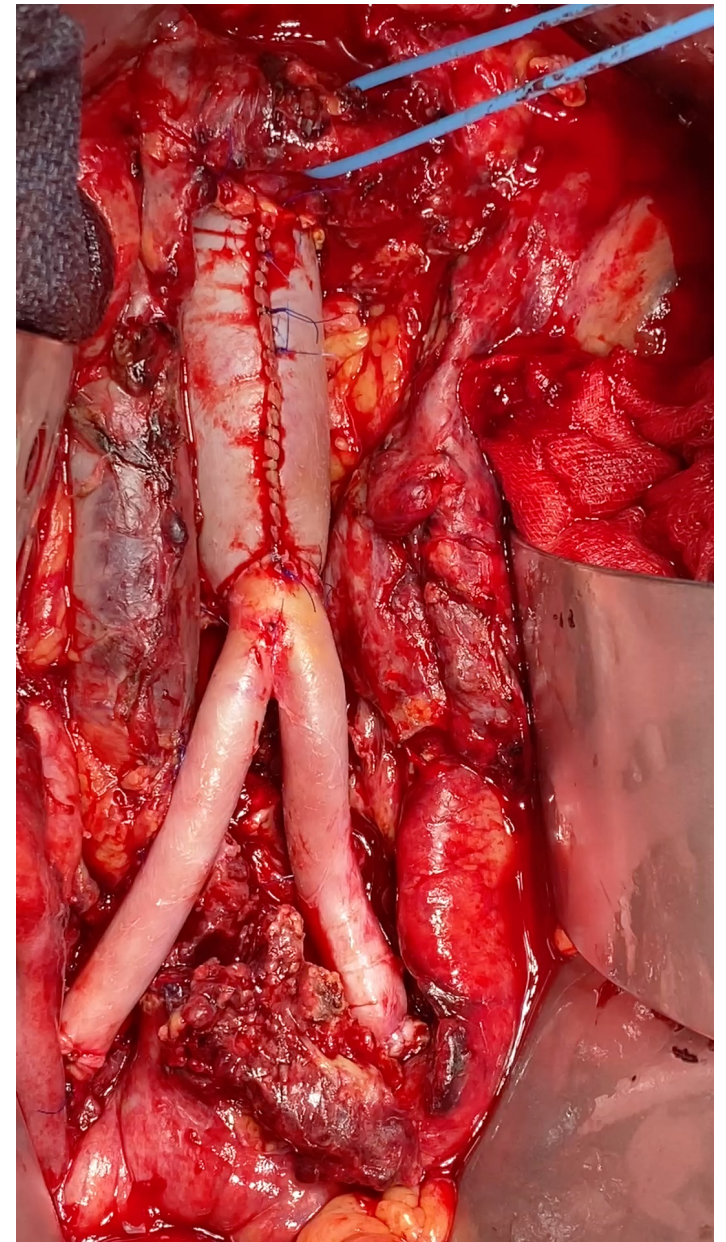
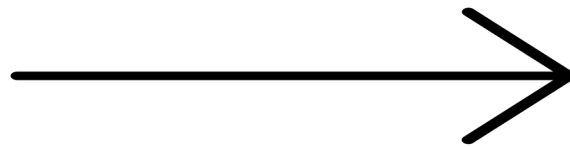




Infections Primitives de l'Aorte



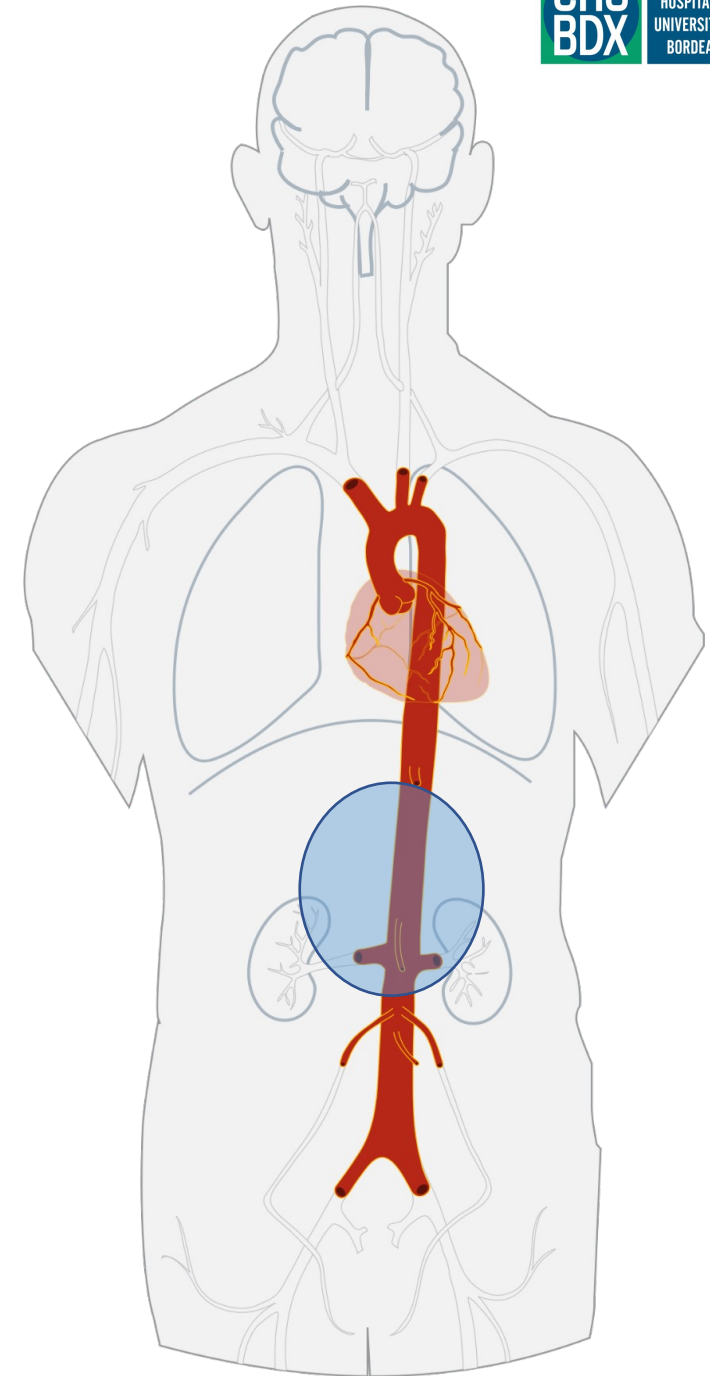
Xavier Bérard

Définition & épidémiologie

- Called “*mycotic*” because of their *mushroom-like* appearance, but recent consensus proposed **Infected Native Aortic Aneurysm, INAA**
- Their incidence is up to **1.3%** of all aortic aneurysms in Western countries and reportedly higher in East Asia.
- Most patients are **male** (3:1) and tend to be **younger** (mean age **69-70 years**) than those with a degenerative non-infected aneurysm (74-78 years).

Anatomie

- The most common locations are in the **abdominal** aorta ($\approx 70\%$) and **thoracic** aorta ($\approx 30\%$); **visceral** MAs are rare (accounting for $<1\%$).
- 85% percent of atherosclerotic aortic aneurysms are located in the infrarenal segment, whereas most aortic MAs are **suprarenal**



Microbiologie

- *S. aureus* and and coagulase-negative staphylococci (at least 50-60%)
- Nontyphoid *Salmonella* (30-40%)
- Others
 - *Enterococcus species*
 - *Streptococcus pneumoniae*
 - *Clostridium species*
 - *Coxiella burnetii*
 - *Mycobacteria*
 - *Fungi (primary aorto-enteric fistula)*

Les recommandations

The main recommendations about mycotic aneurysms come from the **European** and the **American** Societies of Vascular Surgery

Although they do not sensibly differ in terms of content, they are discussed in the AAA treatment guidelines for the ESVS and in those of infected graft for **SVS**

Eur J Vasc Endovasc Surg (2019) 57, 8–93

Editor's Choice — European Society for Vascular Surgery (ESVS) 2019 Clinical Practice Guidelines on the Management of Abdominal Aorto-iliac Artery Aneurysms

AHA SCIENTIFIC STATEMENT

Vascular Graft Infections, Mycotic Aneurysms, and Endovascular Infections

A Scientific Statement From the American Heart Association

Diagnostic

Table 9.1. Suggested diagnostic criteria of mycotic aortic aneurysm.⁶⁸⁸

Combination of the following factors:

Clinical presentation	Abdominal/back pain Fever Sepsis/shock
Laboratory and culture	C-reactive protein ↑ Leucocytes ↑ Positive blood culture or aortic tissue culture
Radiologic findings on CT	Saccular/multi-lobular/eccentric Peri-aortic gas/soft tissue mass Rapid expansion (days) and/or rupture Atypical location (e.g. para-visceral) or multiple aneurysms in different locations

Recommendation 106

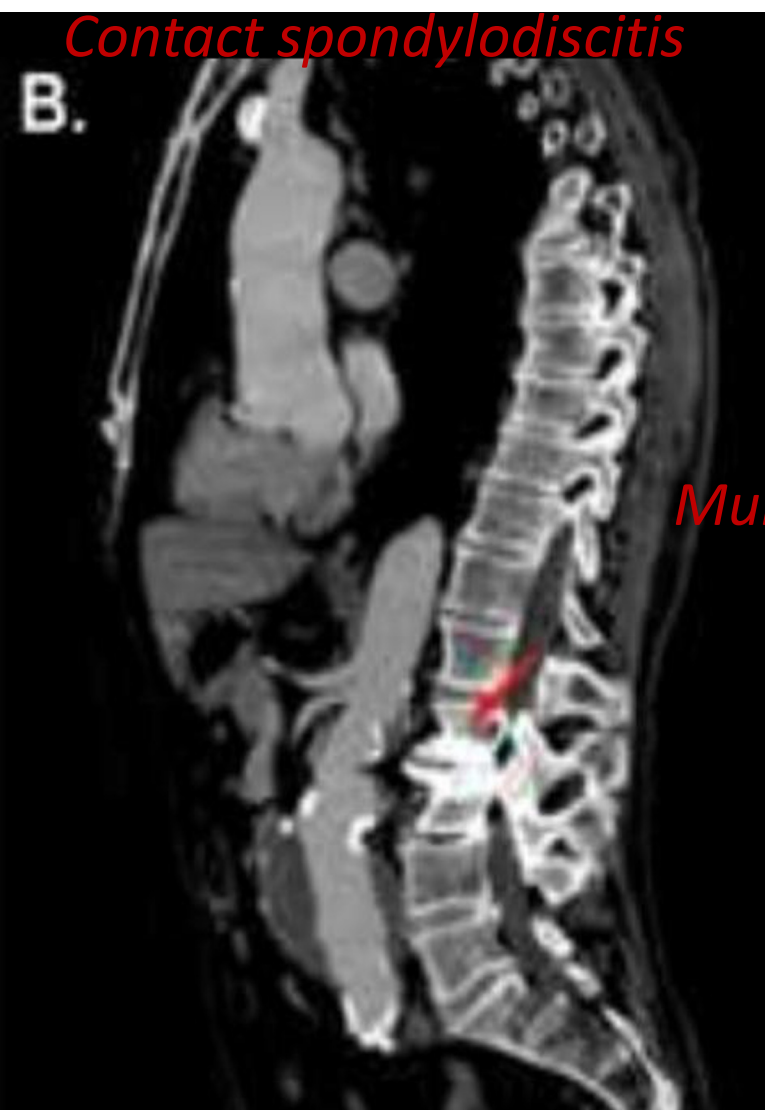
It is recommended that the diagnosis of a mycotic aortic aneurysm is based on a combination of clinical, laboratory, and imaging parameters

Class	Level	References
I	C	[692,689,690]

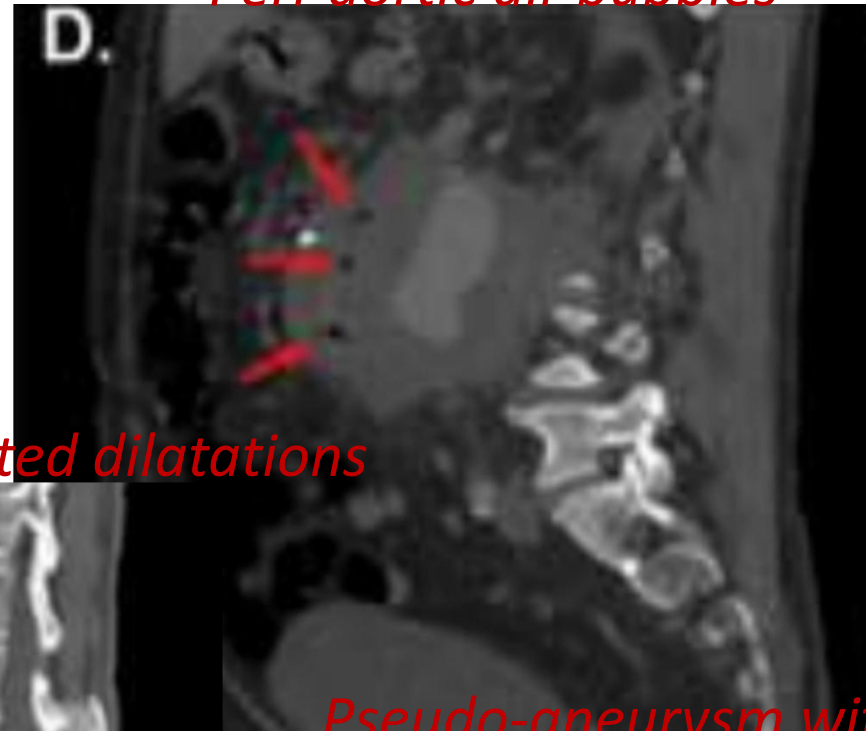
General Principles

1. Patients should be managed by a team of experts in vascular diseases and surgery, cardiology and cardiovascular surgery, critical care medicine (intensivists), radiology, infectious diseases, and microbiology in a facility with emergency access to these services (Class I; Level of Evidence C).

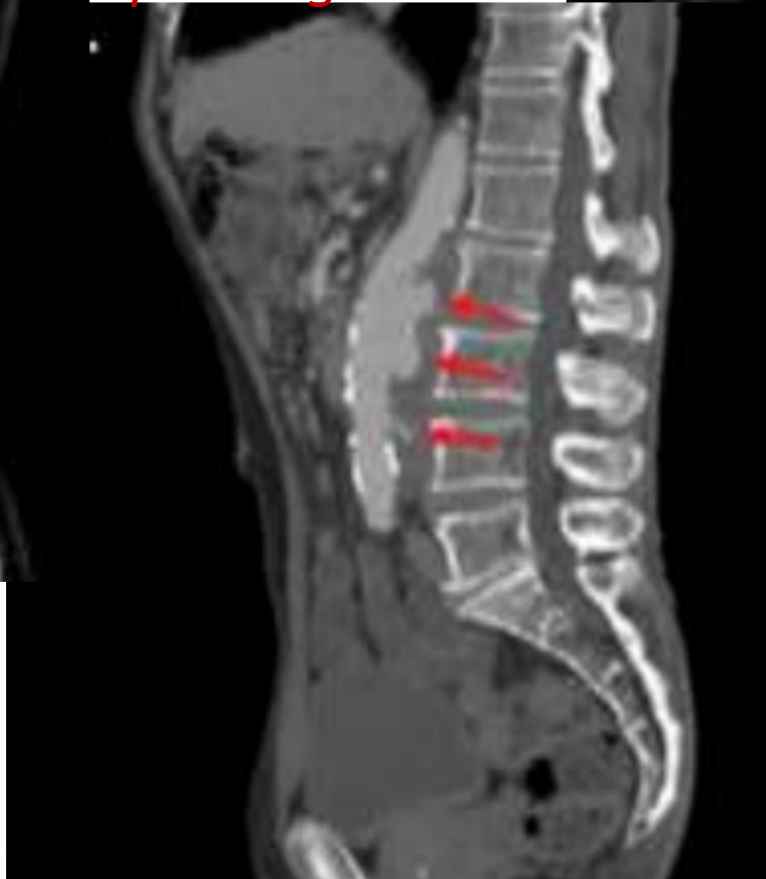
Contact spondylodiscitis



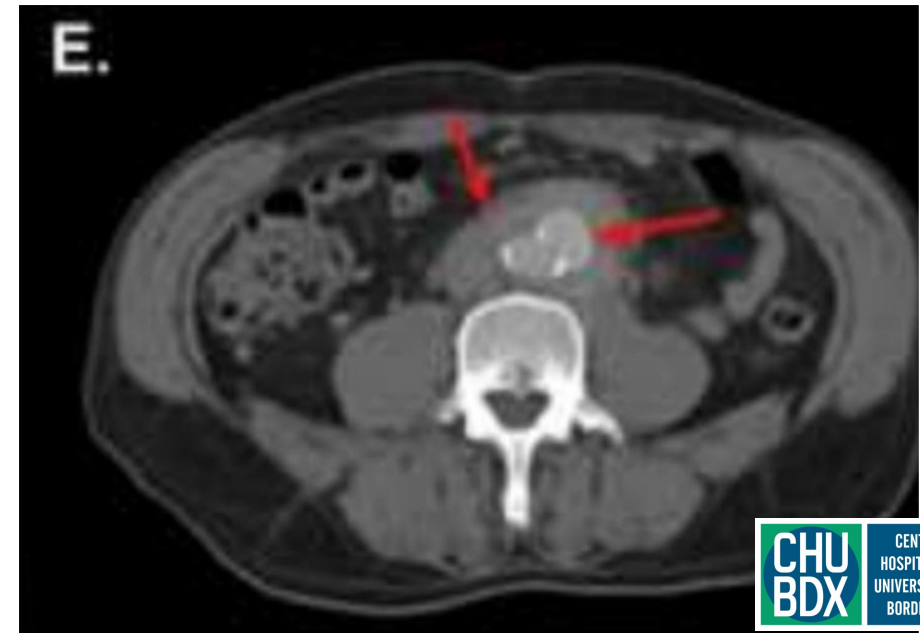
Peri-aortic air bubbles



Multiple-stage lobulated dilatations



Pseudo-aneurysm with peri-aortic infiltr



Traitement Chirurgical

Recommendation 108

Mycotic aneurysm repair is recommended irrespective of aneurysm size

Class	Level	References
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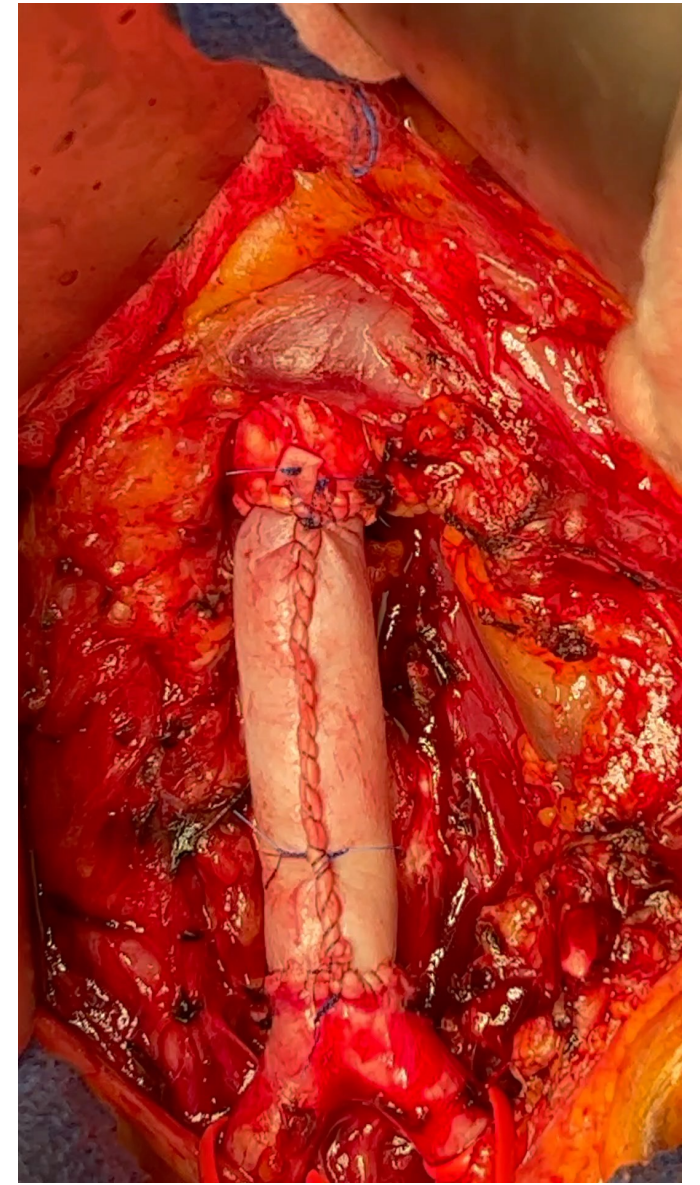
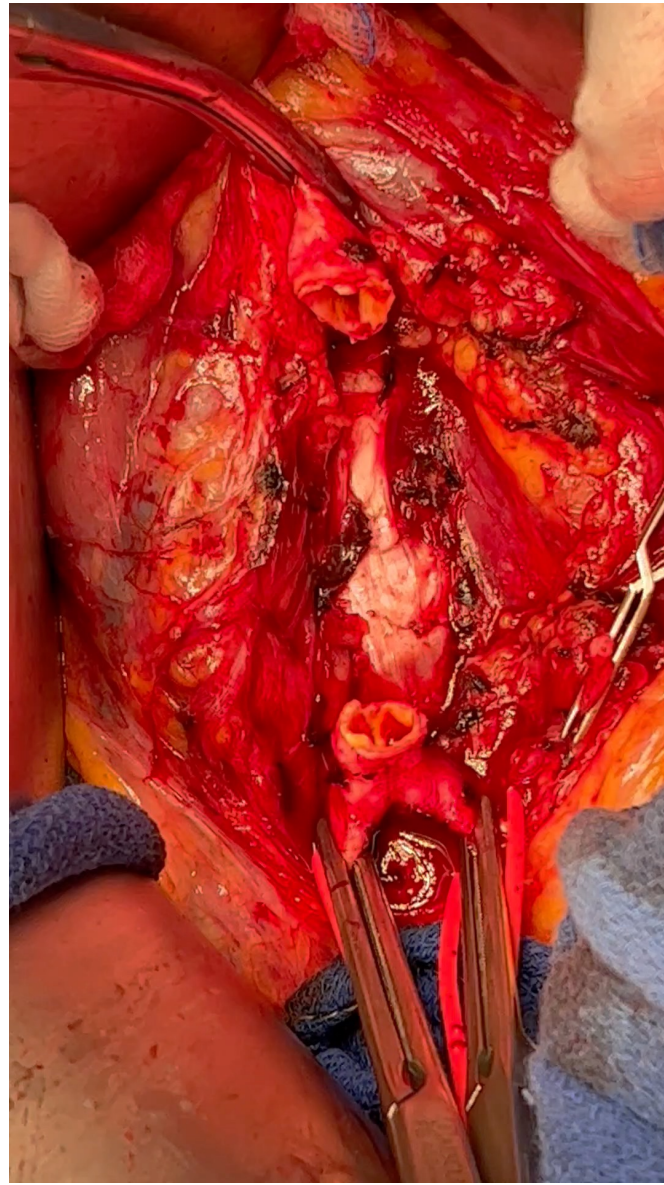
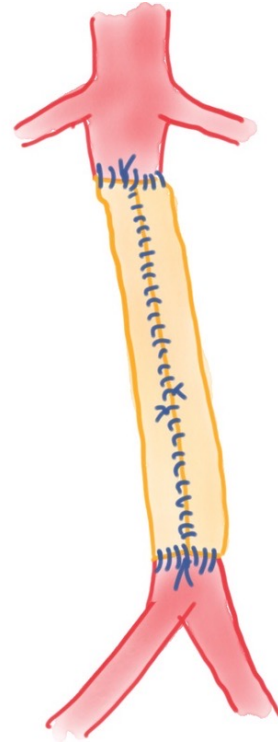
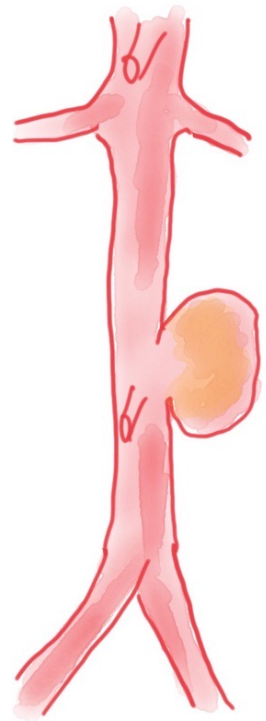
I	C	[710,690]
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Recommendation 109

Surgical techniques used in mycotic aneurysm repair should be considered based on patient status, local routines, and team experience, with endovascular repair being an acceptable alternative to open repair

Class	Level	References
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IIa	C	[702,698,694,690]
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Recommendation 45

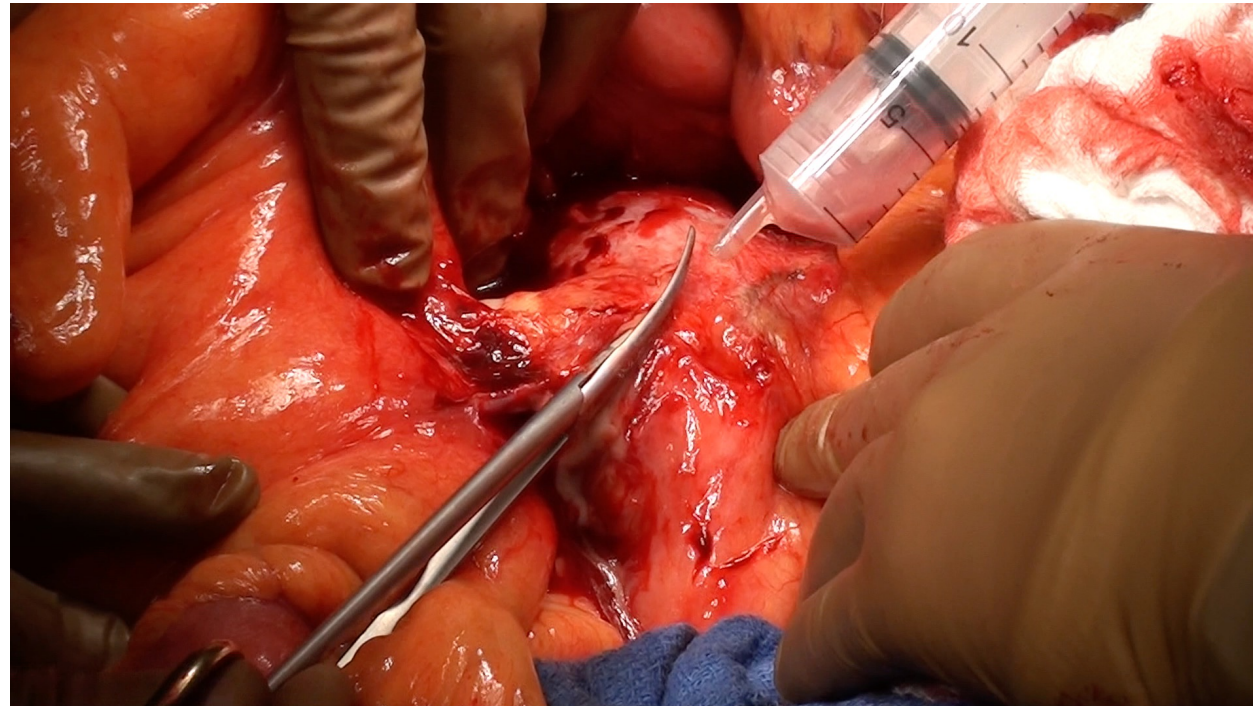
In the emergency setting of active bleeding complicating abdominal aortic graft/endograft infection with or without aorto-enteric fistula, initial treatment with an endograft should be considered, but only as a temporary measure.

Class	Level	References
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IIa	C	[197, 198]
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Les endoprothèses, une solution de sauvetage (bridge surgery)



Bridge for Primary abdominal aorto-enteric Fistula
Gore C3 for bleeding

La chirurgie endovasculaire

3. Endovascular therapy

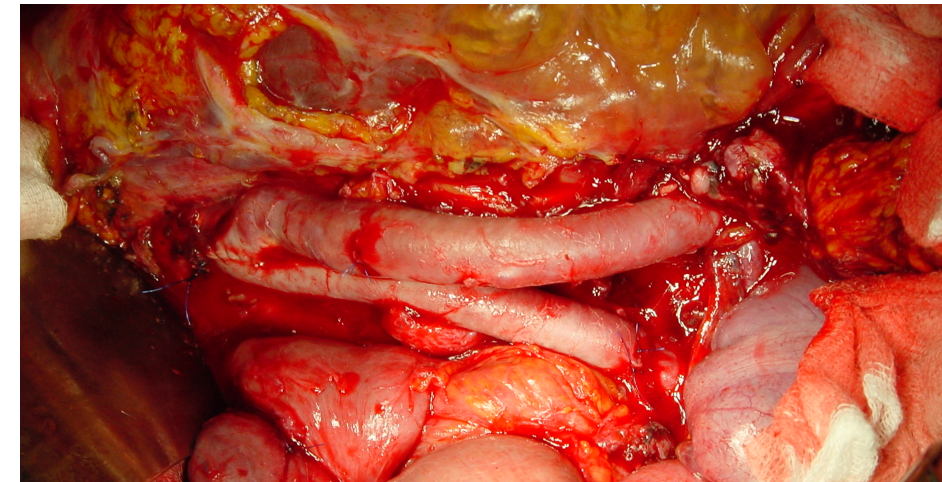
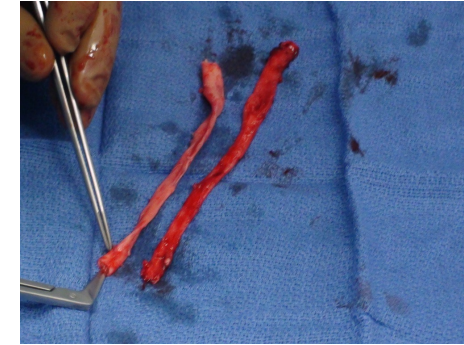
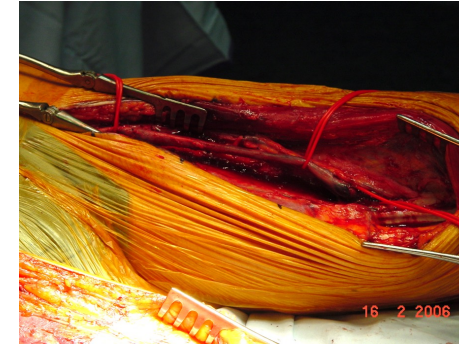
- a. EVT may be considered as a bridge therapy to later open surgical management in these patients (*Class IIb; Level of Evidence C*):
 - i. those with rupture with unstable hemodynamics,
 - ii. those with uncontrolled bleeding with aortoenteric fistula or aortobronchial fistula, or
 - iii. those who are unfit for open surgical repair because of underlying comorbid conditions.
- b. After initial placement of the endovascular device, removal of the device, resection of the aortic MA, and aortic reconstruction may be considered (*Class IIb; Level of Evidence C*).

1. Endovascular device therapy may be considered in patients who are unstable hemodynamically or who are unable to tolerate an open surgical procedure as a bridge procedure to later open surgical repair (*Class IIb; Level of Evidence C*).

Recommendation 39

For patients with an abdominal aortic vascular graft/endograft infection, in situ reconstruction with autologous vein should be considered as the preferred method.

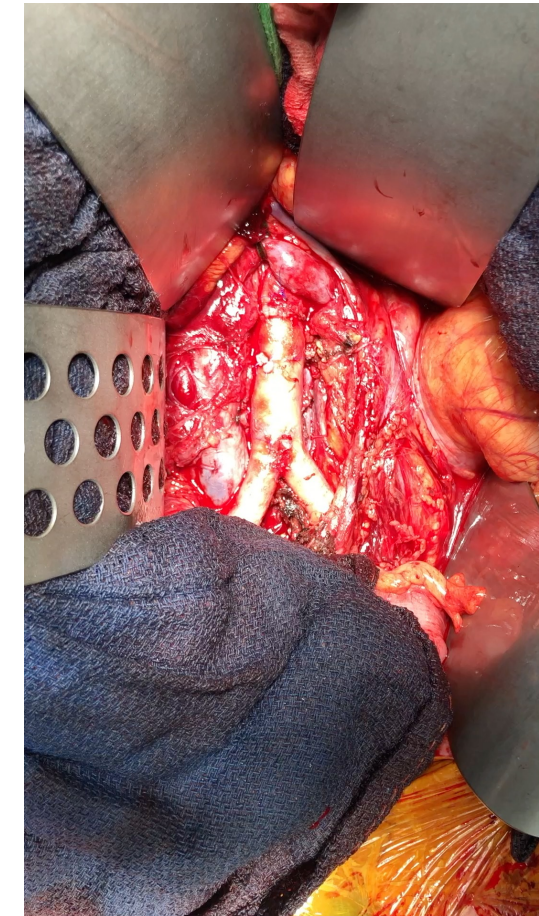
Class	Level	References
IIa	C	[17, 66, 69, 142, 143, 145, 148, 180, 200]



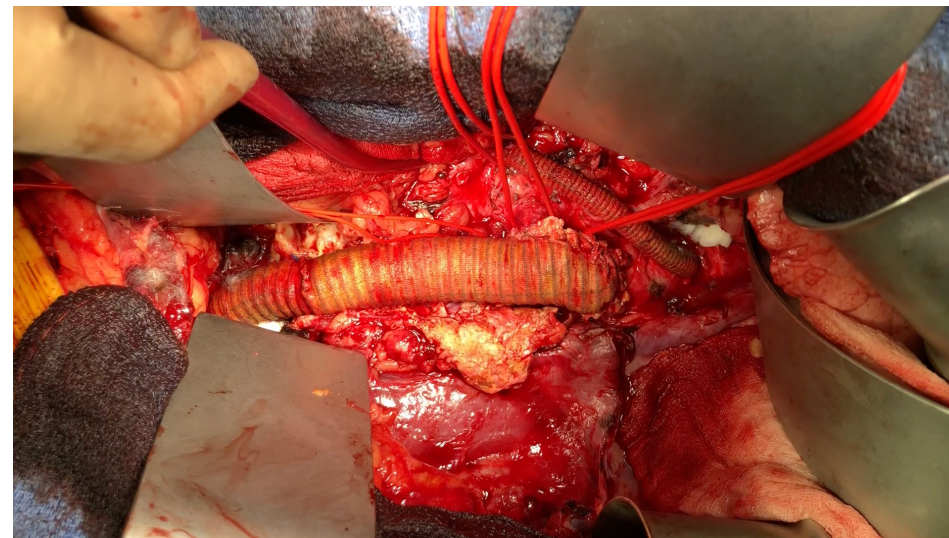
Recommendation 40

For patients with abdominal aortic vascular graft/endograft infection, cryopreserved allografts, silver coated grafts, rifampicin bonded polyester grafts or bovine pericardium should be considered as alternative solutions.

Class	Level	References
Ila	C	[17, 66, 69, 142, 143, 145, 148, 180, 200]



Infected Aorto bifemoral graft removed and replaced by arterial allograft



Infected FEVAR removed and replaced by Silver+Triclosan Graft

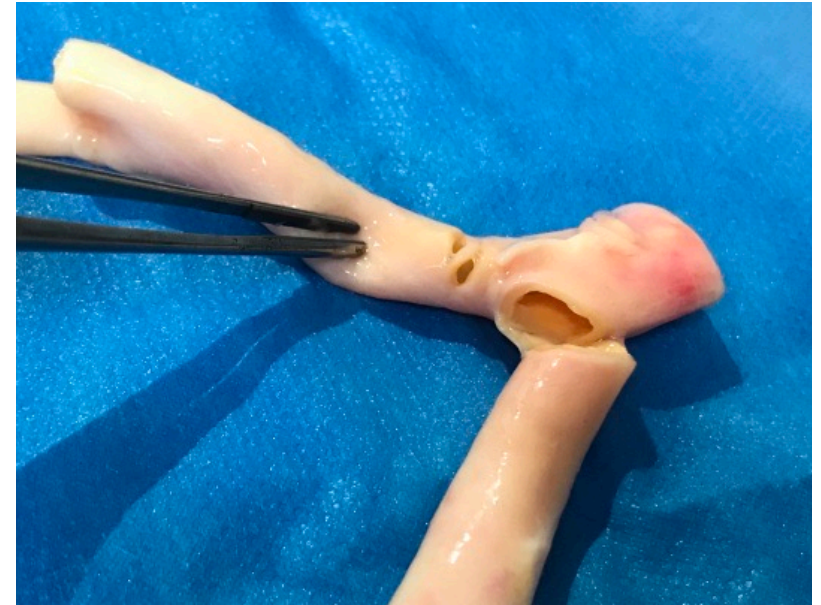


Infected EVAR removed and replaced by tubulised pericardium

Recommendation 43

Lifelong imaging follow up is recommended after in situ reconstruction with cryopreserved allografts for abdominal aortic vascular graft/endograft infection, in order to detect allograft degeneration.

Class	Level	References
I	C	[147, 148, 150, 153]

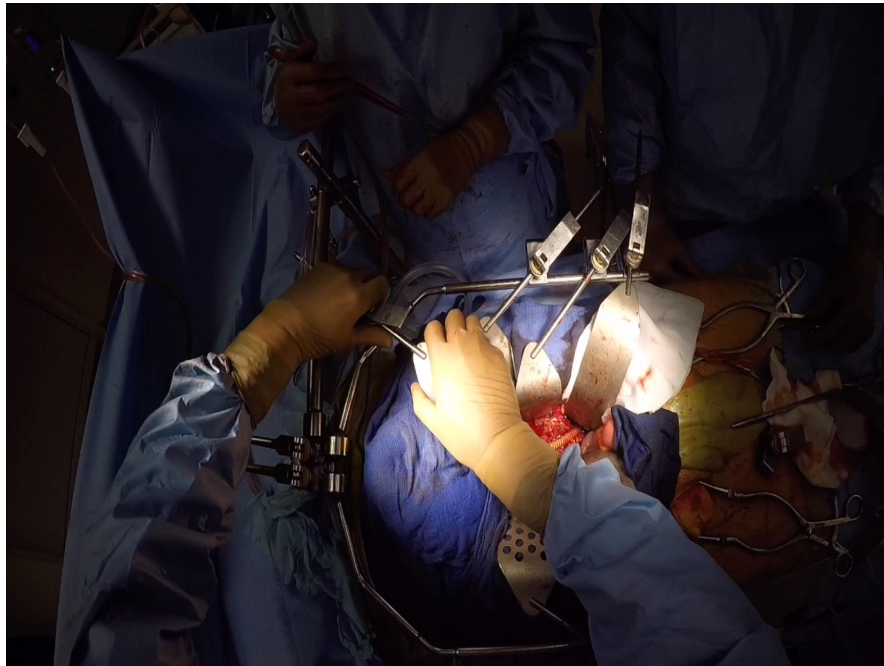


Ruptured defrost allograft artery

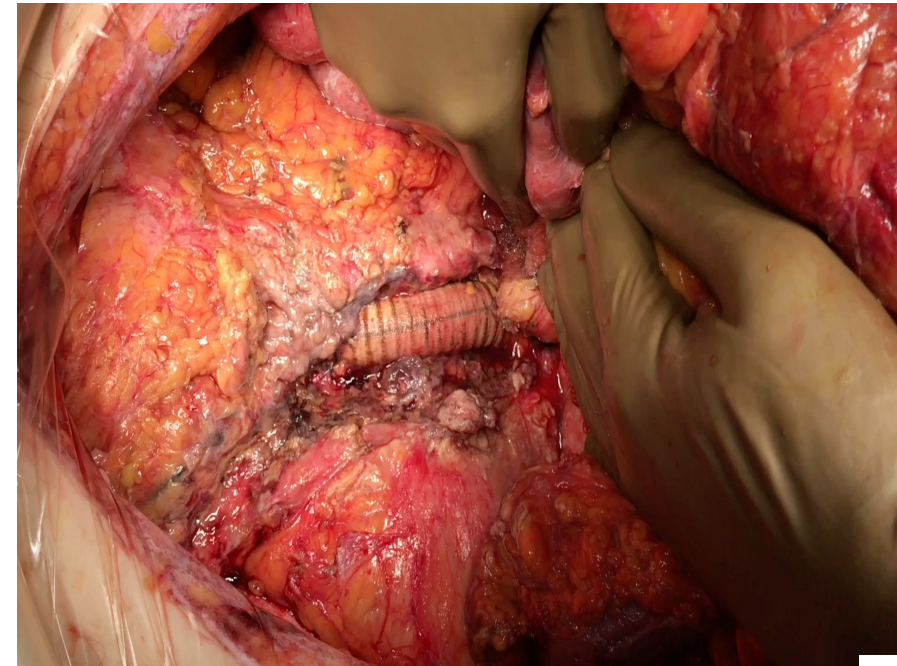
Recommendation 46

In surgical repair of aortic abdominal graft/endograft infection with aorto-enteric fistula, omentoplasty or transfer of autologous vascularised tissue to cover the vascular reconstruction is recommended.

Class	Level	References
I	B	[200]



Omentoplasty



Gerota plasty

Fifteen-year, single-center experience with in situ reconstruction for infected native aortic aneurysms

Xavier Berard, MD, PhD,^a Anne-Sophie Battut, MD,^a Mathilde Puges, MD,^b Mathilde Carrer, MD,^b Katherine Stenson, MD,^d Charles Cazanave, MD, PhD,^b Laurent Stecken, MD,^c Caroline Caradu, MD, PhD,^a and Eric Ducasse, MD, PhD,^a Bordeaux, France; and London, UK

ABSTRACT

Objective: The purpose of the present study was to evaluate the survival and freedom from reinfection for patients with infected native aortic aneurysms (INAAAs) treated with in situ revascularization (ISR) using either open surgical repair (OSR) or endovascular aneurysm repair (EVAR), and to identify the predictors of outcome.

Methods: Patients with INAAAs who had undergone ISR from January 2005 to December 2020 were included in the present retrospective single-center study. The diagnosis of INAAAs required a combination of two or more of the following criteria: (1) clinical presentation, (2) laboratory results, (3) imaging findings, and (4) intraoperative findings. The primary endpoint was 30-day mortality. The secondary endpoints were in-hospital mortality, estimated survival, patency, and freedom from reinfection using the Kaplan-Meier method. The predictive factors for adverse outcomes were evaluated using the Mann-Whitney *U* test or the Fisher exact test and multivariate regression analysis.

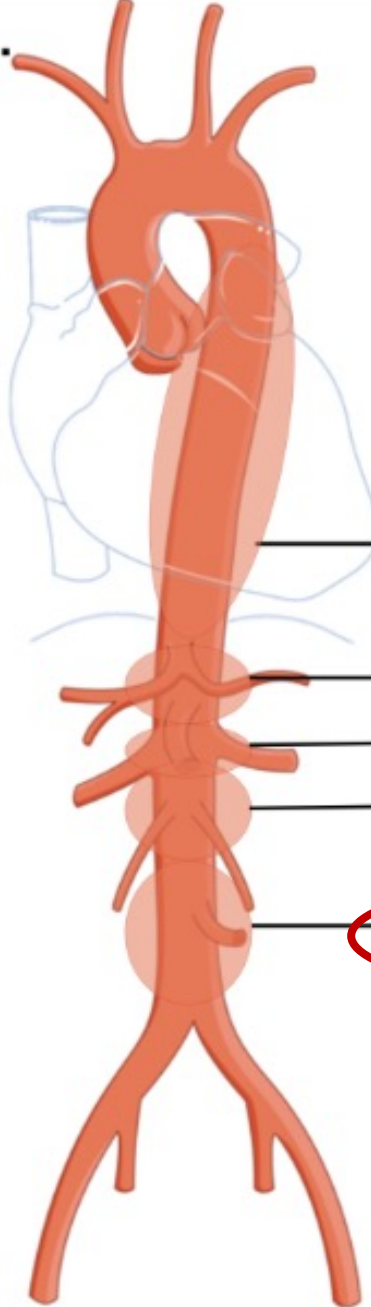
Results: A total of 65 patients (53 men [81.5%]; median age, 69.0 years; interquartile range, 61.5-75.0 years) were included, 31 (47.7%) were immunocompromised, 60 were symptomatic (92.3%), and 32 (49.2%) had presented with rupture, including 3 aortocaval fistulas (4.6%) and 12 aortoenteric fistulas (18.5%). The most common location was infrarenal (*n* = 39; 60.0%). Of the 65 patients, 55 (84.6%) had undergone primary OSR with ISR, 3 (4.6%) had required EVAR as a bridge to OSR, and 8 (12.3%) had undergone EVAR as definitive treatment. The approach was a midline laparotomy for 44 patients (67.7%), mostly followed by reconstruction and aortic-aortic bypass (*n* = 28; 40.6%) and the use of a silver and triclosan Dacron graft (*n* = 30; 43.5%). Causative organisms were identified in 55 patients (84.6%). The 30-day and in-hospital mortality rates were 6.2% (*n* = 4) and 10.8% (*n* = 7). The median follow-up was 33.5 months (interquartile range, 13.6-62.3 months). The estimated 1- and 5-year survival rates were 79.7% (95% confidence interval [CI], 67.6%-87.7%) and 67.4% (95% CI, 51.2%-79.3%). The corresponding freedom from reinfection rates were 92.5% (95% CI, 81.1%-97.1%) and 79.4% (95% CI, 59.1%-90.3%). On multivariate analysis, in-hospital mortality increased with uncontrolled sepsis (*P* < .0001), rapidly expanding aneurysms (*P* = .008), and fusiform aneurysms (*P* = .03). The incidence of reinfection increased with longer operating times (*P* = .009).

Conclusions: The selective use of ISR and OSR combined with targeted antimicrobial therapy functioned reasonably well in the treatment of INAAAs, although larger, prospective, multicenter studies with appropriately powered comparative cohorts are necessary to confirm our findings and to determine the best vascular substitute and precise role of EVAR as a bridge to OSR or definitive treatment. (*J Vasc Surg* 2021; ■:1-12.)

Keywords: Aneurysm; Aortic rupture; Aortitis; Aortoenteric fistula; Infected native aortic aneurysm; Mycotic aneurysm

- Our Bordeaux Cohort
- From 2005 to 2020
- 65 patients with mycotic aortic aneurysms

A.



	OSR n=58	EVAR n=8
TAA IV	5 (8.6) {1}	2 (25.0)
Supra-Renal	3 (5.2)	1 (12.5)
Para-Renal	6 (10.3)	1 (12.5)
Juxta-Renal	7 (12.1)	1 (12.5)
Infra-Renal	36 (62.1) {2}	3 (37.5)

Résultats

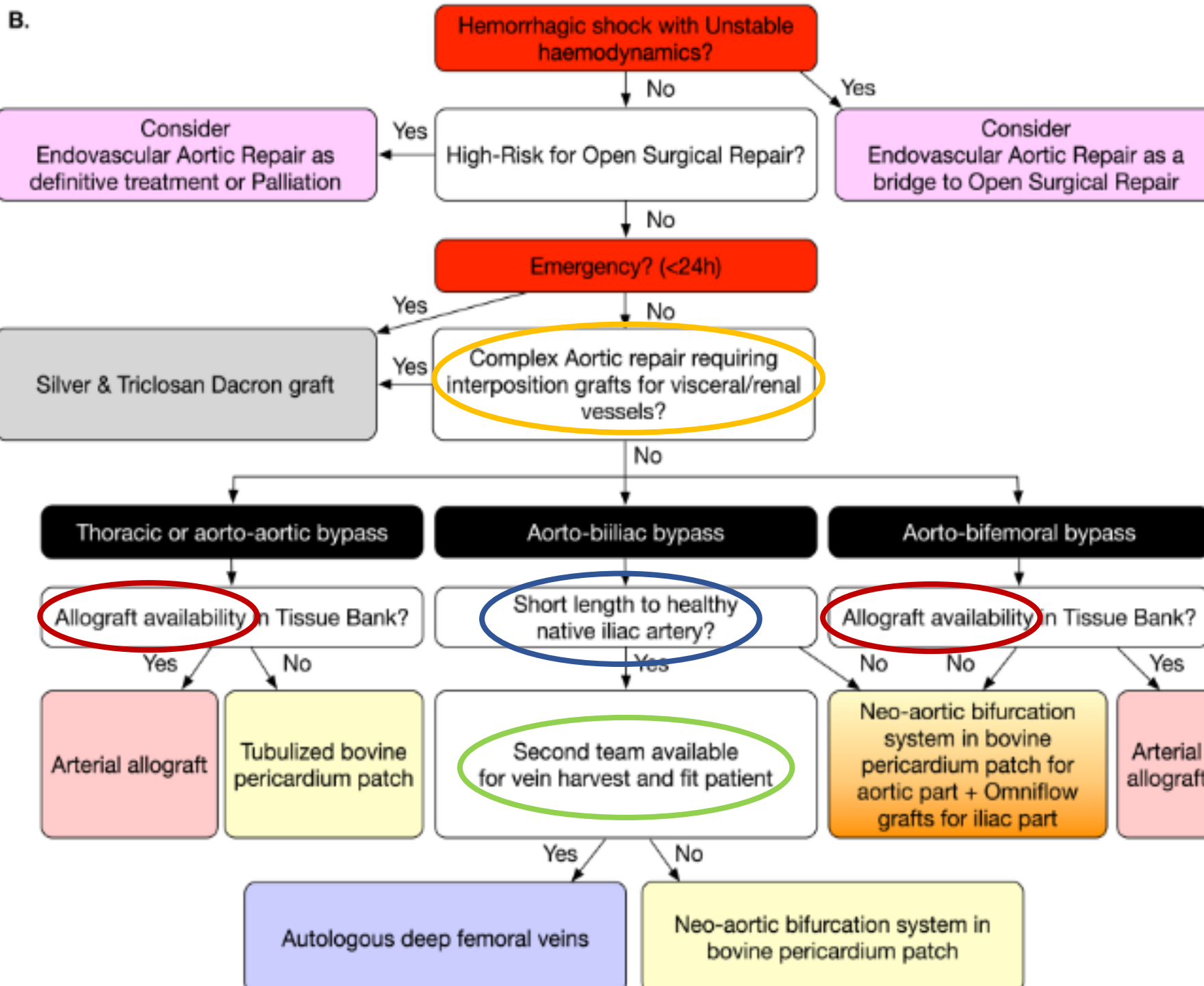
65 patients

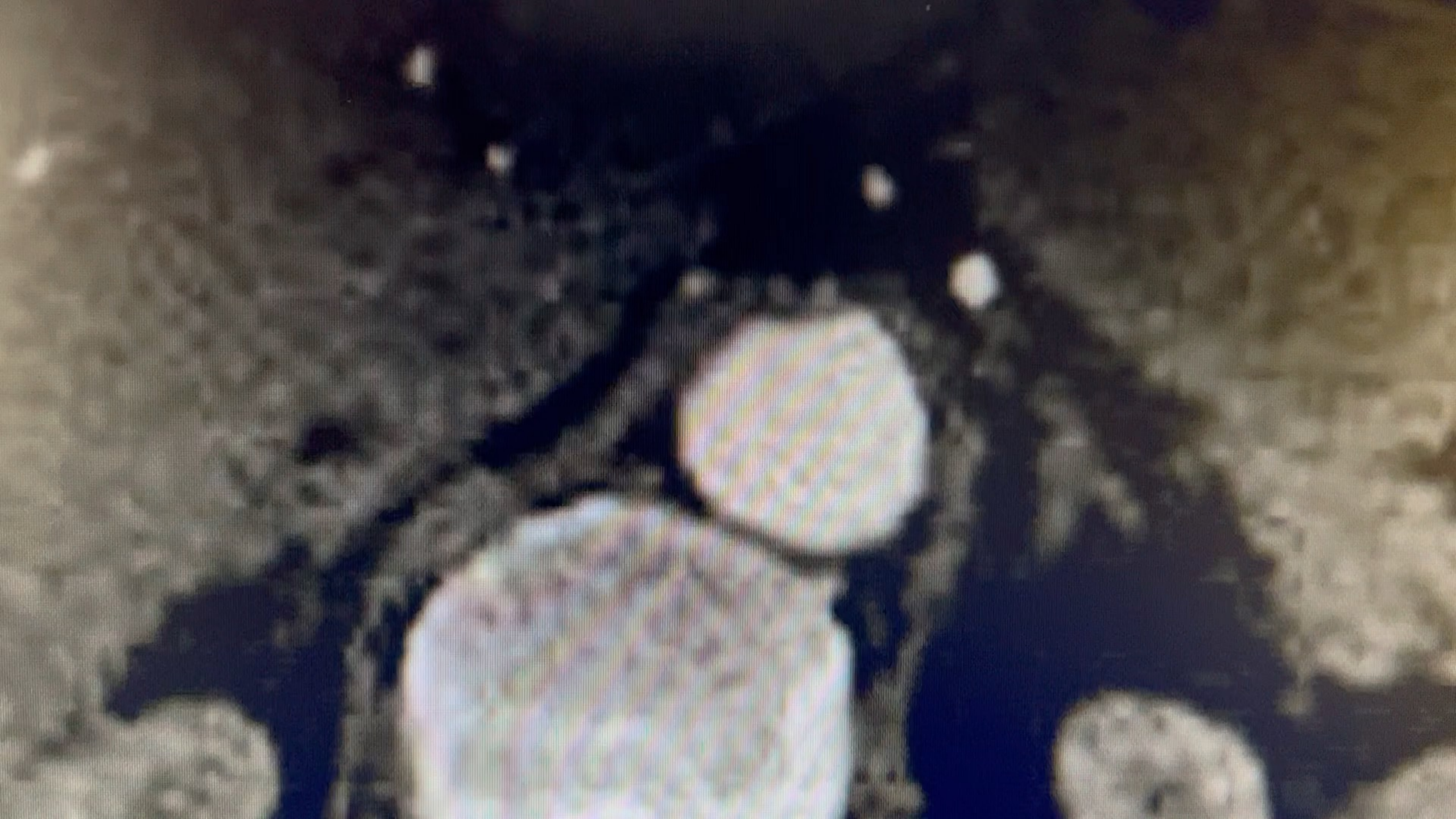
- 53 men (81.5%)
- median age 69.0 years
- 31 (47.7%) immunocompromised.

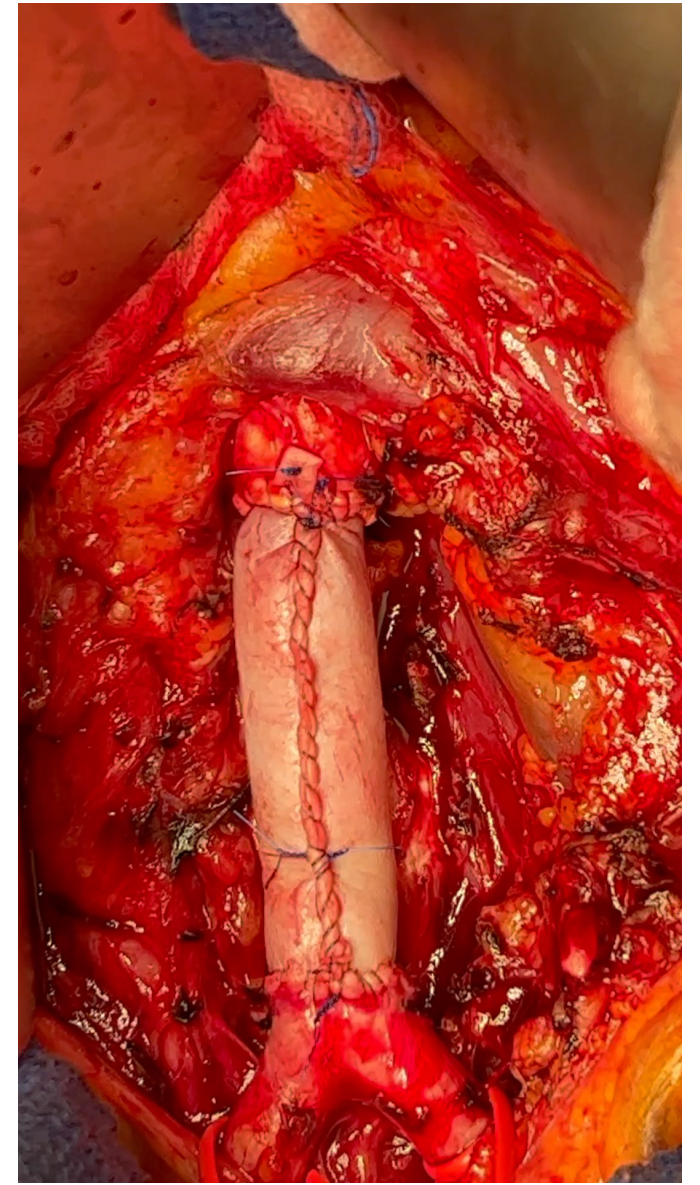
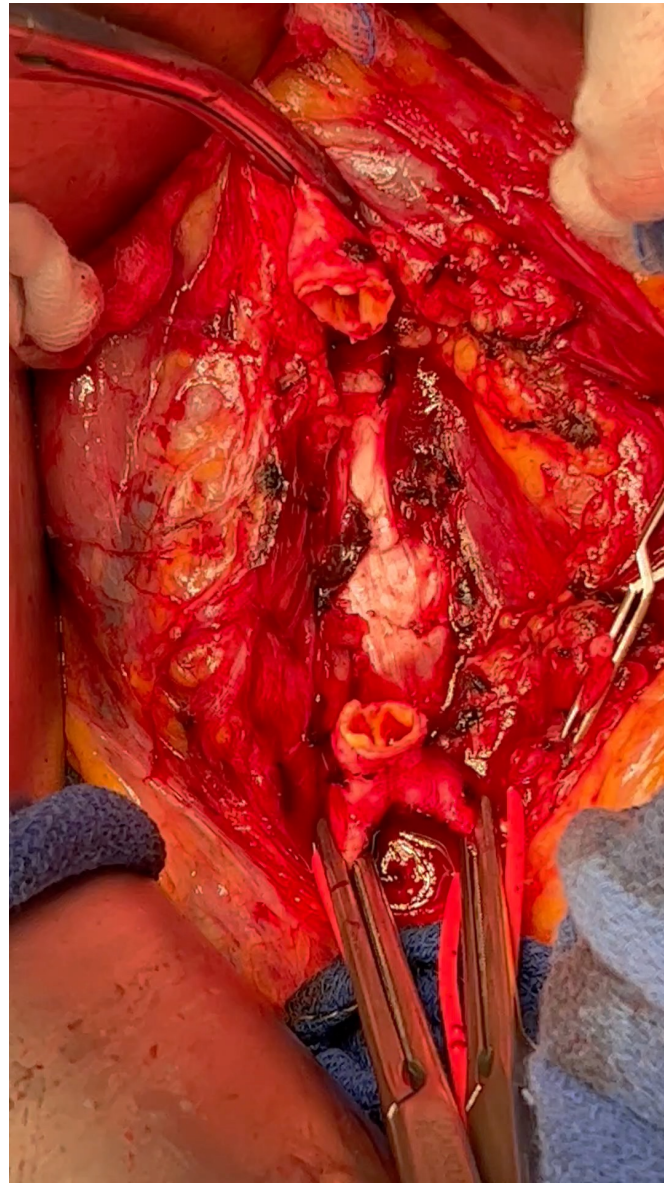
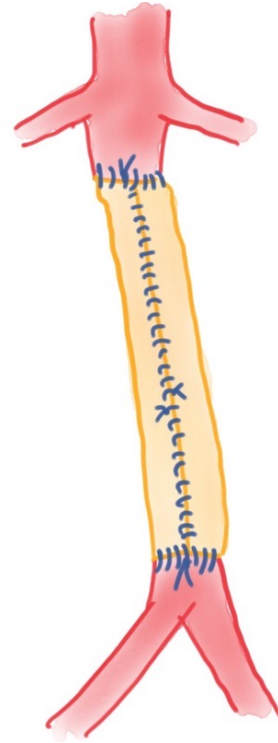
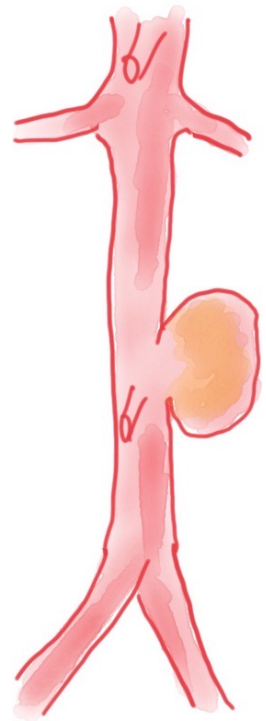
Clinical presentation

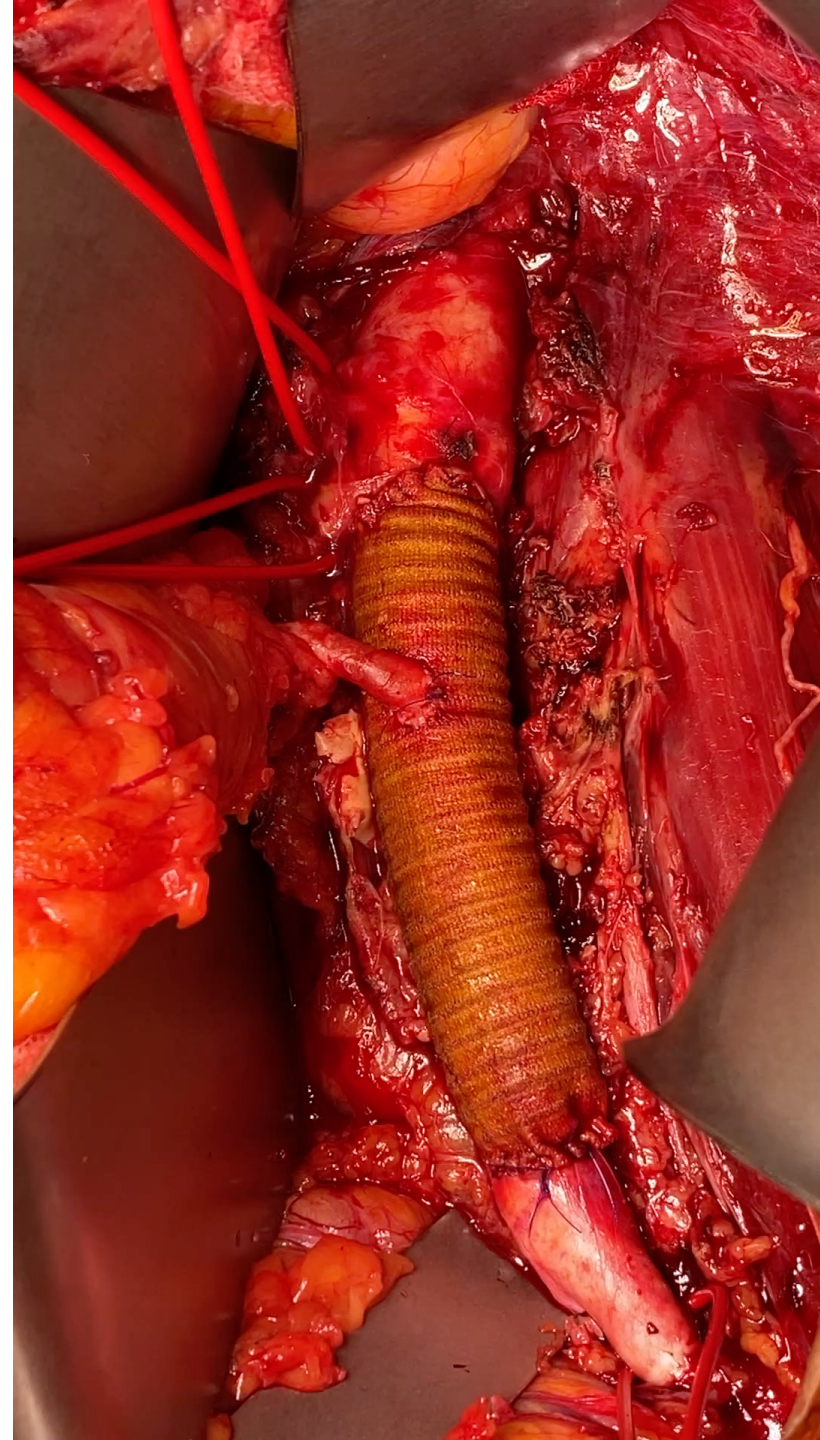
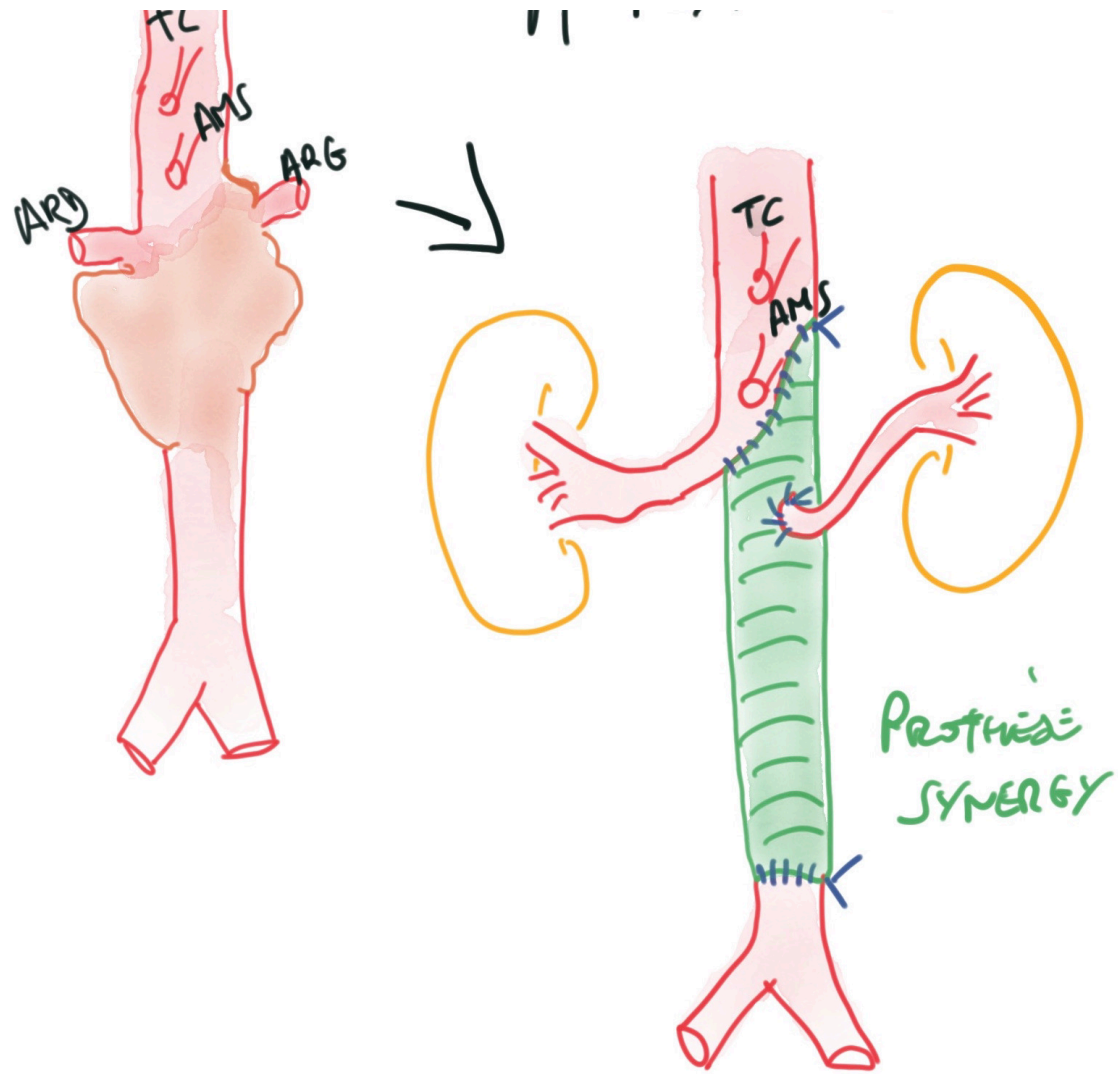
- 60 symptomatic (92.3%)
- 32 (49.2%) ruptures
 - 3 aortocaval fistulae (4.6%)
 - 12 aorto-enteric fistulae (18.5%).

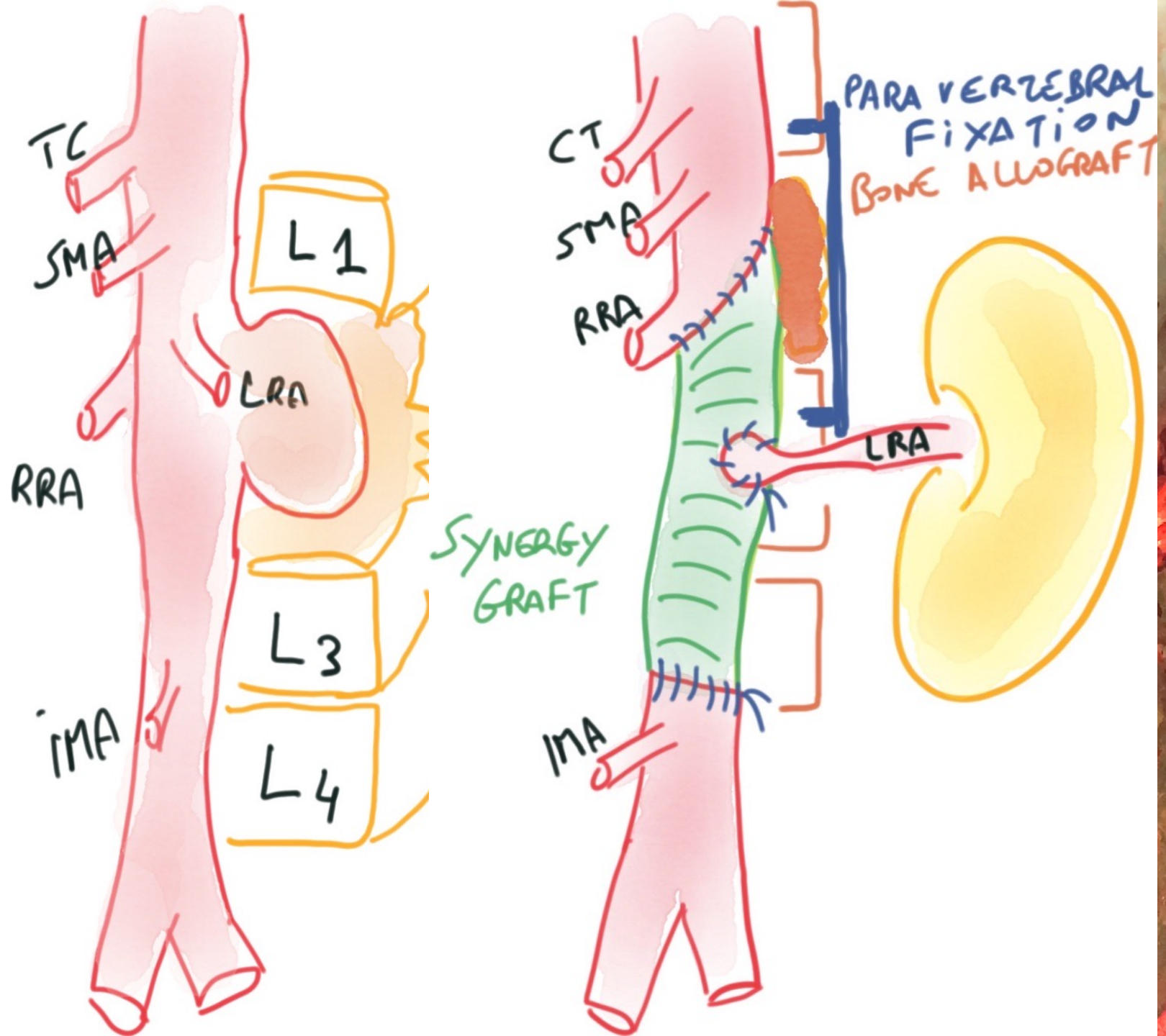
The most common location was **infra-renal**.

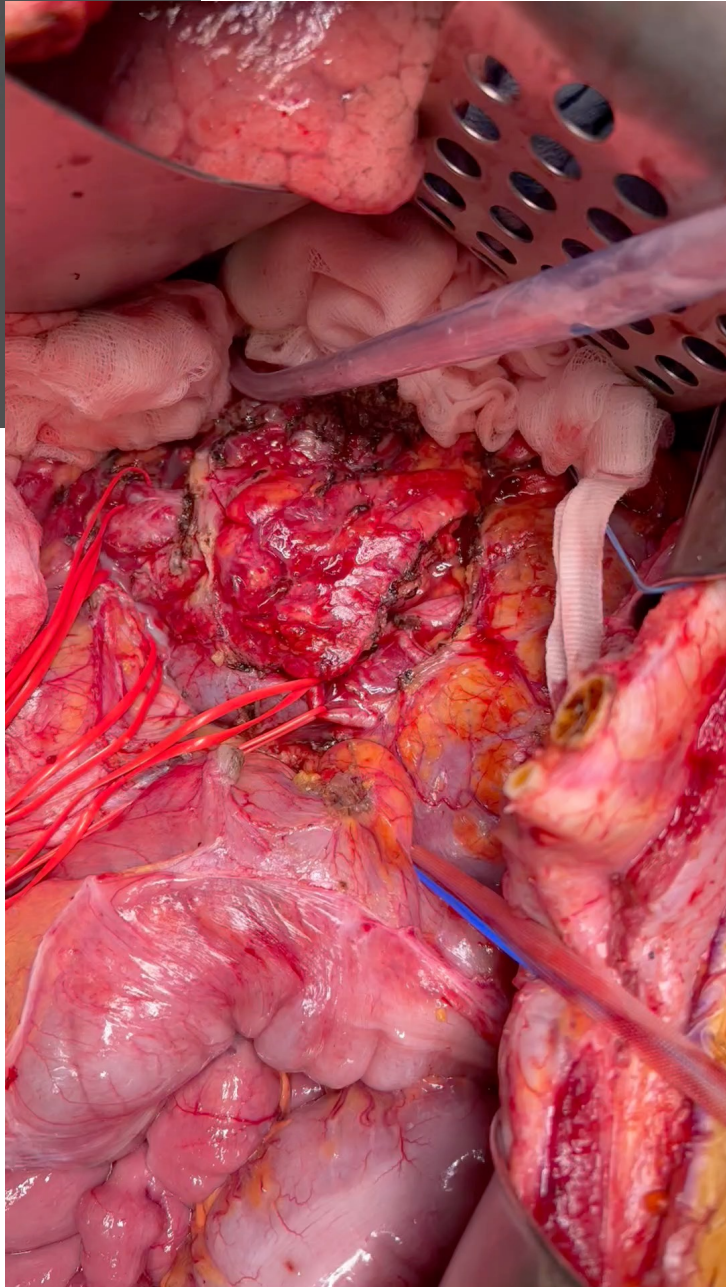






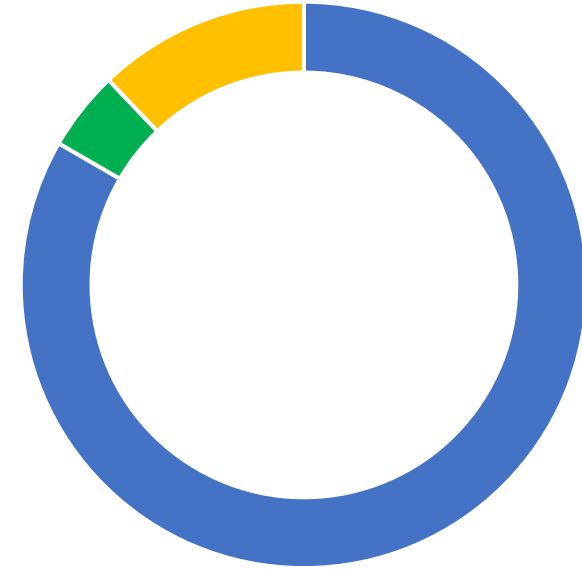






Traitement Chirurgical

- 55 (84.6%) **primary OSR with ISR**
- 3 (4.6%) **EVAR** as a **bridge** to OSR
- 8 (12.3%) **EVAR** as **definitive** treatment.



■ OSR with ISR ■ Bridge EVAR ■ Definitive EVAR

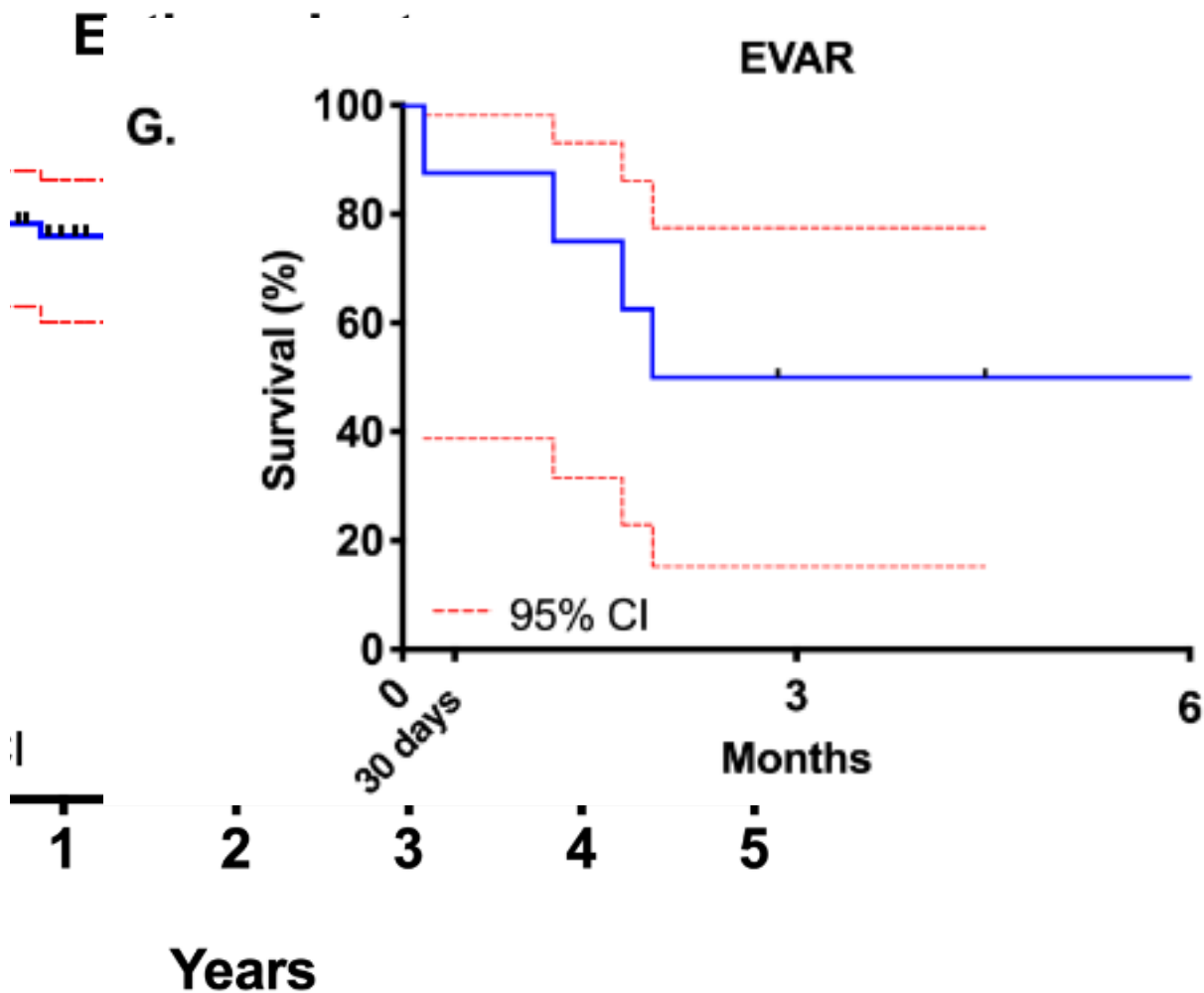
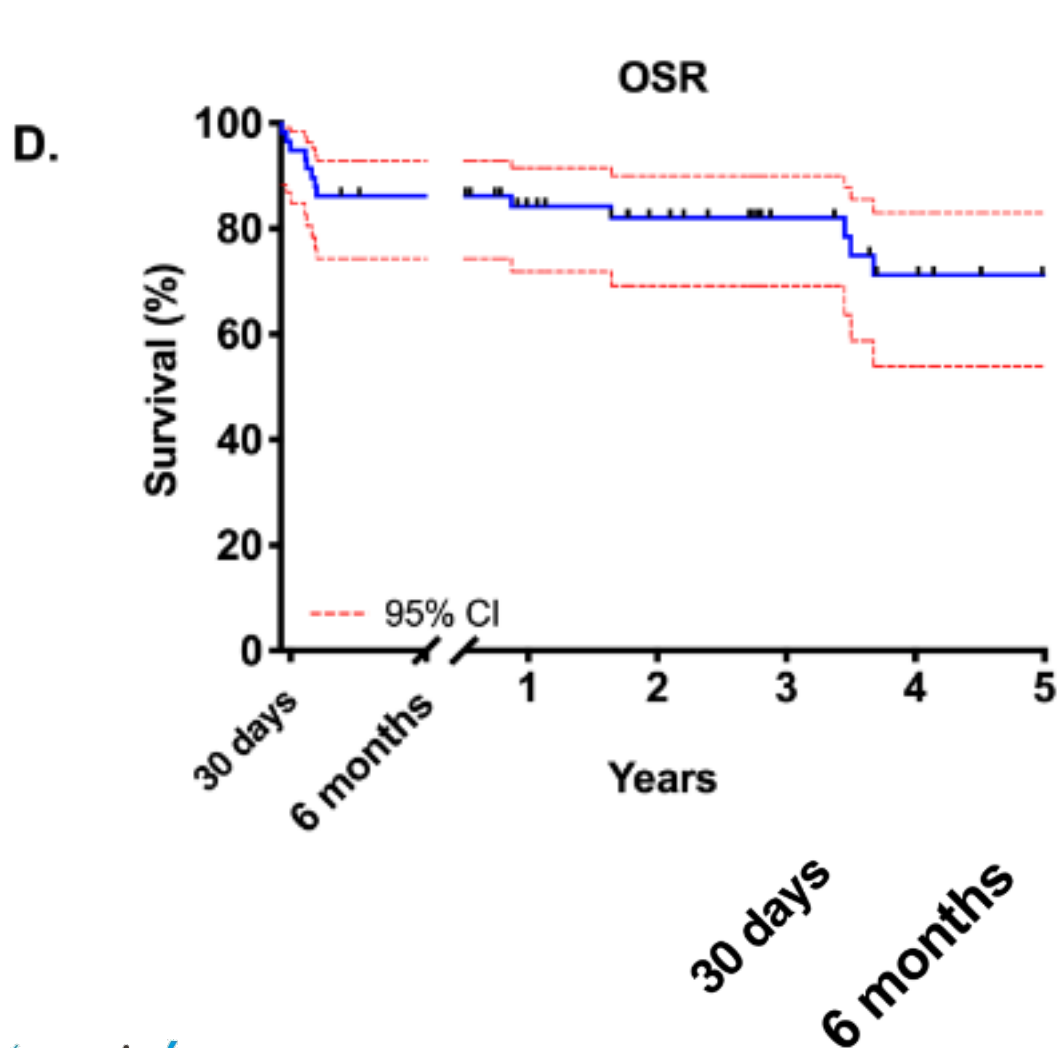
The most common approach :

- a **midline laparotomy** (n=44; 67.7%)
- reconstruction and **aorto-aortic bypass** (n=28; 40.6%)
- use of a **silver & triclosan Dacron** graft (n=30; 43.5%).

Survie

1-year survival : 79.7% (95%CI: 67.6-87.7)

5-year survival : 67.4% (95%CI: 51.2-79.3);



Mortalité

30-day mortality : 6.2% (n=4)

In-hospital mortality : 10.8% (n=7)

90-day mortality: 18.5% (n=12)

In-hospital mortality increased with:

- uncontrolled sepsis (p<.0001)
- rapidly expanding aneurysms (p=.008)
- fusiform aneurysms (p=.03).

Variables

In-hospital mortality

Cancer

Immunosuppressed status

Hemoglobin <10g/dL

White Blood cell count (/mm³)

→ Uncontrolled sepsis

→ Rapidly expanding aneurysms (>5mm/6mo)

→ Pseudo-aneurysm (vs Fusiform)

Resistant microorganisms

Fungal co-infection

Overall Mortality

Pseudo-aneurysm (vs Fusiform)

Rupture

Fever

Uncontrolled sepsis

Rapidly expanding aneurysms (>5mm/6mo)

Fungal co-infection

Antibiotics initiated before surgery
After MDT

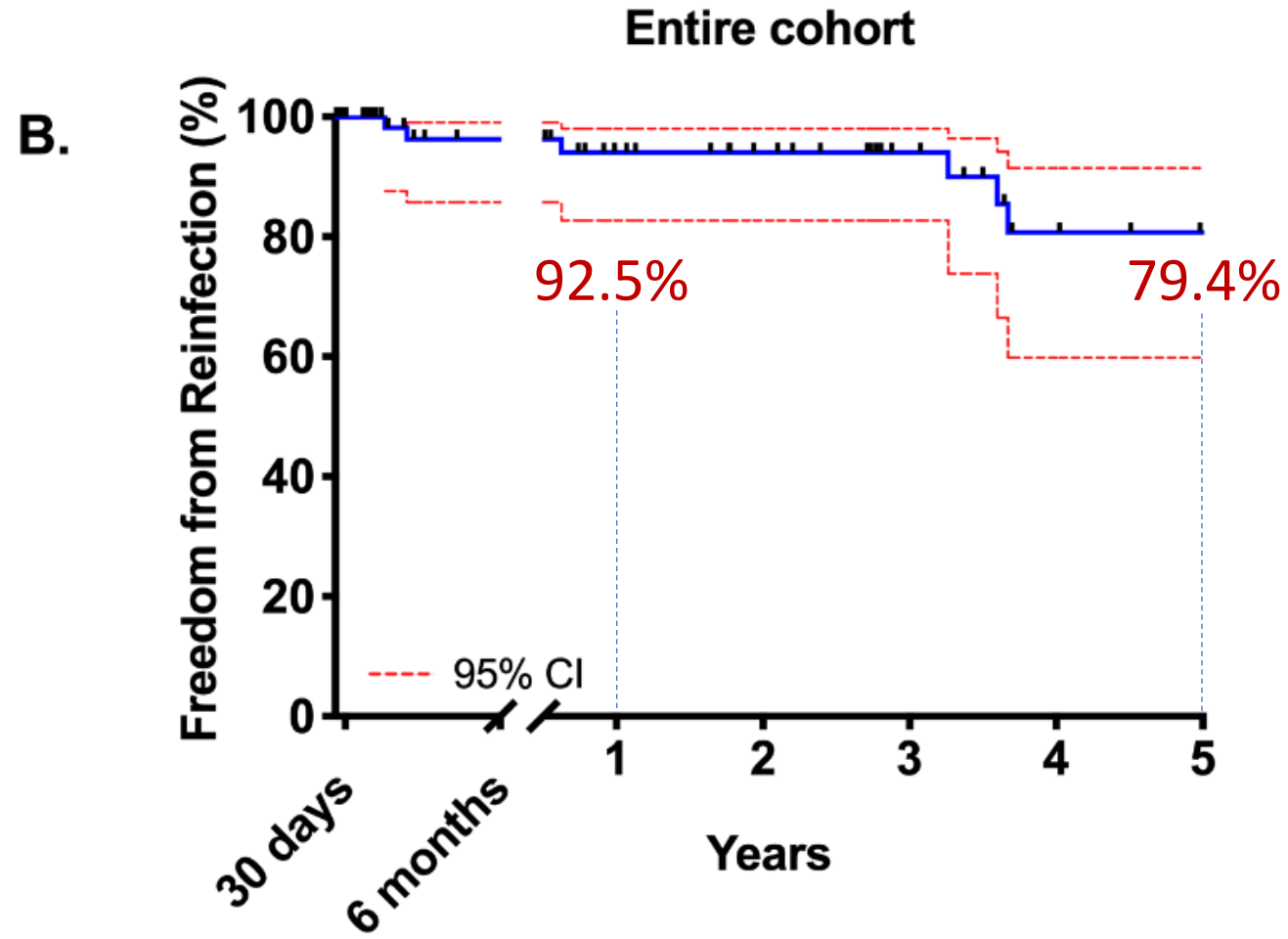
GI tract repair

EVAR as definitive treatment

Secondary abscess drainage

Repeat aortic surgery

Survie sans réinfection



Reinfection

Seven aortic graft reinfections were noted and **only one** ongoing infection **after EVAR** as definitive treatment; they all occurred **after the cessation of antimicrobial therapy**.

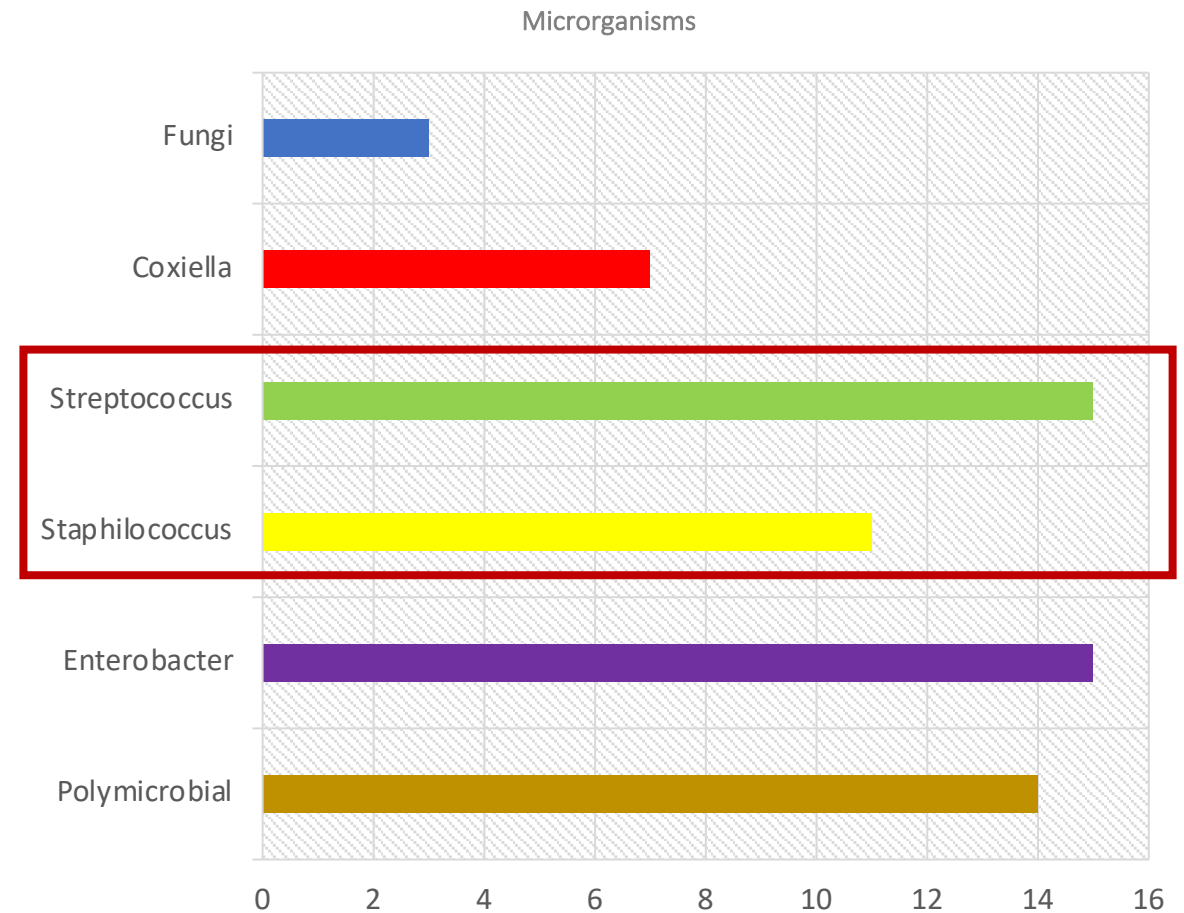
Reinfection rates are higher when a **gastrointestinal tract repair** is needed during index procedure ($p=.03$), and they grow as **operating time** rises ($p<.0001$).

No significant association was found with the type of vascular substitute or vascular repair, nor the different microorganisms or antimicrobial regimens.

Microbiologie

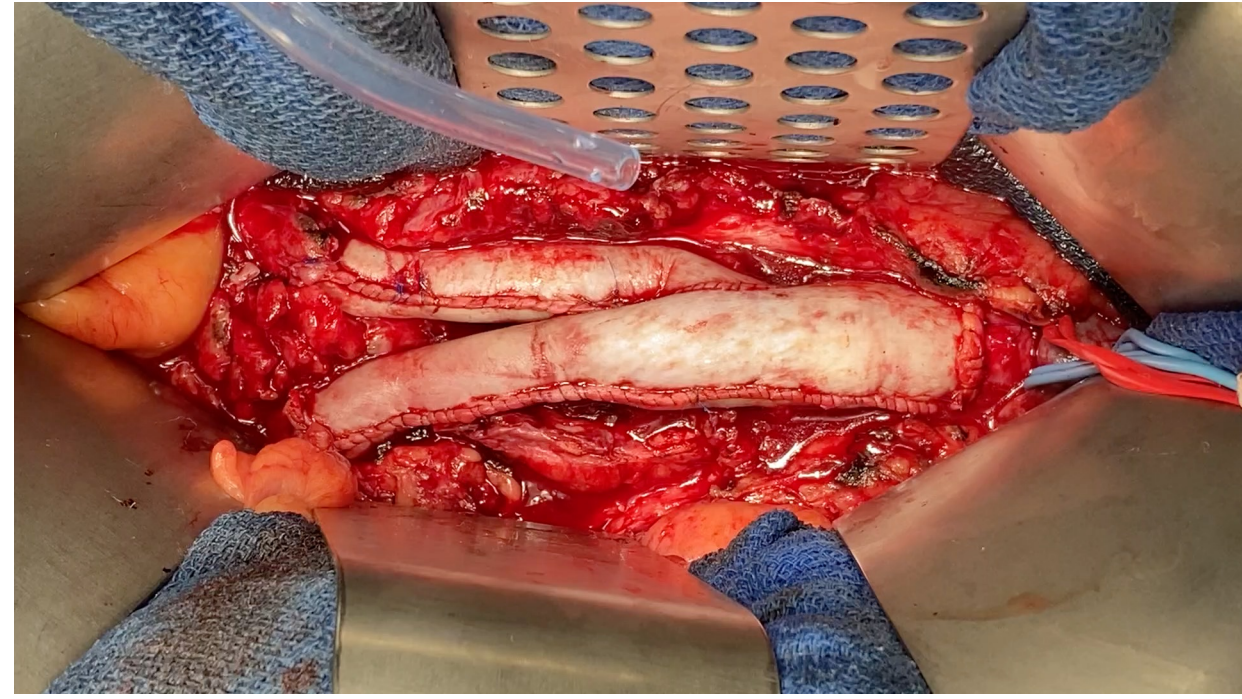
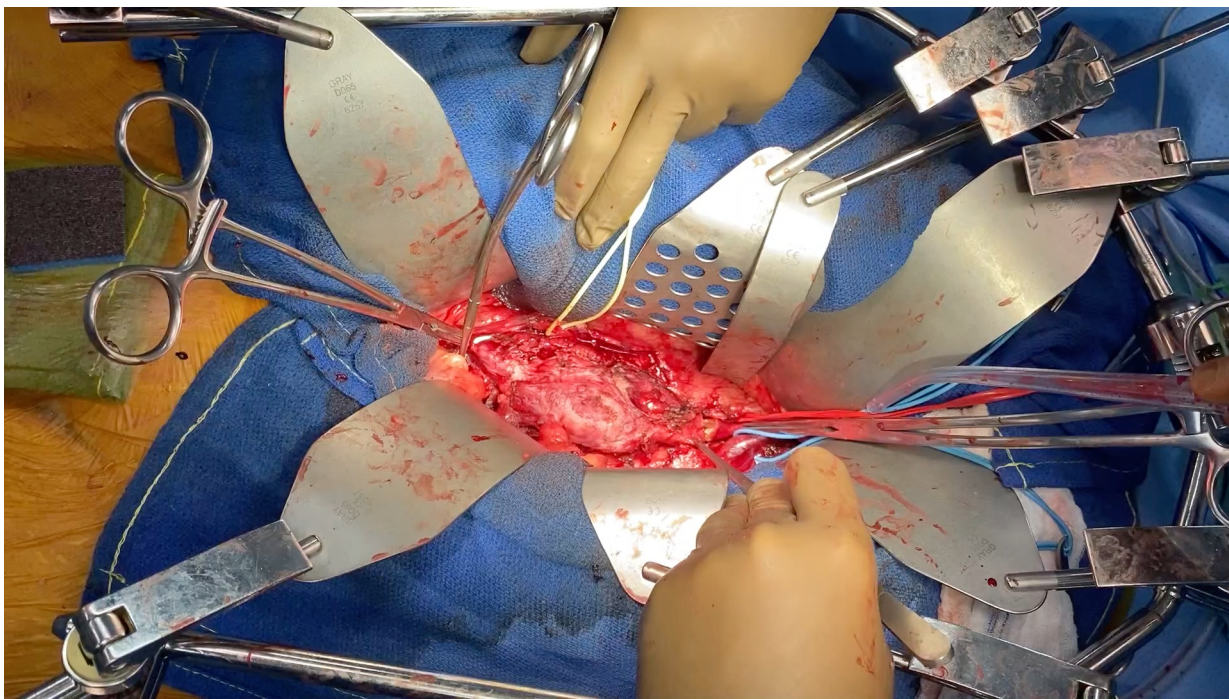
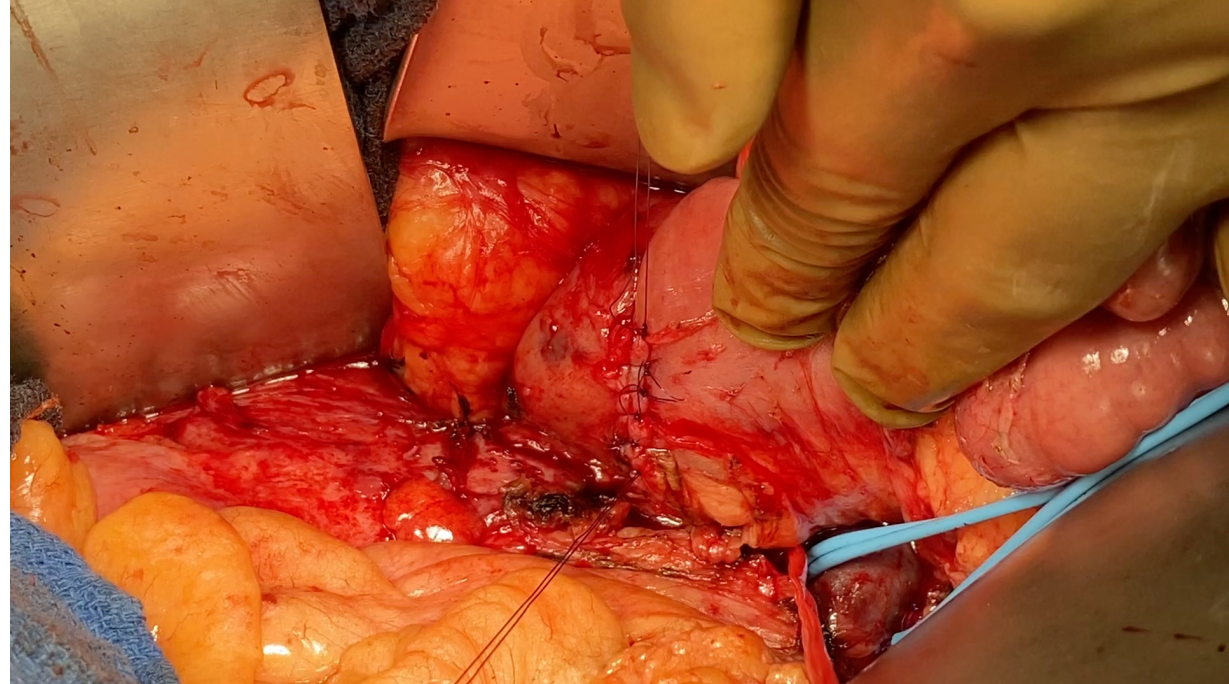
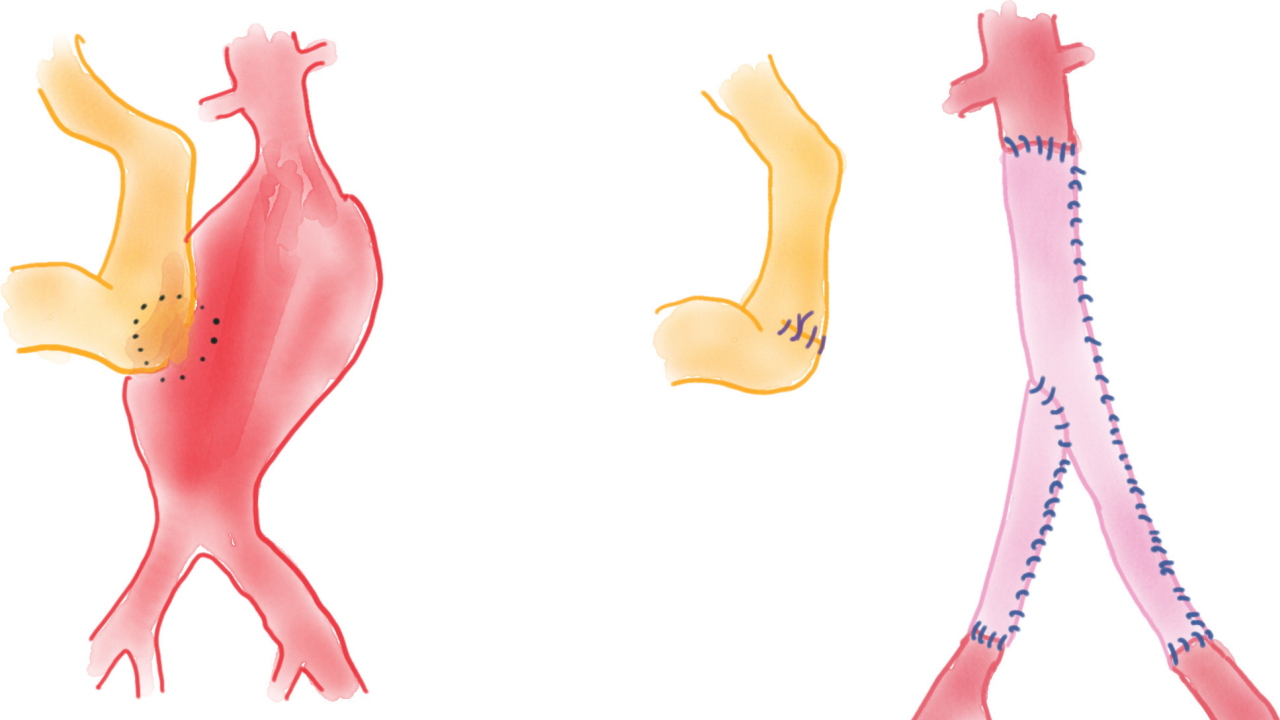
Causative organisms were identified in **55 patients** (84.6%).

19 patients (29.2%) received antimicrobial therapy **before surgery**



Cas particulier des fistules digestives

- Not so rare 12 out 65 mycotic AAA patients (18,5%) in our Bordeaux Cohort
- Most frequent location duodenum



Les prélèvements peropératoires

- Biopsie de paroi aortique pathologique avec envoi en (10 pots)
- **Bactériologie** x 5 pots (dont un pot à congeler pour d'éventuelles PCR)
- **Mycobactériologie** x 1 pot
- **Mycologie** x 2 pots
- **Anatomopathologie** (1 pot formol) et **immunohistochimie** (1 pot sérum physiologique)

Traitement anti-infectieux probabiliste

- à débiter en l'absence de documentation microbiologique en pré-opératoire si sepsis ou choc septique, sinon en per-opératoire après les prélèvements
- **Aortites communautaires (situation quasi-exclusive)**
 - Céfotaxime 2 g sur 30 min 3 fois par jour + gentamicine 8 mg/kg sur 30 min 1 x /j
 - *Si fistule aorto-digestive* : + métronidazole 500 mg 3 x /j + caspofungine 70 mg sur 1 h 1 x /j
- **Allergie aux bêta-lactamines**
 - Aztréonam 2 g sur 30 min 3 x /j + daptomycine 10 mg/kg sur 30 min 1 x /j + gentamicine 8 mg/kg sur 30 min 1 x /j

4 Messages importants

1. Pathologie rare mais **risque de rupture majeur**
2. **Evolution (très) rapide**
3. Prise en charge **en équipe** pluri disciplinaire
4. Suivi post-opératoire rigoureux pour **détecter les signes de reinfections** (ou d'infection persistante endoprothèse+++)