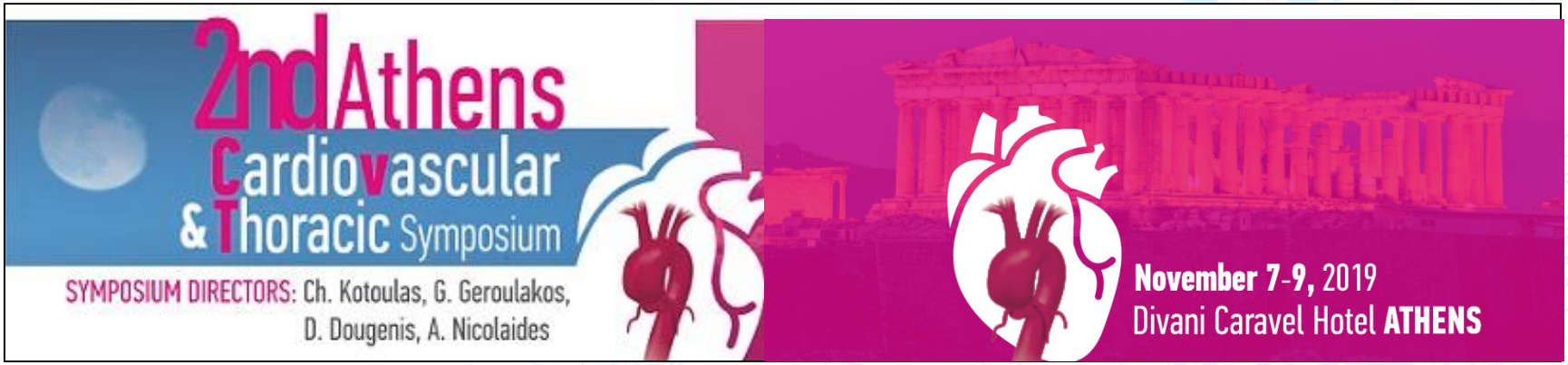


Management of Infected EVARs

Konstantinos G. Moulakakis MD, PhD, FEBVS
Consultant, Vascular Surgeon
Department of Vascular Surgery, Medical School, University of Athens

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Πανεπιστημίου Αθηνών Π.Γ.Ν. "Αττικόν"
Dept. of Vascular Surgery - University of Athens

Endograft infection after EVAR

- **Rare: <1%**
- **Mortality when untreated: >70%**
- **Median time from initial EVAR to the diagnosis of infection: 25 months (range 1-128)**

Setacci C. et al. Management of abdominal endograft infection. J Cardiovasc Surg. 2010, Cernohorsky P et al, J Vasc Surg 2011 – Fatima J et al, J Vasc Surg, 2013 – Argyriou C et al, J Endovasc Ther, 2017

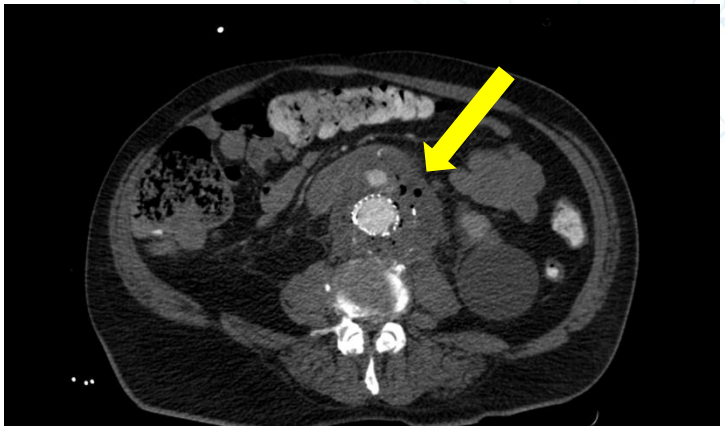
Risk factors

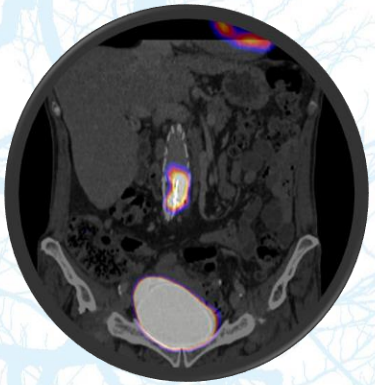
- Emergency case
- Across contaminated areas
- Procedure in the radiology suite
- Existence of perioperative infections (groin, urinary, endocarditis etc.)
- Secondary procedures following EVAR (cuff, translumbar embolization for type II endoleak etc.)

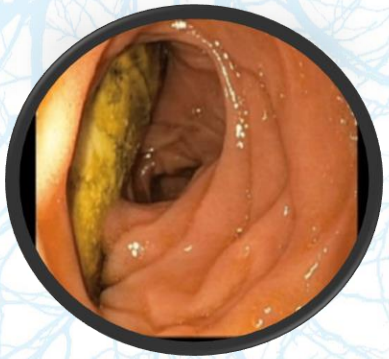
Argyriou C et al, J Endovasc Ther, 2017

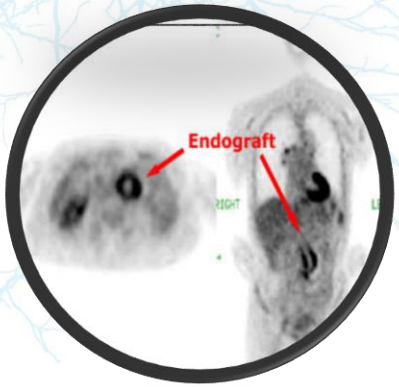
Diagnosis

- Symptoms and clinical findings (pain, fever, GI bleeding)
- Elevated infection parameters: CRP, WBC
- Evidence of graft infection on imaging (CT, leucocytes scan, PET)
- Isolation of microorganisms either from blood, or drain material, or the endograft itself









Microorganisms Involved

20-83% of microorganisms are identified preoperatively in blood cultures

↑f

- St. Aureus 22 - 60%
- Streptococcus sp. 11%
- E. Coli <13%
- Enterococci <13%
- Pseudomonas, Serratia, Klebsiella, Ent.Cloacae ≈ 10%
- Candida Ablicans , Mycetes 6%
- Multiple pathogens 21%



Numan F. et al. Management of endograft infections. J Cardiovasc Surg . 2011
Setacci C. et al. Management of abdominal endograft infection. J Cardiovasc Surg. 2010

Management of Infected Endograft

Treatment options

1. Open Repair (excision and extra-anatomical or in situ)
2. Endovascular (BRIDGING)?
3. Conservative



1. Open Repair - Principles of Management

1. Explantation of the endograft
2. Wide and complete debridement of infected necrotized tissue to provide a clean wound in which healing can occur
3. Establishment of blood flow to the distal bed
4. Prolonged antibiotics coverage to reduce sepsis and prevent secondary graft infection

Meta-analysis

JOURNAL OF ENDOVASCULAR THERAPY
A SAGE Publication
ISEVS

Journal of Endovascular Therapy
1–10
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DOI: 10.1177/1526602817722018
www.jevt.org
SAGE

Endograft Infection After Endovascular Abdominal Aortic Aneurysm Repair: A Systematic Review and Meta-analysis

Christos Argyriou, MD, PhD[1], George S. Georgiadis, MD, PhD[1], Miltos K. Lazarides, MD, PhD, FEBVS[1], Efstratios Georgakarakos, MD, PhD, MSc[1], and George A. Antoniou, MD, PhD, MSc, FEBVS[2]

Recent Metanalysis

- 12 Papers, 362 patients (mean age 72 years; 279 men)
- The incidence of graft infection after EVAR was 0.6%
- Less than half of the patients (40%) had emergency surgery.

Table 3. Methods of Treating Infected Endografts in the Patient Cohort.[a]

In situ reconstruction	233 (64)
Extra-anatomical bypass	58 (16)
Conservative treatment	9 (2.5)
Endovascular treatment	2 (1)
No treatment	1 (0.5)
Not reported	59 (16)

[a]Data are given as counts (percentage).

Table 2. Type of Aortic Endograft Used at the Initial Endovascular Aneurysm Repair.[a]

Zenith[b]	82 (23)
Excluder[c]	74 (20)
AneuRX[d]	33 (9)
TAG[c]	21 (5)
Talent[d]	14 (4)
Ancure[e]	13 (4)
Endurant[d]	11 (3)
Endologix[f]	10 (3)
Medtronic (unknown type)	7 (2)
Anaconda[g]	7 (2)
Viabahn[c]	3 (1)
Homemade endografts	2 (0.5)
Ovation[h]	1 (0.5)
Not reported	84 (23)

1. The 30-day/in-hospital mortality was **26.6%**
2. Overall follow-up mortality **was 45.7%**
3. The 30-day/in-hospital mortality for 9 **patients treated conservatively was 63.3%.**

Treatment and outcomes of aortic endograft infection

Matthew R. Smeds, MD,[a] Audra A. Duncan, MD,[b] Michael P. Harlander-Locke, MPH,[c] Peter F. Lawrence, MD,[d] Sean Lyden, MD,[e] Javariah Fatima, MD,[f] and Mark K. Eskandari, MD,[g] on behalf of the Vascular Low-Frequency Disease Consortium, *Little Rock, Ark; Rochester, Minn; Bradenton and Gainesville, Fla; Los Angeles, Calif; Cleveland, Ohio; and Chicago, Ill*

Variable[a]	*Extra-anatomic bypass (n = 11)*	*Prosthetic (n = 111)*	*Cryoallograft (n = 54)*	*NAIS (n = 21)*	P *value*
EBL, mL	3909 ± 1539	4142 ± 524	3588 ± 374	4986 ± 752	NS
Operative time, min	320 ± 99	359 ± 22	502 ± 54	543 ± 38	<.001
Perioperative mortality	2 (18)	14 (13)	4 (7)	2 (10)	.103
Complications	7 (64)	40 (36)	14 (26)	7 (33)	.046

EBL, Estimated blood loss; *NAIS*, neoaortoiliac system; *NS*, not significant.
[a]Continuous data are shown as the mean ± standard deviation and categoric data as number (%).

J Vasc Surg, 2016

- 206 patients (EVAR, n=180; TEVAR, n = 26)
- Survival 56% at 5 years

- Prosthetic graft (silver, rifampicin..) was associated with higher reinfection and graft-related complications and decreased survival compared with autogenous reconstruction.

Attikon Hospital, 2009-2019



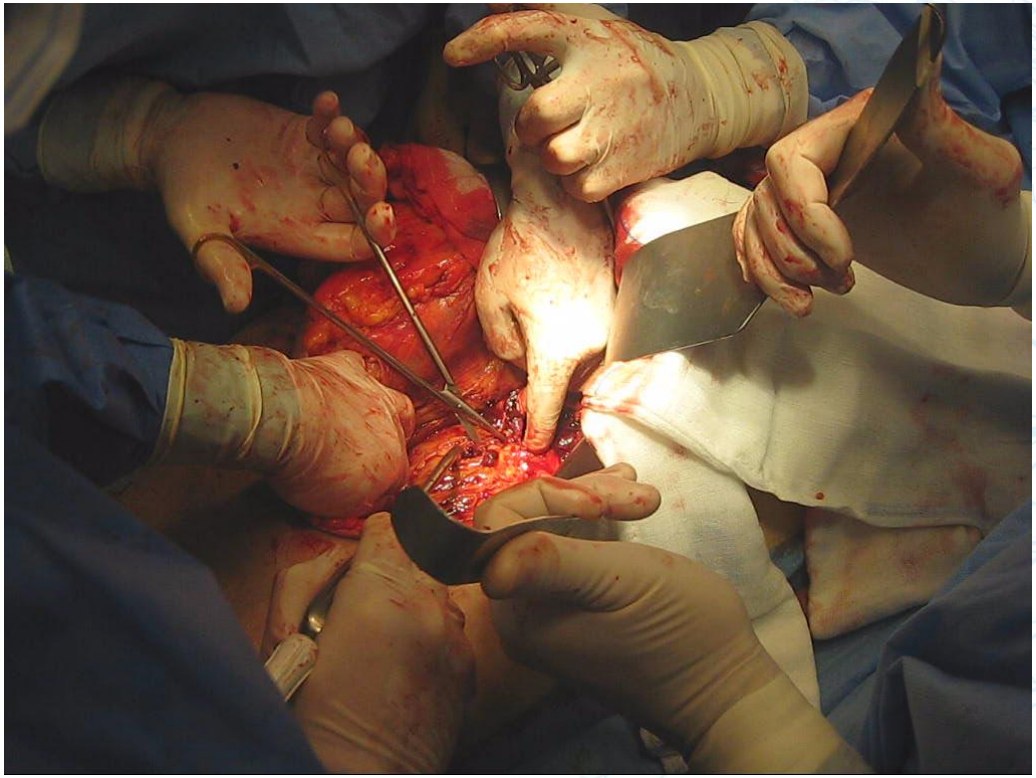
- Overall, **846 patients underwent EVAR**
- In total 9 cases of **endograft infection** **(0.82%/ 2 pts. from another institution)**.
- 4 Neo-aortoiliac System (NAIS)
- 2 Graft Excision & Extra-anatomic bypass
- 3 High Risk Patients, **CONSERVATIVE**

Endograft Infection ± AEF

	Type of Procedure	30-d Outcome	Recurrence of Infection	FU/Infection related Death
1	NAIS	ALIVE	YES	4m, DEATH
2	NAIS	DEATH	-	
3	NAIS	ALIVE	NO	ALIVE
4	NAIS	ALIVE	NO	ALIVE
5	EXCISION, BYPASS	ALIVE	NO	ALIVE
6	EXCISION, BYPASS	ALIVE	NO	ALIVE
7	DRAINAGE	ALIVE	YES	36m, DEATH
8	DRAINAGE	DEATH	-	
9 AEF	DRAINAGE,GUT REP.	ALIVE	YES	6m, DEATH

30-d Mortality: 16.6%, Overall FU (mean 38 ± 24 m) mortality 33.3%

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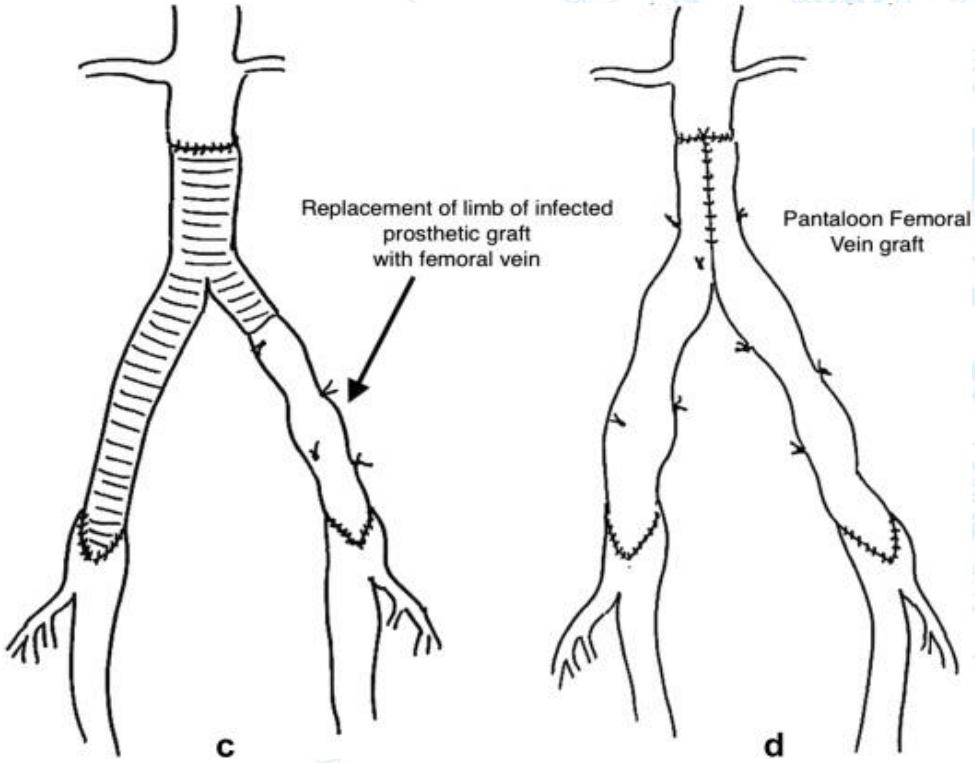




Endograft excision and axillary-bifemoral BP

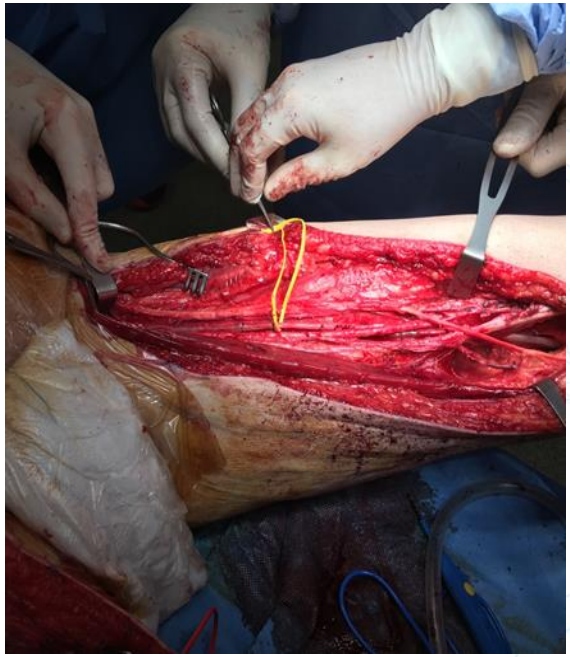
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Neo-aortoiliac System Procedure

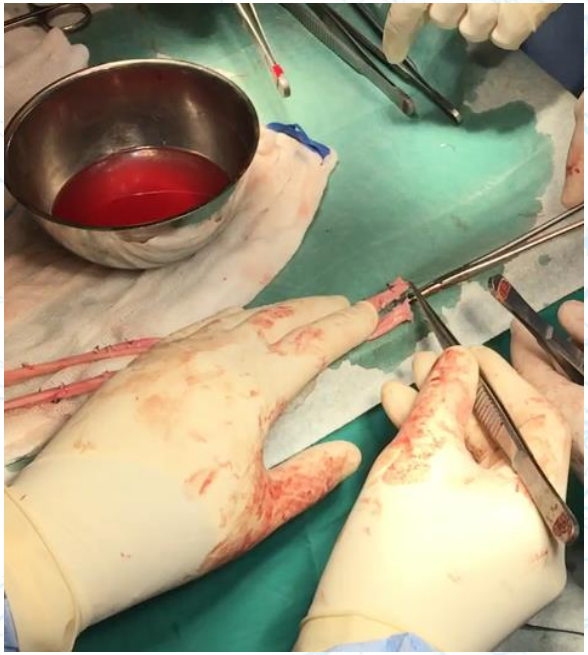


Clagett GP, et al. Creation of a neo-aortoiliac system from lower extremity deep and superficial veins. Ann Surg. 1993

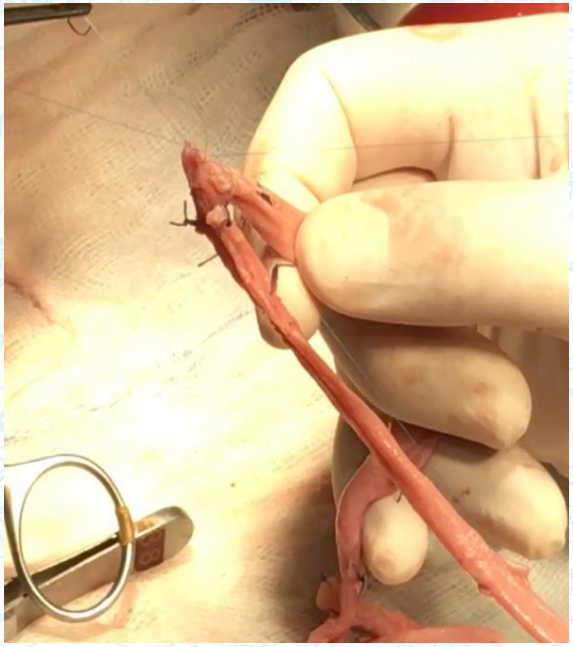
NAIS procedure



We take each femoral vein along its entire length from the profunda to the popliteal vein



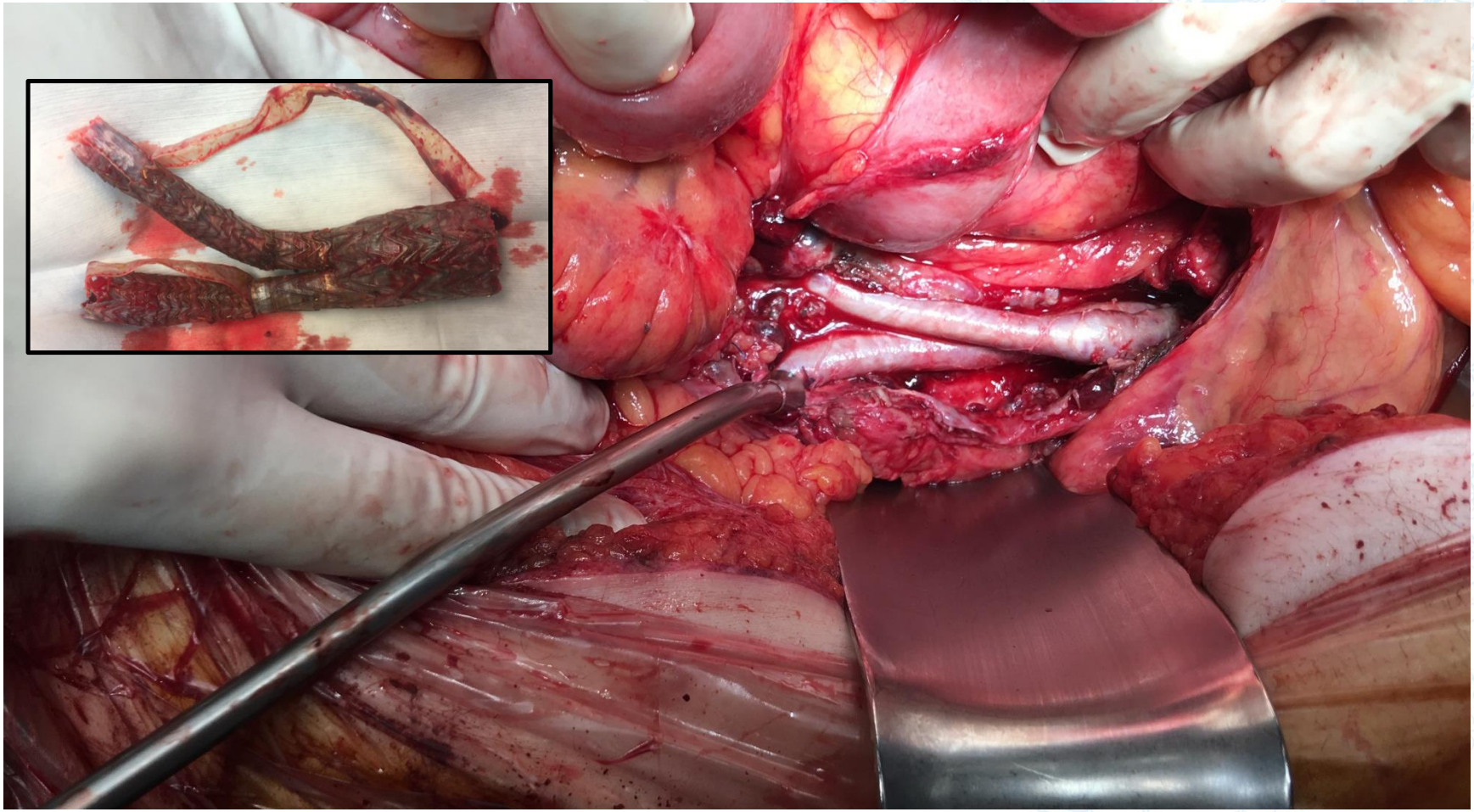
Longitudinal incision in each limb



the two veins are sewn together in a Y-shape fashion

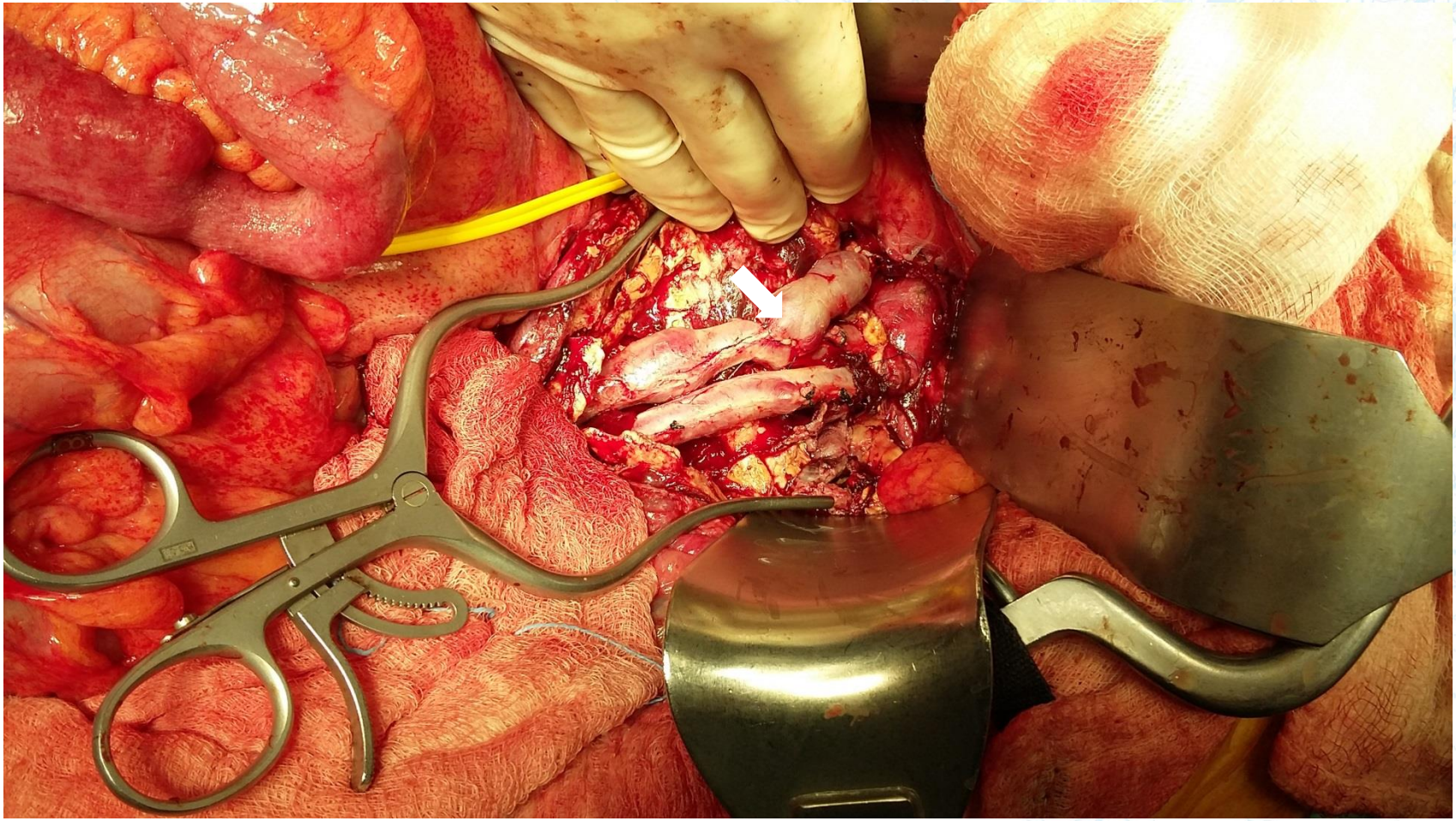
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NAIS procedure



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NAIS and bypass to the right renal artery



the graft is placed on the area of the excised endograft….

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Complications and Outcome

Variable[a]	*Extra-anatomic bypass (n = 11)*	*Prosthetic (n = 111)*	*Cryoallograft (n = 54)*	*NAIS (n = 21)*	P *value*
EBL, mL	3909 ± 1539	4142 ± 524	3588 ± 374	4986 ± 752	NS
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EBL, Estimated blood loss; *NAIS*, neoaortoiliac system; *NS*, not significant.
[a]Continuous data are shown as the mean ± standard deviation and categoric data as number (%).

Complication Rate 26-64 %

Perioperative Mortality 7-18 %

Long-term survival with a 5-year rate is around 50%

Smeds et al. JVS 2016, Chaufour X et al, J Vasc Surg, 2016 – Argyriou C et al, JEVT 2017

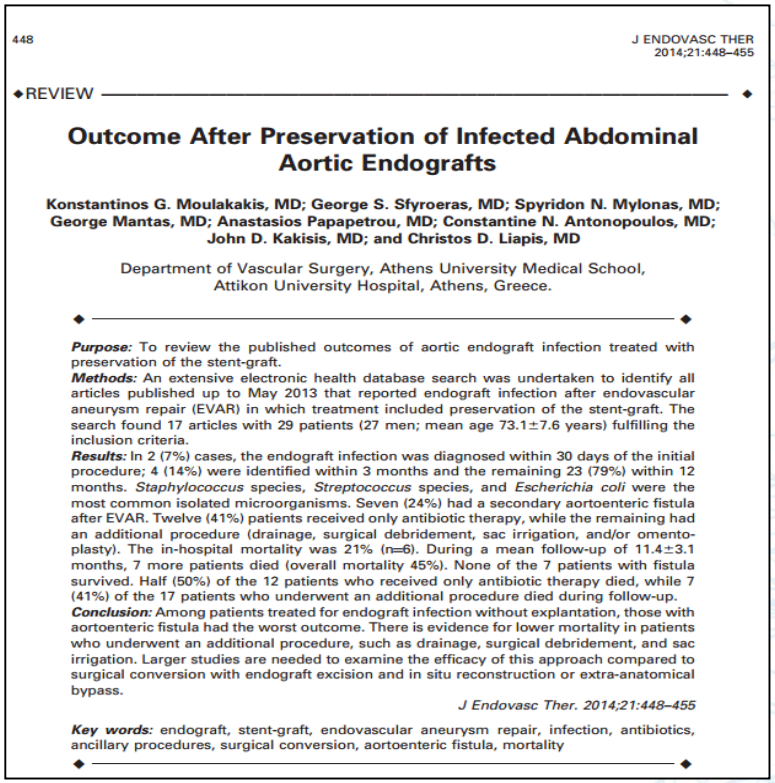
High mortality and morbidity rates, especially when undertaken in patients with severe comorbidities



The Graft Must Come Out: What If It Can't?

Is there alternative option ?

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Dept. of Vascular Surgery - University of Athens



448 J ENDOVASC THER 2014;21:448–455

REVIEW

Outcome After Preservation of Infected Abdominal Aortic Endografts

Konstantinos G. Moulakakis, MD; George S. Sfyroeras, MD; Spyridon N. Mylonas, MD; George Mantas, MD; Anastasios Papapetrou, MD; Constantine N. Antonopoulos, MD; John D. Kakisis, MD; and Christos D. Liapis, MD

Department of Vascular Surgery, Athens University Medical School, Attikon University Hospital, Athens, Greece.

Purpose: To review the published outcomes of aortic endograft infection treated with preservation of the stent-graft.
Methods: An extensive electronic health database search was undertaken to identify all articles published up to May 2013 that reported endograft infection after endovascular aneurysm repair (EVAR) in which treatment included preservation of the stent-graft. The search found 17 articles with 29 patients (27 men; mean age 73.1±7.6 years) fulfilling the inclusion criteria.
Results: In 2 (7%) cases, the endograft infection was diagnosed within 30 days of the initial procedure; 4 (14%) were identified within 3 months and the remaining 23 (79%) within 12 months. *Staphylococcus* species, *Streptococcus* species, and *Escherichia coli* were the most common isolated microorganisms. Seven (24%) had a secondary aortoenteric fistula after EVAR. Twelve (41%) patients received only antibiotic therapy, while the remaining had an additional procedure (drainage, surgical debridement, sac irrigation, and/or omentoplasty). The in-hospital mortality was 21% (n=6). During a mean follow-up of 11.4±3.1 months, 7 more patients died (overall mortality 45%). None of the 7 patients with fistula survived. Half (50%) of the 12 patients who received only antibiotic therapy died, while 7 (41%) of the 17 patients who underwent an additional procedure died during follow-up.
Conclusion: Among patients treated for endograft infection without explantation, those with aortoenteric fistula had the worst outcome. There is evidence for lower mortality in patients who underwent an additional procedure, such as drainage, surgical debridement, and sac irrigation. Larger studies are needed to examine the efficacy of this approach compared to surgical conversion with endograft excision and in situ reconstruction or extra-anatomical bypass.

J Endovasc Ther. 2014;21:448–455

Key words: endograft, stent-graft, endovascular aneurysm repair, infection, antibiotics, ancillary procedures, surgical conversion, aortoenteric fistula, mortality

Endograft Infection and Treatment with Preservation of the Endograft: Early Results in 3 Cases

Konstantinos G. Moulakakis,[1] Giorgos S. Sfyroeras,[1] John D. Kakisis,[1] Anastasios Papapetrou,[1] Constantine N. Antonopoulos,[1] George Mantas,[1] Elias N. Brountzos,[2] and Christos D. Liapis,[1] Athens, Greece

We present 3 cases of stent graft infection in patients who were treated with preservation of the endograft. In the first patient, the contamination of the endograft was the consequence of a bleeding aortoenteric fistula, whereas in the second patient, the endograft was implanted into a ruptured contaminated aortic aneurysm because of the patient's hemodynamic instability. In the third patient, the presence of a consistent type Ia endoleak after a chimney graft procedure followed by secondary interventions led to an infection of the stent graft. In each case, a laparotomy was performed with debridement, followed by appropriate antibiotic therapy. The first patient suffered a fatal pulmonary embolism. The other 2 patients are alive 4 and 24 months after the diagnosis of endograft infection. In unstable patients or those with severe comorbidities who cannot tolerate endograft excision and aortic reconstruction, surgical debridement followed by appropriate antibiotic therapy can be a temporary or bridging solution.

1991-2013 Systematic Review, 29 pts treated conservatively

1. Moulakakis KG, Sfyroeras GS, Mylonas SN, Mantas G, Papapetrou A, Antonopoulos CN, Kakisis JD, Liapis CD. Outcome after preservation of infected abdominal aortic endografts. J Endovasc Ther. 2014
2. Moulakakis KG, Liapis CD et al. Endograft infection and treatment with preservation of the endograft: early results in 3 cases. Ann Vasc Surg. 2014

Outcome After Preservation of Infected Abdominal Aortic Endografts

Konstantinos G. Moulakakis, MD; George S. Sfyroeras, MD; Spyridon N. Mylonas, MD; George Mantas, MD; Anastasios Papapetrou, MD; Constantine N. Antonopoulos, MD; John D. Kakisis, MD; and Christos D. Liapis, MD

Department of Vascular Surgery, Athens University Medical School, Attikon University Hospital, Athens, Greece.

J ENDOVASC THER
2014;21:448–455

29 Pts. were treated conservatively…

In-hospital mortality was **21%** (n=6).

During a brief mean follow-up of 11.4±3.1 months, **overall mortality 45%**.

Conclusions: There is evidence for **lower mortality in patients who underwent an additional procedure, such as drainage, surgical debridement, and sac irrigation compared to those receiving only antibiotics**.

Pts with fistula have a 100% mortality if left untreated

Preoperative Predictors of mortality due to endograft infection

- Presentation with severe sepsis
- Ongoing sepsis and not good response to antibiotics
- Polymicrobial sepsis and Gram (-) compared to Gram (+)
- AEF
- Advanced ASA physical status



Chaufour X et al, J Vasc Surg, 2016 – Argyriou C et al, J Endvoasc Ther, 2017

Conclusions

1. An open repair with endograft explantation is the ideal treatment option

2. Conservative treatment has a poor outcome and should be reserved only for high risk pts unfit for open repair

3. Operations are high-risk procedures due to underlying sepsis, comorbidities and the extent of resection required

4. They should be considered as emergency cases, otherwise severe sepsis or aortic fistula may occur



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Tips and Tricks for Open conversion and explantation of an Infected endograft

- Surgical approach
- Site of aortic cross-clamping
- Options for stent graft removal

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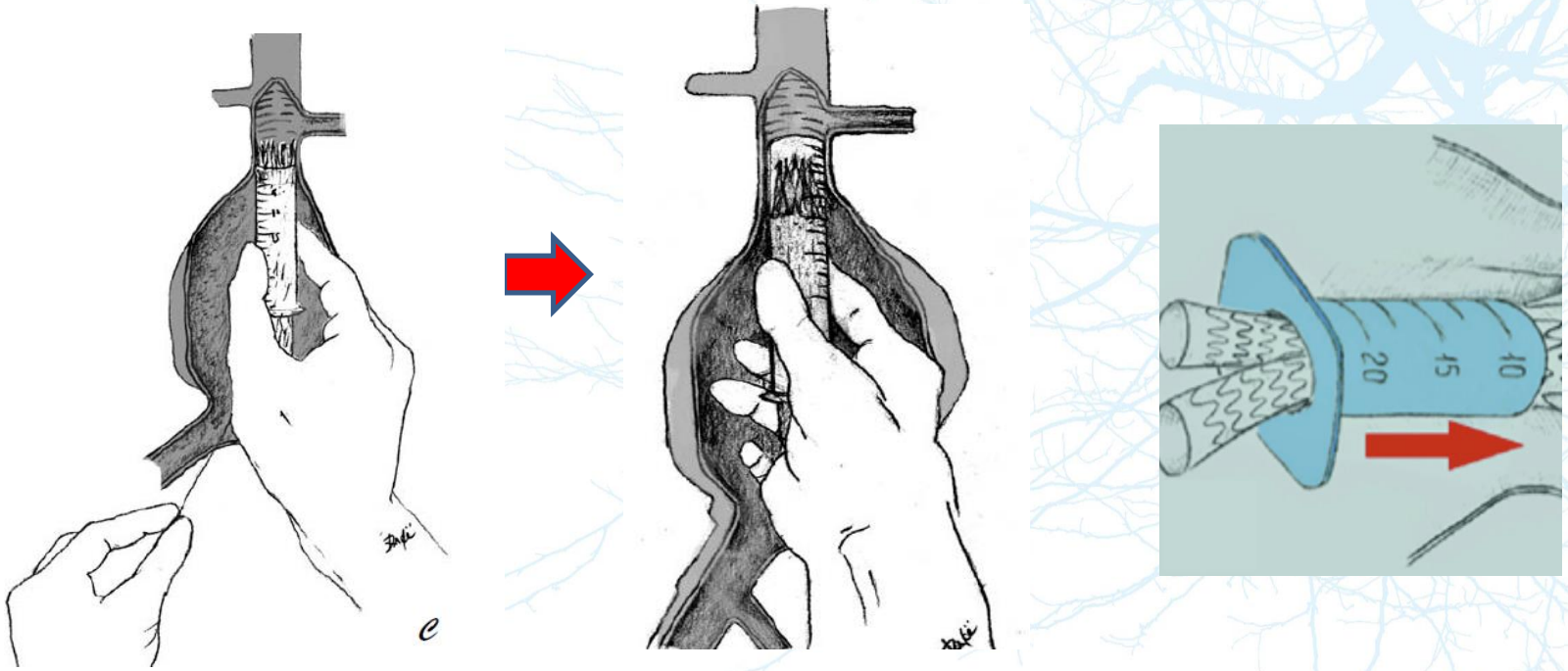
Explantation of an infrarenal endograft using the "clamp and pull" method

Gentle traction or traction with compression can be an effective retrieval maneuver for endografts without barbs or hooks



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Technical tip for Removal of an endograft with suprarenal fixation



Collapsing the proximal fixation into a 20-mL syringe. The main body is resheathed by advancing the device cranially while keeping the graft stable.

Koning OH. Technique for safe removal of an aortic endograft with suprarenal fixation. J Vasc Surg.2006

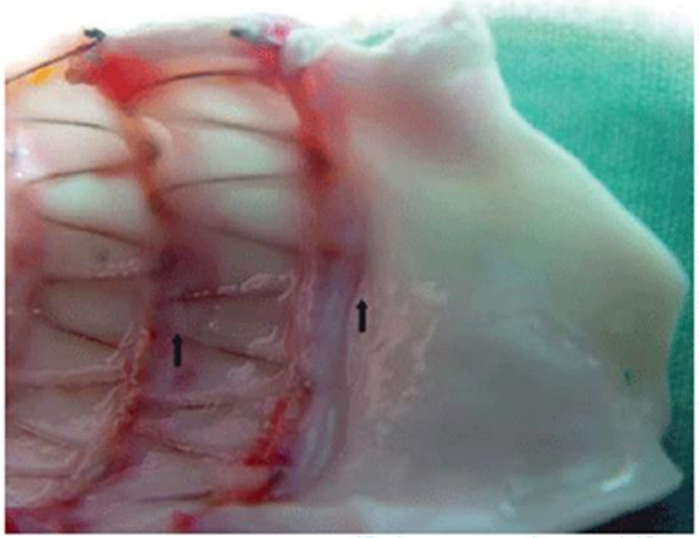
Conversion to Open Repair After Endografting for Abdominal Aortic Aneurysm: A Review of Causes, Incidence, Results, and Surgical Techniques of Reconstruction

Konstantinos G. Moulakakis, MD[1]; Ilias Dalainas, MD[1]; Spyridon Mylonas, MD[2]; Triantafillos G. Giannakopoulos, MD[1]; Efthimios D. Avgerinos, MD[1]; and Christos D. Liapis, MD[1]



Factors that may influence the feasibility of aortic stent-graft explantation

- The fixation system (hooks or barbs)
- The associated periaortic inflammatory reaction and endograft incorporation
- The presence of any additional grafts, cuffs, or coils placed as secondary interventions



JEVT 2010

Antimicrobial treatment

- Critical
- No evidence regarding the optimal duration, although a **minimum of 4-6 weeks intravenous** followed by **up to 6 months oral** therapy is advised
- When operation unacceptable (high risk) → long-term suppressive treatment, even life-long antibiotic administration