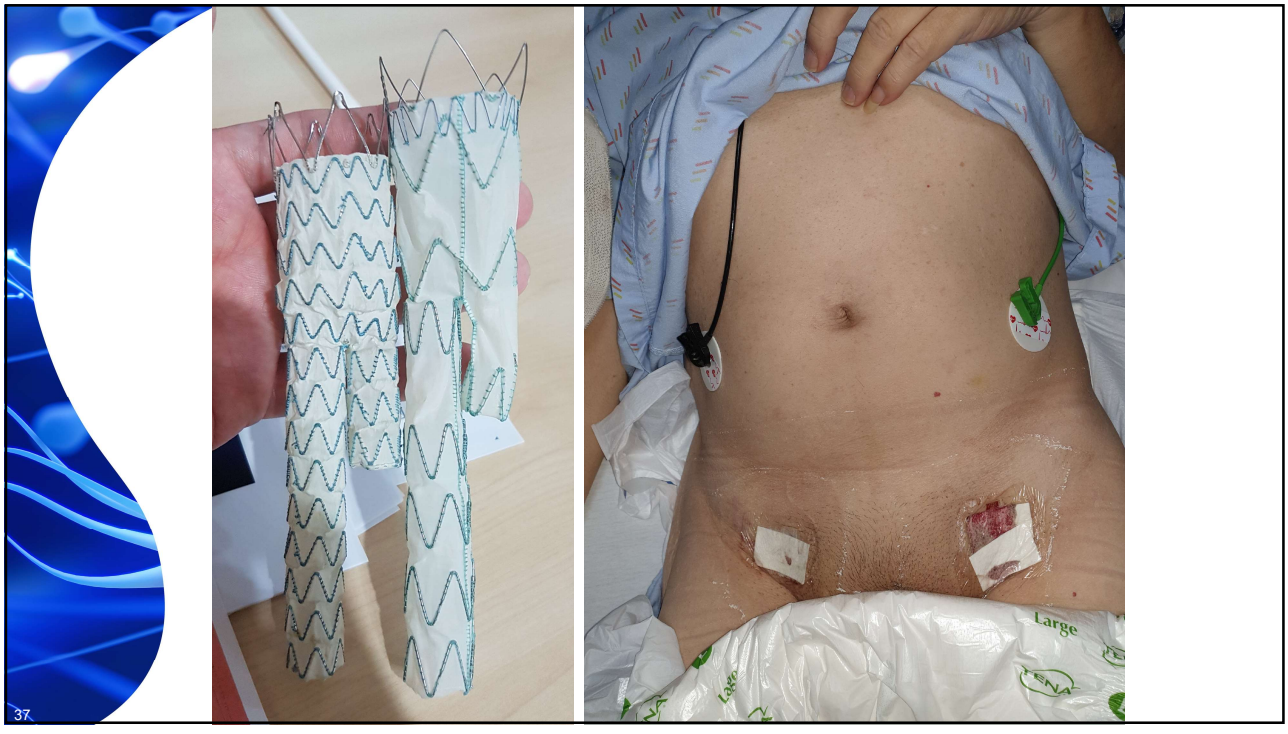

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Outcomes

- EVAR is associated with a threefold reduction in perioperative mortality compared with propensity-matched patients undergoing elective OSR[1] including even younger patients with fewer comorbidities[2,3].

1. Schermerhorn ML, O'Malley AJ, Jhaveri A, Cotterill P, Pomposelli F, Landon BE. Endovascular vs. open repair of abdominal aortic aneurysms in the Medicare population. N Engl J Med 2008;358:464-74.
2. Siracuse JJ, Gill HL, Graham AR, Schneider DB, Connolly PH, Sedrakyan A, et al. Comparative safety of endovascular and open surgical repair of abdominal aortic aneurysms in low risk male patients. J Vasc Surg 2014;60:1154-8.
3. Hicks CW, Wick EC, Canner JK, Black JH 3rd, Arhuidese I, Qazi U, et al. Hospital-level factors associated with mortality after endovascular and open abdominal aortic aneurysm repair. JAMA Surg 2015;150:632-6.

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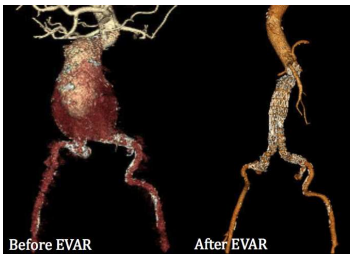
Causes of poor outcomes

- Cardiovascular and pulmonary disease are leading causes of early and late death
- Despite the reduced risk of EVAR vs Open repair, EVAR has moderate to high risk of complications
- Overall EVAR outcomes are superior to those achieved with contemporary open repair, especially if done under LA/RA



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Complications of EVAR

- Endoleaks
- Distal microembolisation – trash feet
- Endograft limb occlusion
- Access site complications e.g. pseudoaneurysms
- Graft migration / component separation
- Ischemic colitis → flexible sigmoidoscopy!
- Post-implantation syndrome
- Graft infection

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Complications of EVAR

- Pneumonia
- Renal failure / CIN
- AMI
- Deep vein thrombosis
- Conversion to open
- Laparotomy-related complications due to open conversion
  - Adhesive bowel obstruction
  - Incisional hernia~ 10% within 6 years
  - >20% of patients treated by OSR require reoperations within 8 years
- Mandatory postoperative surveillance – annual reintervention rate 10%

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Surveillance

- Goal of postoperative surveillance = Prevent late rupture and aneurysm-related death
  - Late rupture 8 years after EVAR is >5%
- Anastomotic aneurysm or aneurysmal dilation in the adjacent visceral aorta or iliac arteries may occur

Year	5	10	15
Incidence (%)	1	5	20

- Abdominal and pelvic CT imaging is recommend every 5 years after OSR

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EVAR Surveillance

- CT at 1 / 6 / 12 months and yearly thereafter
- 6-month CT scan can be eliminated if the 1-month scan shows no concerning endoleak or sac enlargement.
- Further surveillance with ultrasound is safe if CT at 1 year demonstrates
  - No endoleak and stable sac size
  - Type II endoleak and a stable aneurysm size
- New endoleak, graft migration, or aneurysm sac growth >5 to 10 mm should prompt further evaluation with a CT scan

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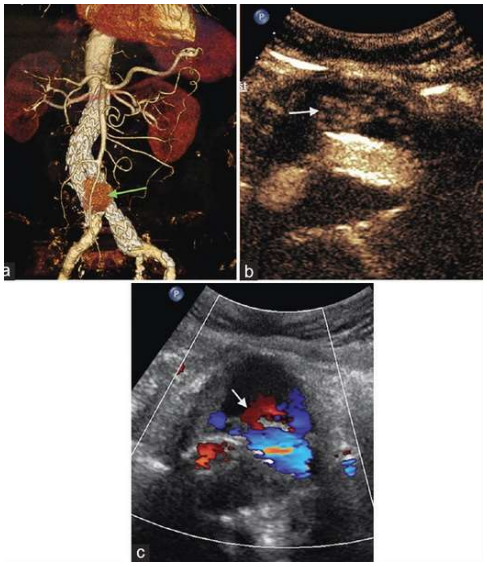
EVAR Surveillance

- Contrast-enhanced ultrasound (CEUS) accurate in detecting type I and type III endoleaks as well as sac enlargement
  - Eliminates ionizing radiation exposure
  - Less costly
  - Avoids risk of contrast nephropathy



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Emergency Management Of Ruptured AAA

- Active bleeding is arrested by hypotension and tamponade by posterior parietal peritoneum
- Permissive hypotension → minimal resuscitation
- Urgent CT aortogram vs. Straight to OT
- **rEVAR** vs. Open repair
- Endovascular first approach with improving 5 year survival rates following EVAR of rAAA

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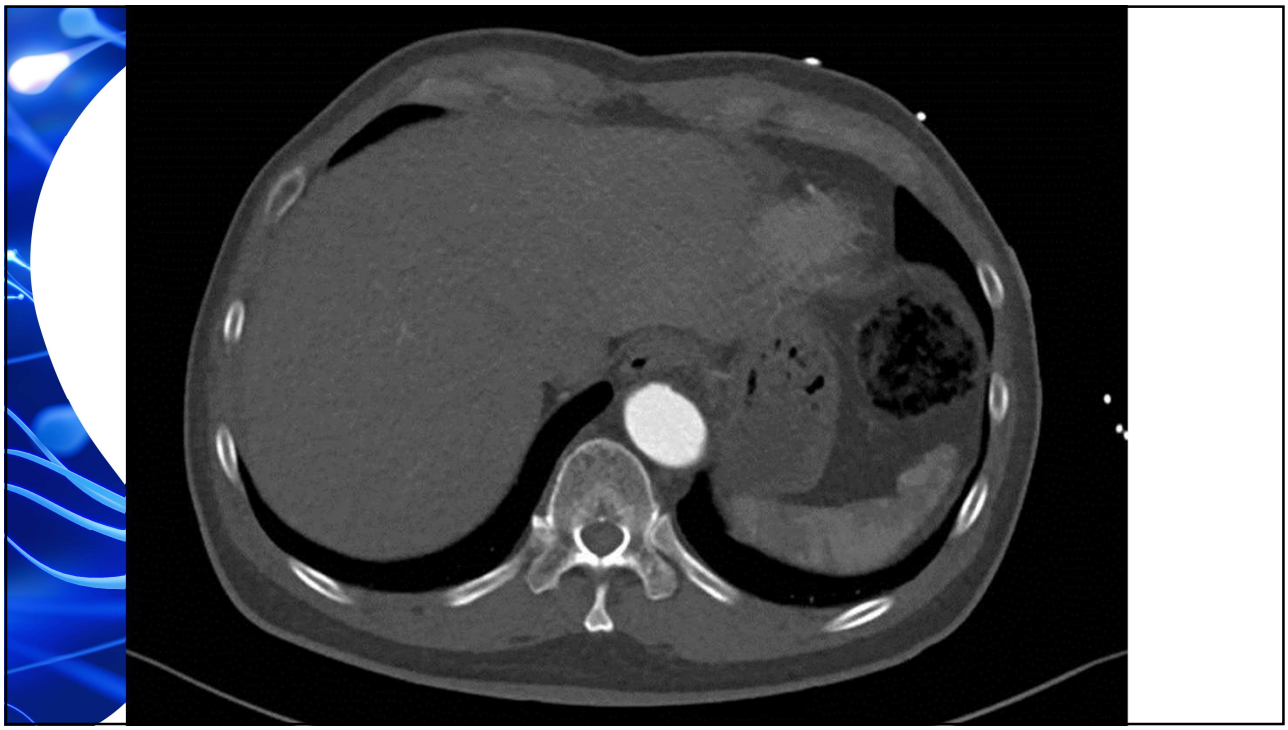

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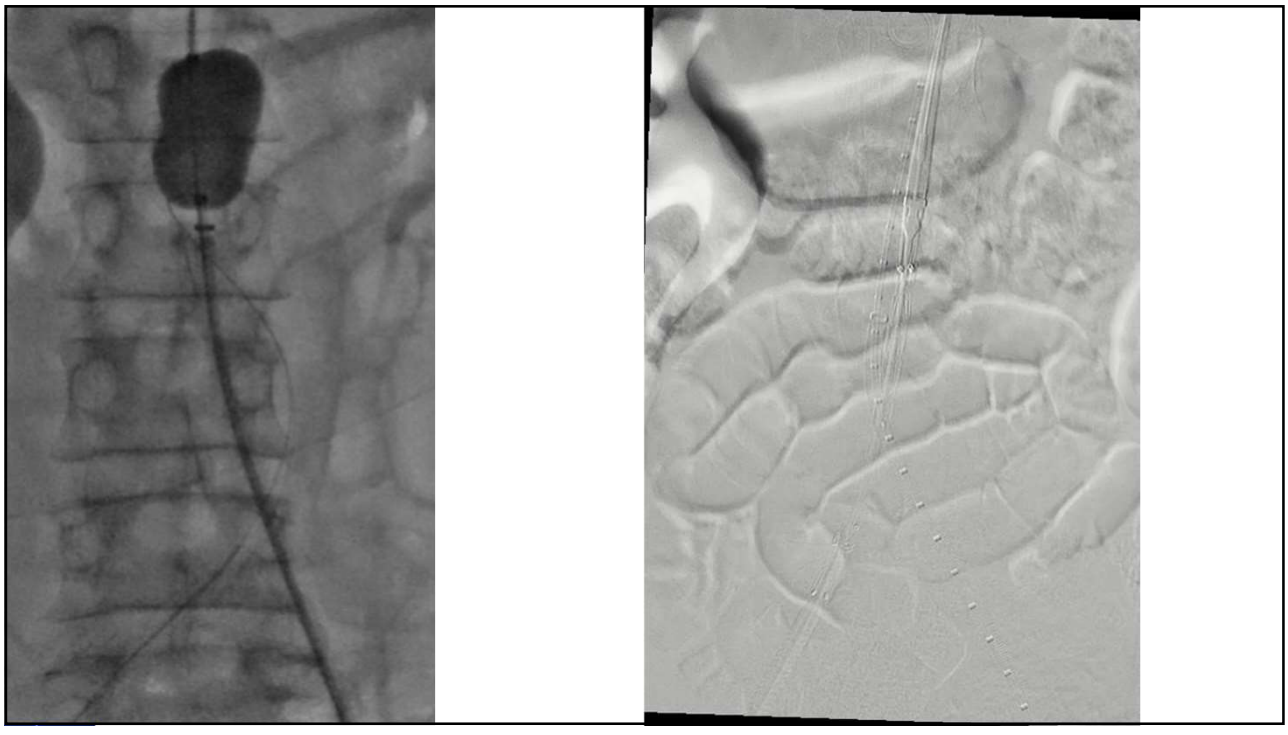

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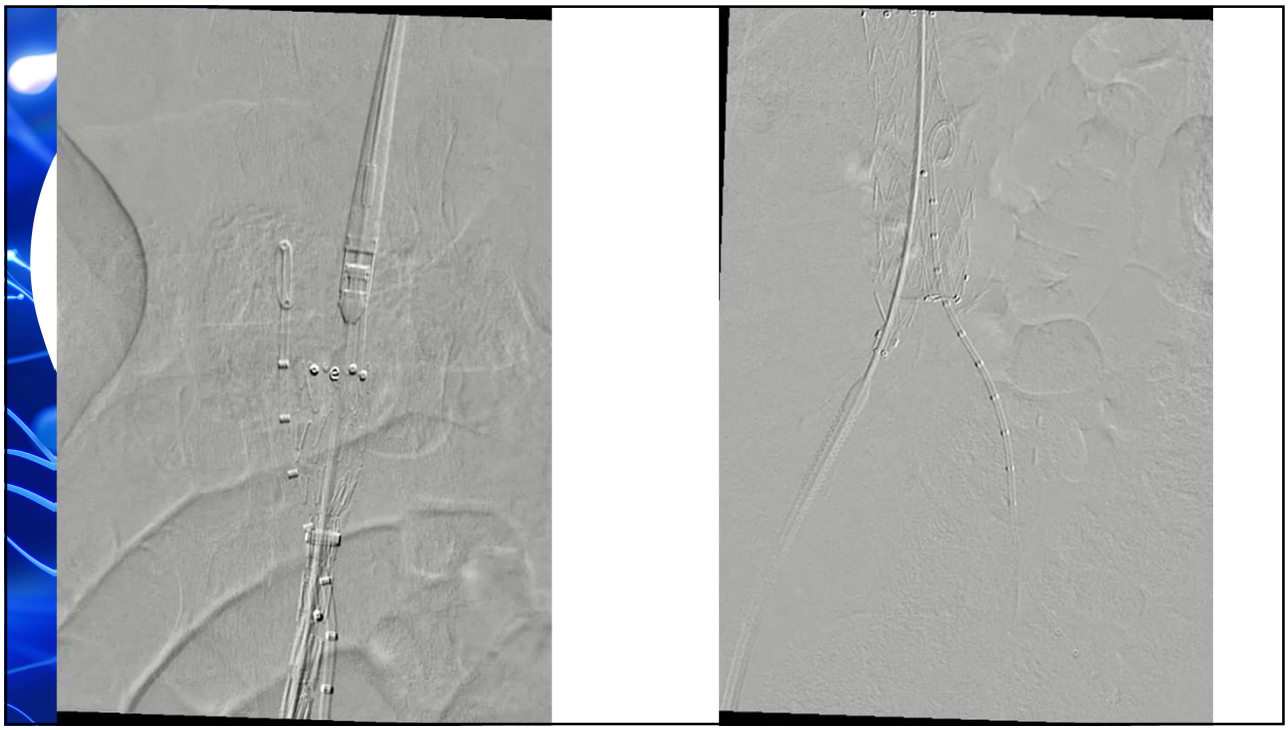

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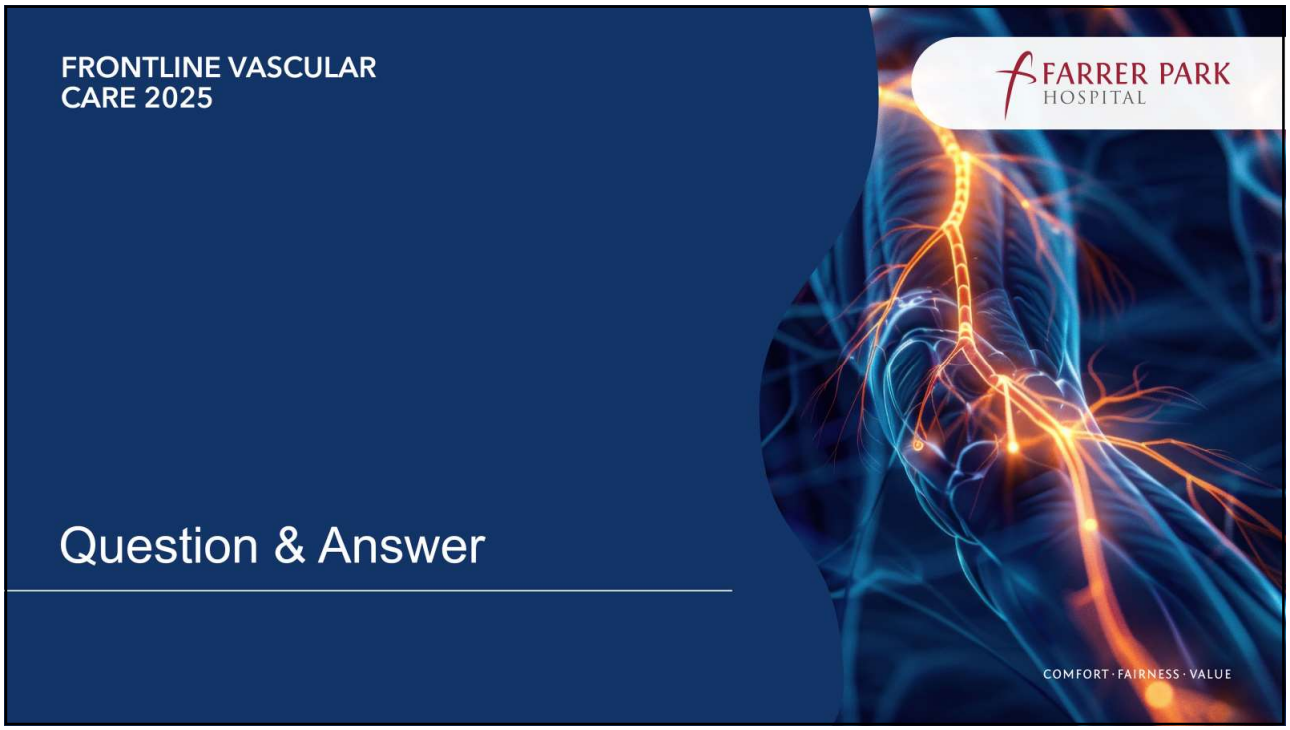
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Question & Answer
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