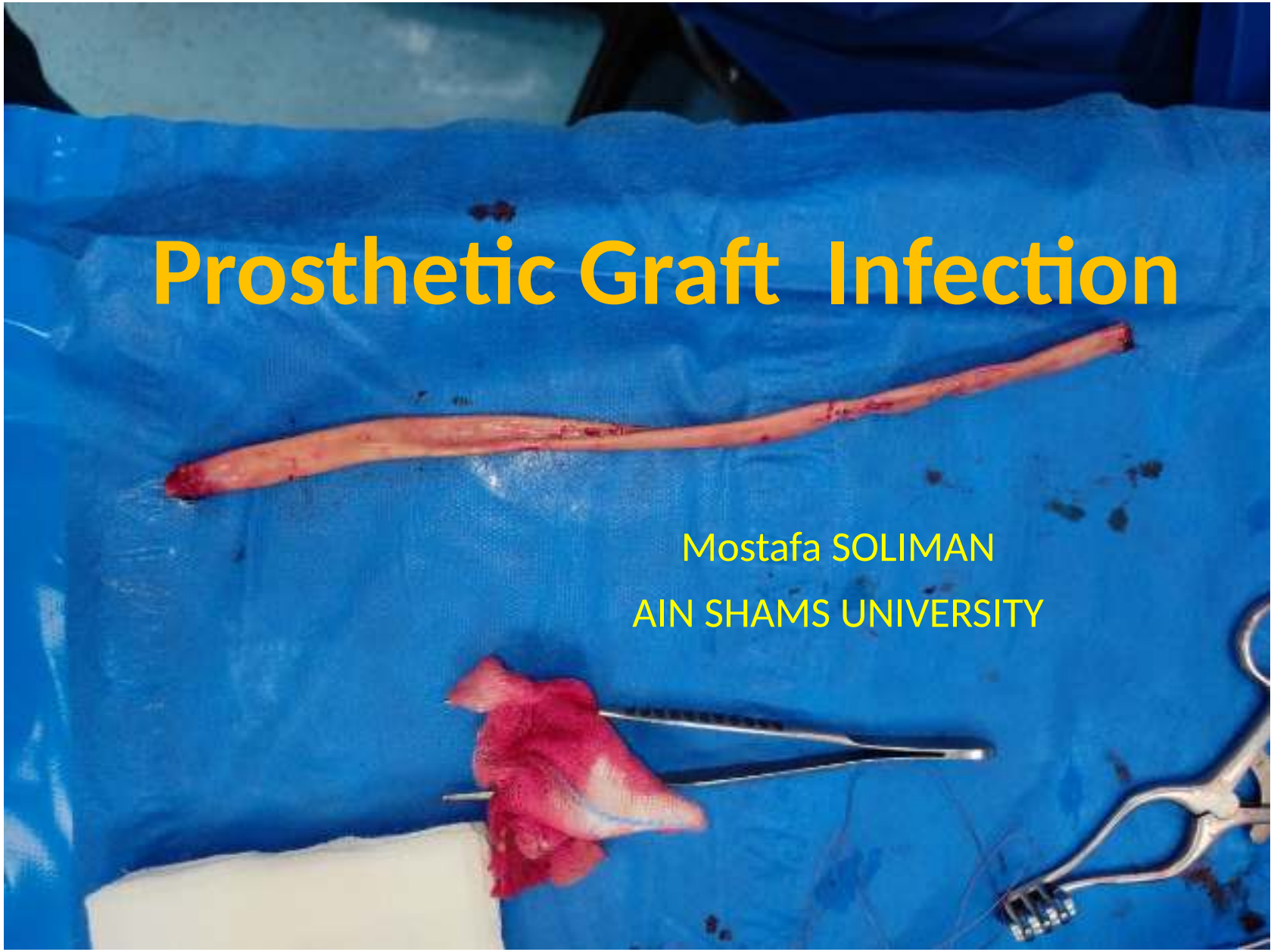
# GUIDELINES

**Table 1.** Level of evidence

| | |
|---|---|
| Level of evidence A | Data derived from multiple randomized clinical trials or meta analyses. |
| Level of evidence B | Data derived from a single randomized clinical trials or large non-randomized studies. |
| Level of evidence C | Consensus of opinion of the experts and/or small studies, retrospective studies, registries. |

**Table 2.** Classes of recommendations

| Classes of recommendations | Definition |
|---|---|
| Class I | Evidence and/or general agreement that a given treatment or procedure is beneficial, useful, effective. |
| Class II | Conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of the given treatment or procedure. |
| *Class IIa* | *Weight of evidence/opinion is in favour of usefulness/efficacy.* |
| *Class IIb* | *Usefulness/efficacy is less well established by evidence/opinion.* |
| Class III | Evidence or general agreement that the given treatment or procedure is not useful/effective, and in some cases may be harmful. |



# Prosthetic Graft Infection

Mostafa SOLIMAN

AIN SHAMS UNIVERSITY

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# Prosthetic Graft  Infection

- How to report ?
  - Time. ( in relation to insertion )
  - Depth
  - Extent

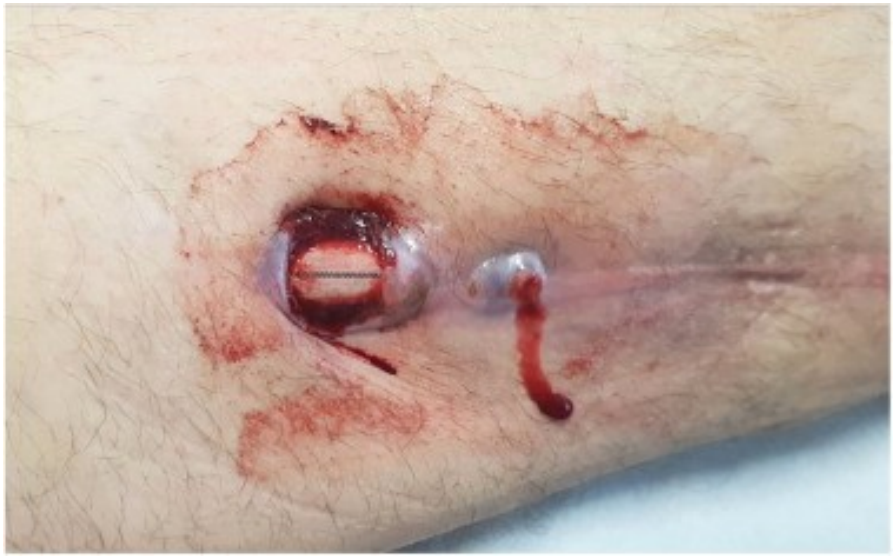
- How to diagnose ?
- How to confirm ?
- How to deal with ?

How to report ?

- Time. ( in relation to insertion )

- **Incidence :**
  - around 1- 5 %
- **CLINICAL CLASSIFICATIONS OF PROSTHETIC GRAFT INFECTIONS**

1. **TIME OF APPEARANCE AFTER IMPLANTATION**
   - Early: <4 mo
   - Late: >4 mo



## CLINICAL CLASSIFICATIONS OF PROSTHETIC GRAFT INFECTIONS

## How to report ?

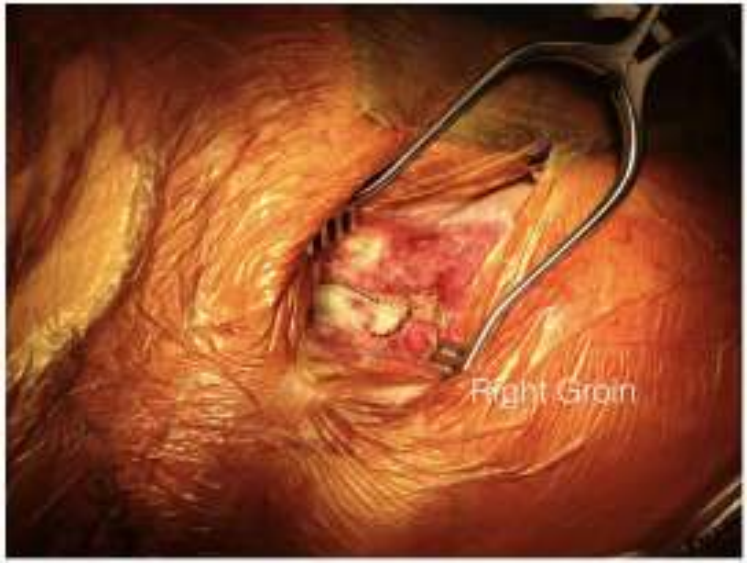
- Depth

### 2. RELATIONSHIP TO POSTOPERATIVE WOUND INFECTION

**(SZILAGYI'S CLASSIFICATION) & (SAMSON"S CLASSIFICATION)**

- Grade I: cellulitis involving the wound

| |
|---|
| *Szilagyi classification:* |
| Grade I: cellulitis involving the wound |
| Grade II: infection involving subcutaneous tissue |
| Grade III: infection involving the vascular prosthesis |
| *Samson classification:* |
| Group 1: no deeper than dermis |
| Group 2: subcutaneous tissue, no direct contact with the graft |
| Group 3: body of graft but not anastomosis |
| Group 4: exposed anastomosis, no bleeding, no bacteraemia |
| Group 5: anastomosis involved, bleeding, bacteraemia |



## 3. EXTENT OF GRAFT INVOLVEMENT (BUNT'S CLASSIFICATION MODIFIED)

How to report ?
➢ Extent

- **P0 graft infection**: Cavitary Graft Infection

  (aortic arch; abdominal and thoracic aortic interposition; aortoiliac, aortofemoral, iliofemoral graft infections)

- **P1 graft infection**: Noncavitary Graft Infection (entire anatomic course)

  (carotid-subclavian, axilloaxillary, axillofemoral, femorofemoral, femorodistal, dialysis access bridge graft infections)

- **P2 graft infection**: Extracavitary **P**ortion Infection of a graft whose origin is cavitary

  ( infected groin segment of an aortofemoral or thoracofemoral graft,

  cervical infection of an aortocarotid graft)

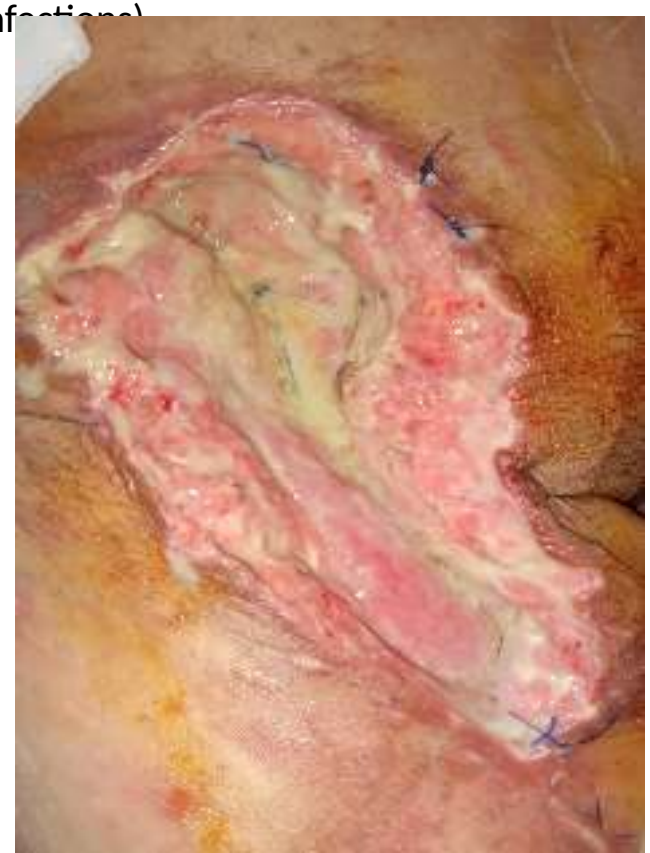
- **P3 graft infection:** Prosthetic Patch Infection

  (carotid and femoral endarterectomies with prosthetic patch closure)

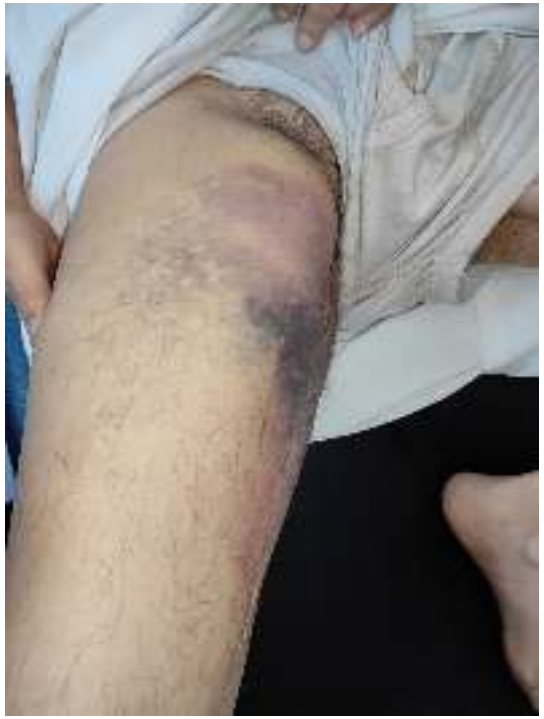
- **Graft-enteric erosion (GEE)**

- **Graft-enteric fistula (GEF)**

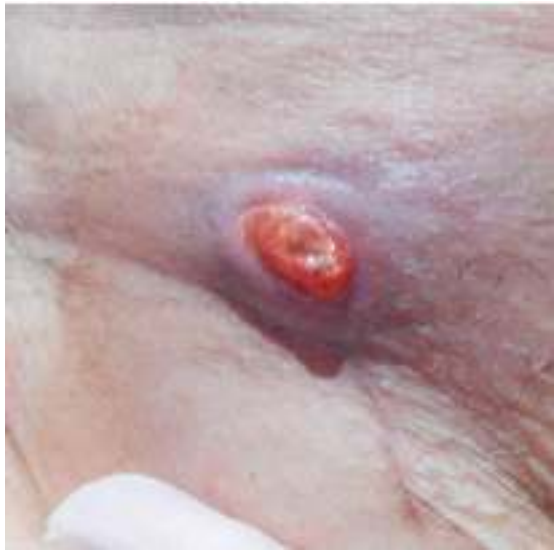
- **Aortic stump sepsis after excision of an infected aortic graft**



# How to diagnose ?



1. **Clinical manifestation:**
    a. Unexplained fever sepsis, ileus, or abdominal distention
    b. In groin involvement : The initial sign of infection is usually overlying inflammation/ cellulitis, cutaneous draining sinus tract, or anastomotic pseudoaneurysm.



    c. Any patient with gastrointestinal bleeding and an aortic graft should be presumed to have graft infection and GEE/GEF until either another source of bleeding is conclusively identified on endoscopy or no graft-bowel communication is verified at surgery.

# How to diagnose ?

2. **Labs:**
   a. An elevated WBC count with a left-shifted differential count and an increased erythrocyte sedimentation rate
   b. Positive blood culture results are uncommon (<5%) but, when present, indicate an advanced graft infection or virulent organisms (or both).

# Microbiological diagnosis is important

How to diagnose ?

- Early graft infections (<3 months) any type of bacteria or fungi

  obvious signs of infections, such as :

  ( fever and sepsis, wound infections, and signs of peri-graft infection ).

- Late graft infections (>3 months) Staphylococcal organisms

  low grade infections predominantly with local symptoms :

  (fistula , peri-aortic gas and pseudoaneurysm formation )

  often with normal laboratory parameters.

| Recommendation 3 | | |
|---|---|---|
| **To obtain microbiological proof of vascular graft/endograft infection, the yield of at least three deep rather than superficial samples should be considered.** | | |
| **Class** | **Level** | **References** |
| IIa | C | Baron *et al.* (2013),[21] Padberg *et al.* (1995)[23] |

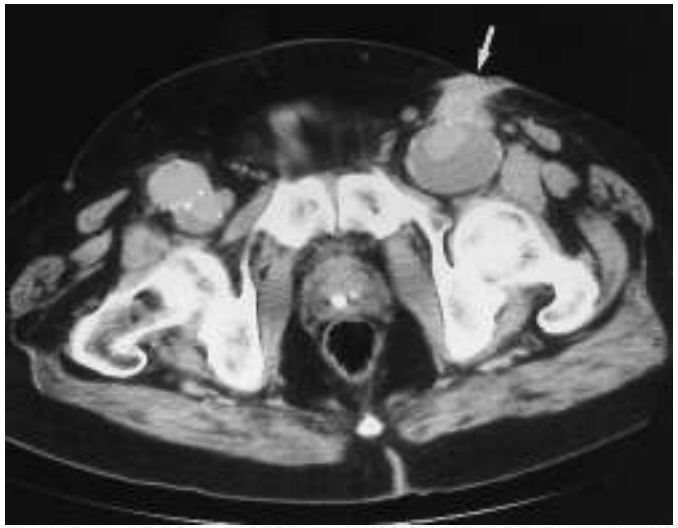
# How to diagnose ?

**3. Ultrasonography:**

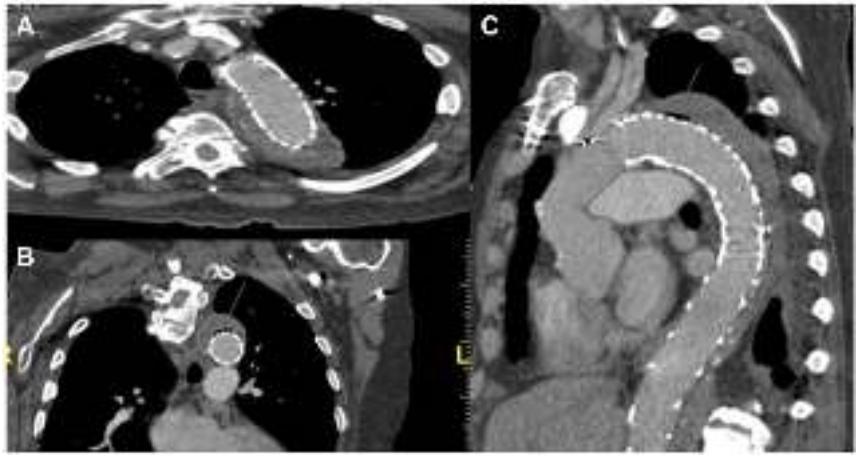
- Color duplex scanning can reliably differentiate a perigraft fluid collection from an anastomotic pseudoaneurysm, hematoma, and soft tissue masses (e.g., enlarged lymph nodes).
- Diagnostic accuracy depends on the skill of the examiner and the ability to adequately image the graft. Imaging of the graft within the abdominal cavity can be obscured by intestinal gas and obesity.
- Ultrasonography has the advantage of being the most accurate vascular imaging technique for verifying vessel or graft patency and assessing pulsatile masses adjacent to grafts in the groin and limbs.

# How to diagnose ?

**4. CT & PET-CT , SPECT-CT**



- Diagnostic criteria consistent with infection include:
  - the loss of normal tissue planes (e.g., fat density) of the retroperitoneal or subcutaneous perigraft structures (indicative of inflammation),
  - collections of fluid or gas around the graft,
  - false aneurysm formation, and
  - adjacent vertebral or bony osteomyelitis.




- Any gas in periprosthetic tissues beyond 2 or 3 months after implantation is an abnormal CT finding suggestive of graft infection.
- CT angiography provides assessment of continuity of the arterial lumen, associated distribution of occlusive disease, and the presence of thrombus at planned clamp sites and may enable operative planning for arterial reconstruction.

# How to diagnose ?

- CT scan is important tool for diagnosis esp. in advanced case of infection with 94% sensitivity and specificity

  decreased to 64% in low grade infections.

| Recommendation 7 | | |
|---|---|---|
| **For suspected vascular graft/endograft infection, CTA is recommended as the first line diagnostic modality.** | | |
| **Class** | **Level** | **References** |
| I | B | Reinders Folmer *et al.* (2018)[37] |

# How to diagnose ?

**5. MRI:**

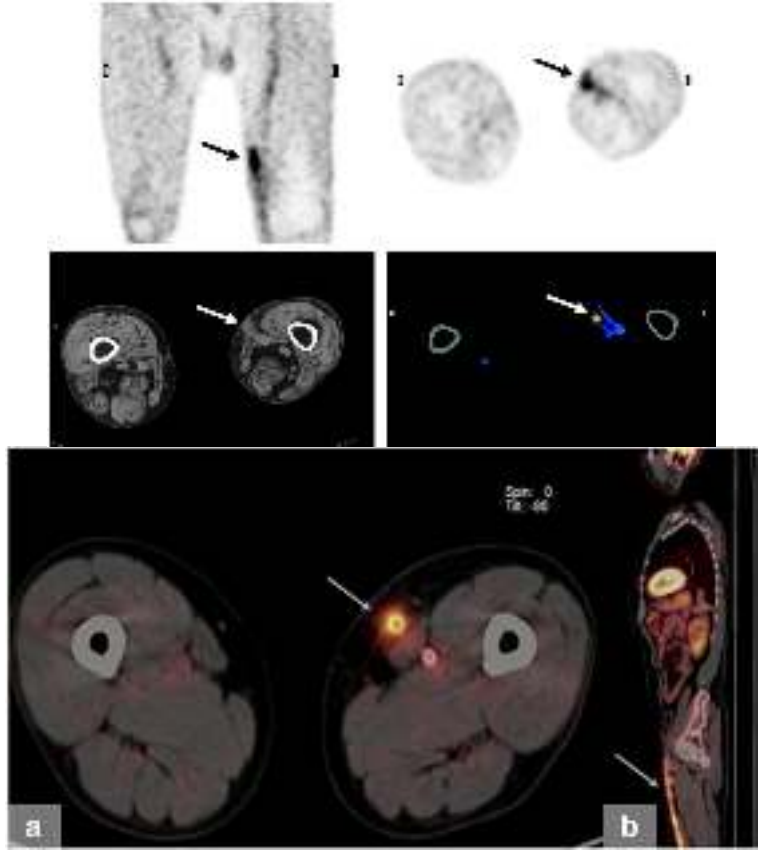
MRI provides anatomic imaging equivalent to that of CT but is better able to distinguish between perigraft fluid and fibrosis on the basis of differences in signal intensity between T1- and T2-weighted images.

| Recommendation 8 | | |
|---|---|---|
| **For patients suspected of vascular graft/endograft infection, if CTA is contra-indicated, the use of MRA may be considered.** | | |
| **Class** | **Level** | **References** |
| IIb | C | Shahidi *et al.* (2007)[38] |

# How to confirm ?

- PET combined with CT scanning is a reliable non-invasive imaging modality with a sensitivity of 77-93% and a specificity of 70-89%.

- A focal fluoro-deoxyglucose (FDG) uptake with a SUV value > 8 in agreement with the clinical picture > 4-6 mo post-operatively is a strong indicator of graft infection.




**Recommendation 9**

**For patients with a clinical suspicion of vascular graft/endograft infection and with non-convincing findings on CTA, the use of 18F-FDG-PET combined with low dose CT is recommended as an additional imaging modality to improve diagnositc accuracy.**

| Class | Level | References |
|---|---|---|
| I | B | Reinders Folmer *et al.* (2018)[37] |

**Recommendation 10**

**In patients with a clinical suspicion of peripheral vascular graft/endograft infection, single photon emission computed tomography, if available, is recommended as an additional imaging modality to improve diagnostic accuracy.**

| Class | Level | References |
|---|---|---|
| I | B | Reinders Folmer *et al.* (2018)[37] |

# Algorithm

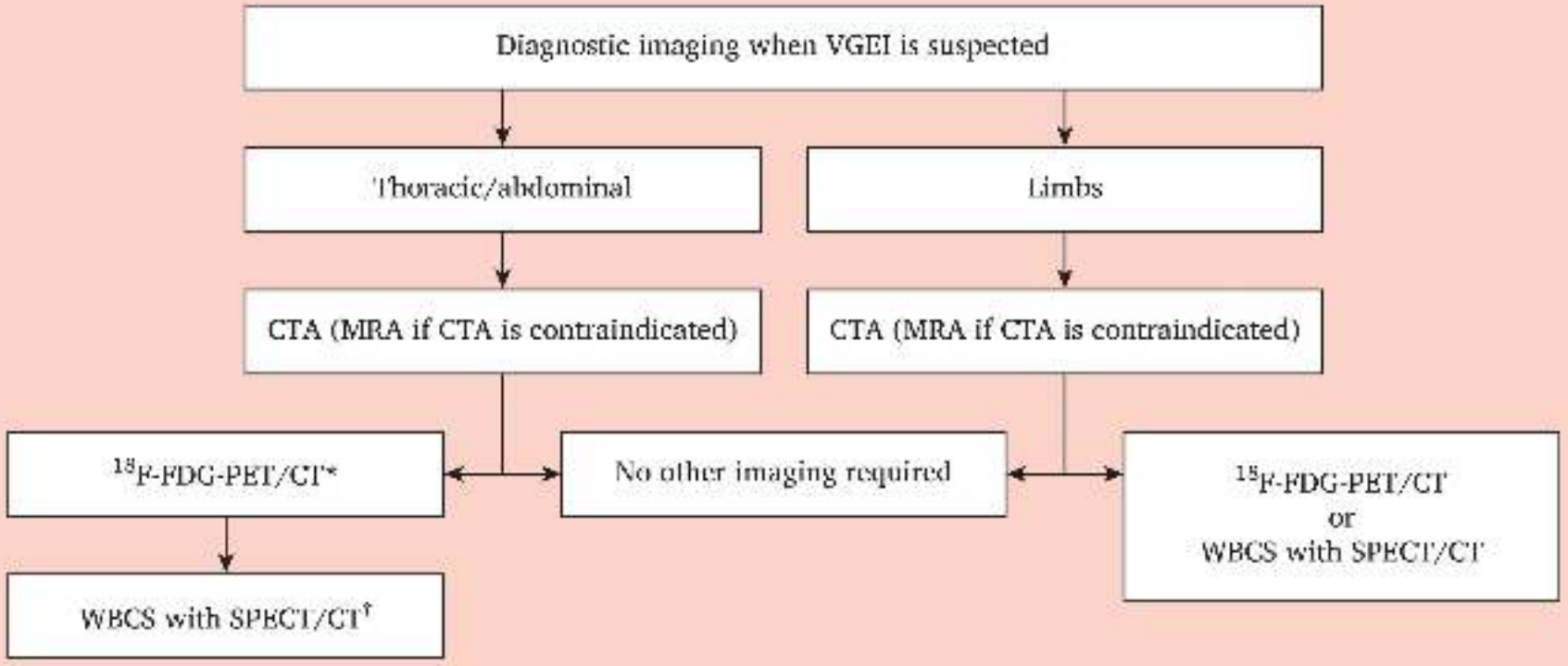



**Figure 2.** Imaging workflow if vascular graft/endograft infection (VGEI) is suspected, divided into thoracic/abdominal and limb grafts. CTA – computed tomography angiography; MRA – magnetic resonance angiography; $^{18}$F-FDG-PET/CT – $^{18}$F-fluoro-D-deoxyglucose positron emission tomography/computed tomography; WBCS – white blood cell scintigraphy; SPECT/CT – single photon emission computed tomography/computed tomography. *$^{18}$F-FDG PET/CT can add more information, particularly in inconclusive CT. In some high grade infection cases a second imaging modality as 18F-FDG PET/CT and/or WBCS combined with SPECT/CT may be useful to map the extent of the infection. †WBCS can be applied if available otherwise, $^{18}$F-FDG PET/CT can be used.

# Final Report

**Table 5. The MAGIC classification**[1]

| Criterion | Clinical/surgical | Radiology | Laboratory |
|---|---|---|---|
| *Major* | | | |
| | Pus (confirmed by microscopy) around graft or in aneurysm sac at surgery | Perigraft fluid on CT scan ≥ 3 months after insertion | Organisms recovered from an explanted graft |
| | Open wound with exposed graft or communicating sinus | Perigraft gas on CT scan > 7 weeks after insertion | Organisms recovered from an intra-operative specimen |
| | Fistula development, e.g., aorto-enteric or aortobronchial | Increase in perigraft gas volume demonstrated on serial imaging | Organisms recovered from a percutaneous, radiologically guided aspirate of perigraft fluid |
| | Graft insertion in an infected site, e.g., fistula, mycotic aneurysm, or infected pseudo-aneurysm | | |
| *Minor* | | | |
| | Localised clinical features of graft infection, e.g., erythema, warmth, swelling, purulent discharge, pain | Other, e.g., suspicious perigraft gas/fluid soft tissue inflammation; aneurysm expansion; pseudo-aneurysm formation; focal bowel wall thickening; discitis/osteomyelitis; suspicious metabolic activity on FDG-PET/CT; radiolabelled leukocyte uptake | Blood culture(s) positive and no apparent source except graft infection |
| | Fever >38°C with graft infection as most likely cause | | Abnormally elevated inflammatory markers with graft infection as most likely cause, e.g., erythrocyte sedimentation rate, C reactive protein, white cell count |

CT = computed tomography; FDG-PET/CT = 18F-fluoro-D-deoxyglucose positron emission tomography/computed tomography

# How to deal with ?

## Graft infection

- 0.3% - 6% after OSR.  0.2 - 1% after EVAR.

Serious , high morbidity and mortality of aortic graft infections

(20 - 75% combined morbidity and mortality in various series)

So, we have to know ???

How to deal with ?

# What are ?

## The Risk factors

| Table 6. Risk factors for vascular graft/endograft infection[6,7] |
|---|
| *Pre-operative risk factors* |
| Prolonged pre-operative hospitalisation |
| Infection in a remote or adjacent site |
| Recent percutaneous arterial access at the implant site |
| Emergency/urgent procedure |
| Re-intervention |
| Lower limb infection (ulcer, gangrene, cellulitis) |
| Groin incision |
| *Intra-operative risk factors* |
| Breach in aseptic technique |
| Prolonged operation time |
| Concomitant gastrointestinal or genitourinary procedure |
| *Post-operative risk factors* |
| Post-operative wound complications (infection, skin necrosis, lymphocoele, seroma, haematoma) |
| Graft thrombosis |
| *Patient related risk factors/altered host defences* |
| Malignancy |
| Lymphoproliferative disorder |
| Immune disorders |
| Corticosteroid administration |
| Chemotherapy |
| Malnutrition |
| Diabetes mellitus/peri-operative hyperglycaemia |
| Chronic renal insufficiency/end stage renal disease |
| Liver disease/cirrhosis |
| Immunosuppression by non-suspended anti-tumour necrosis factor alpha |

How to deal with ?

# Avoid ?

**Recommendation 81**

In patients with previous abdominal aortic aneurysm repair antibiotic prophylaxis should be considered in conjunction with high risk infectious procedures, including abscess drainage, dental procedures requiring manipulation of the gingival or peri-apical region of the teeth or breaching the oral mucosa, as well as in immuno-compromised patients undergoing surgical or interventional procedures

| Class | Level | References |
|---|---|---|
| IIa | C | [535,380,536] |

**Recommendation 80**

In patients with previous abdominal aortic aneurysm repair routine use of antibiotic prophylaxis in conjunction with dental or other surgical procedures for prevention of graft infection is not recommended

| Class | Level | References |
|---|---|---|
| III | C | [535,380,536] |

**Recommendation 12**

Before implantation of any vascular graft/endograft, elimination of any potential source of sepsis, especially of dental origin, should be considered.

| Class | Level | References |
|---|---|---|
| IIa | C | Habib *et al.* (2015)[63] |

**Recommendation 11**

In every case where a vascular graft/endograft is implanted, antimicrobial prophylaxis to cover the first 24 hours, by intravenous administration of a first/second generation cephalosporin or vancomycin in the event of penicillin allergy, is recommended.

| Class | Level | References |
|---|---|---|
| I | A | Stewart *et al.* (2007)[56] |

# Aggressive treatment is important

## Treatment options

1. **Graft preservation/ local therapy**:

   Early infection, no sepsis Not Dacron, graft body only, no anastomosis, segmental

2. **Graft excision only**:

   Graft thrombosis, viable limb, adequate collateral

3. **Excision and ex situ bypass**:
   1. Simultaneous:
   2. Staged:

4. **In situ replacement**:
   3. Prosthetic: No sepsis, no GEE/GEF Biofilm infection
   4. Autologous vein (neo-aortic graft reconstruction using SFV
      GEE/GEF, severe occlusive disease
   5. Antibiotic impregnated grafts
   6. Cryopreserved arterial allografts

5. **Adjuncts:**
   7. Parenteral Antibiotics
   8. Antibiotic-loaded beads
   9. Local muscle coverage

**Recommendation 77**

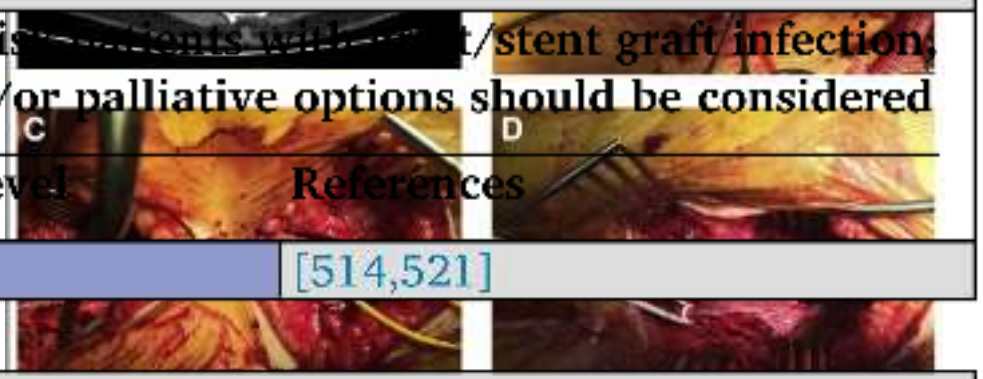
For radical treatment of aortic graft or stent graft infection complete graft/stent graft explantation is recommended

| Class | Level | References |
|---|---|---|
| I | C | [514,521] |

**Recommendation 78**

In selected high ri[illegible]/stent graft infection, conservative and/or palliative options should be considered

| Class | Level | References |
|---|---|---|
| IIa | C | [514,521] |




**Recommendation 79**

In situ reconstruction with prosthetic material is not recommended in heavily contaminated or infected areas

| Class | Level | References |
|---|---|---|
| III | C | [521] |

# THANK YOU