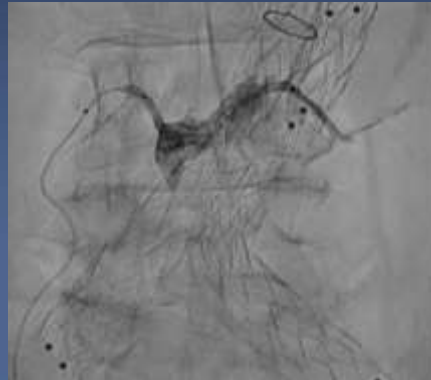


Type 2 Endoleaks Should Be Treated.

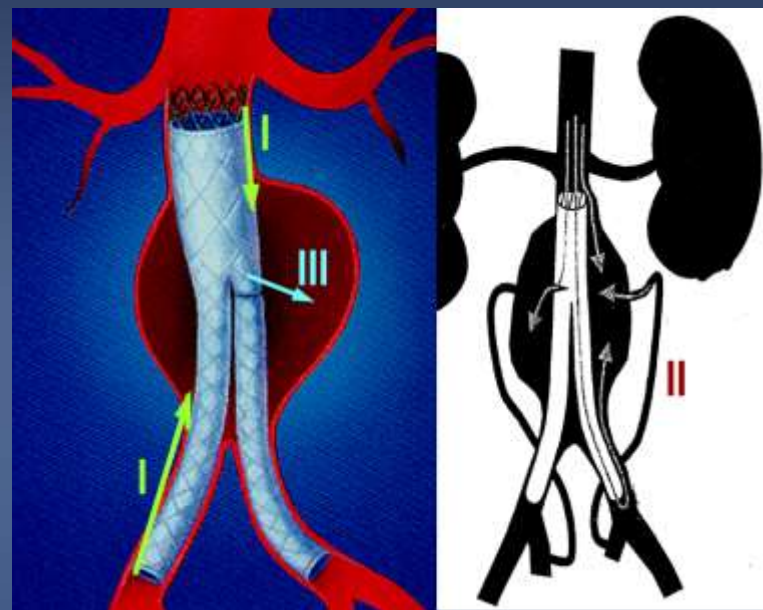


Hojong Chun, MD, PhD

Department of Radiology
Eunpyeong St. Mary's Hospital
The Catholic University of Korea

Classification of Endoleak

- Type 1 Attachment endoleaks (distal or proximal)
- **Type 2 Branch flow endoleaks (collateral)**
- Type 3 Mid-graft or Modular
- Type 4 Fabric porosity
- Type 5 Endotension



Natural Course of Type 2 Endoleak

- Most common cause of endoleaks after EVAR
- Incidence ~25% at repair, 10~15% at 6 months
- Spontaneous resolution: 50% at 1 year
- Risk rupture: 0.9 % from meta-analysis

- Persistent (> 6 months) type 2 endoleak: 20%
- High incidence of secondary intervention: 20%
- Aneurysm sac expansion : ~38%

→ Not always benign in nature

Treatment Options for Type 2 Endoleak

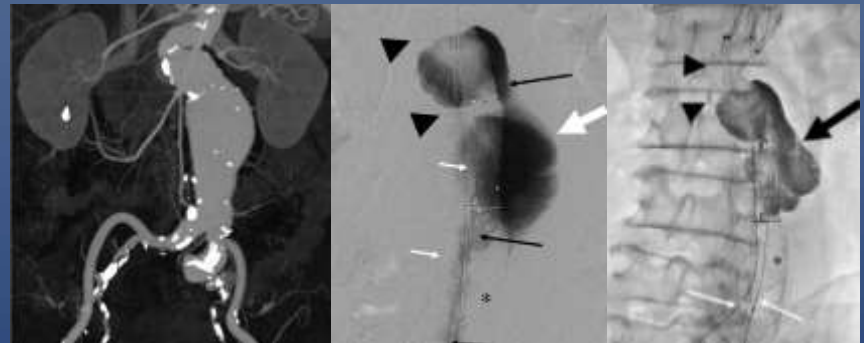
- **Pre-EVAR**

- Prophylactic embolization of possible feeding artery
: Inferior mesenteric, lumbar, accessory renal arteries



- **During EVAR**

- Sac embolization
- EVAS with Nellix system

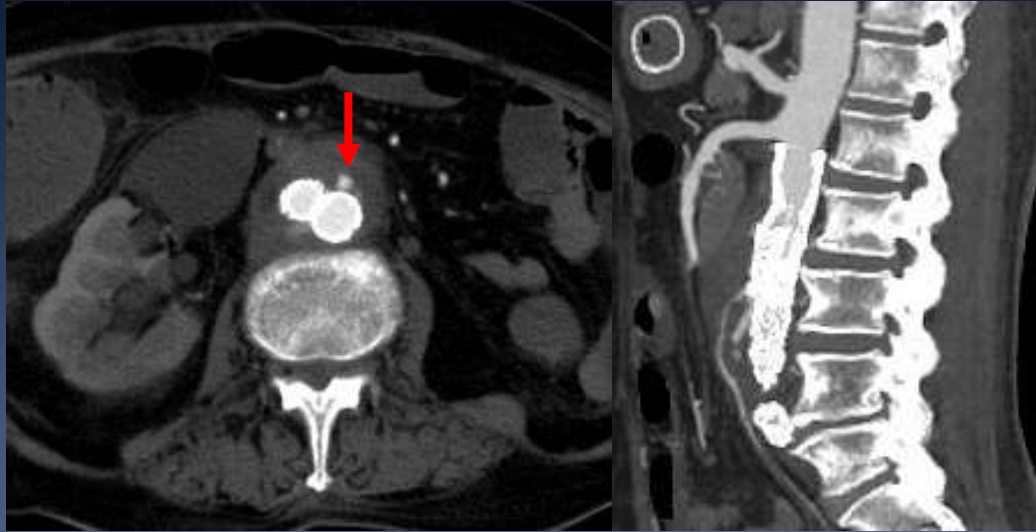


- **Post-EVAR**

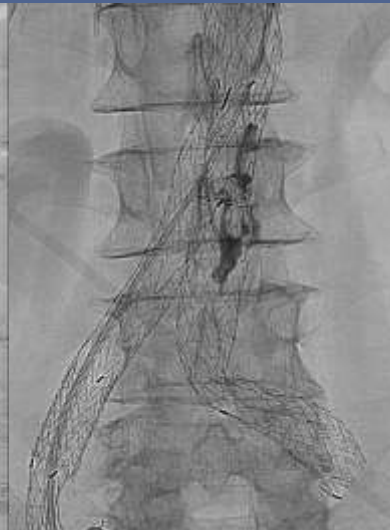
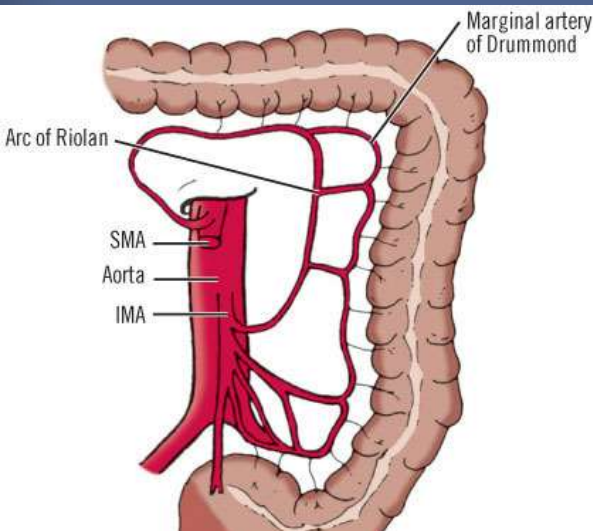
Post-EVAR Embolization

- **Transarterial approach**
- **Sac puncture**
 - Direct
 - Transcaval
- **Transealing or perigraft approach**

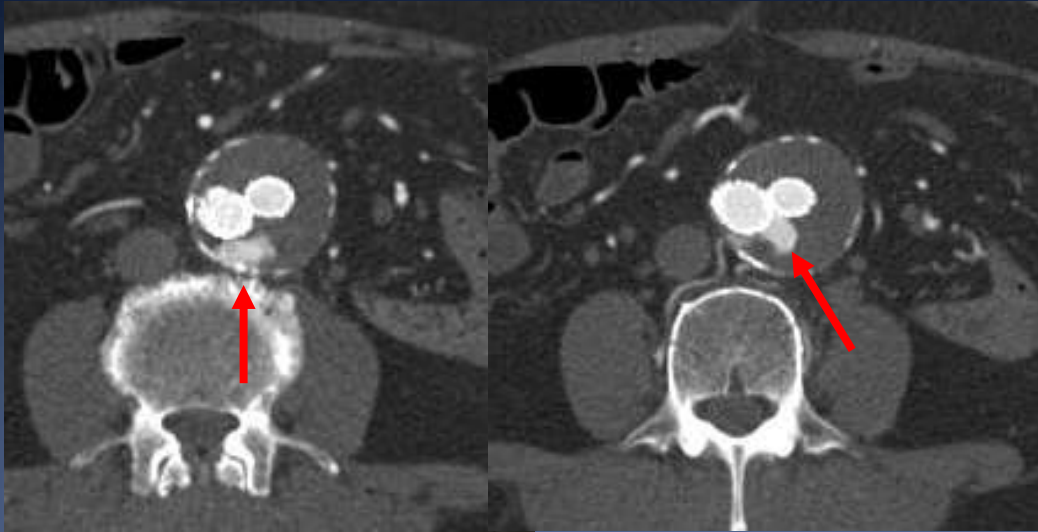
Transarterial Approach



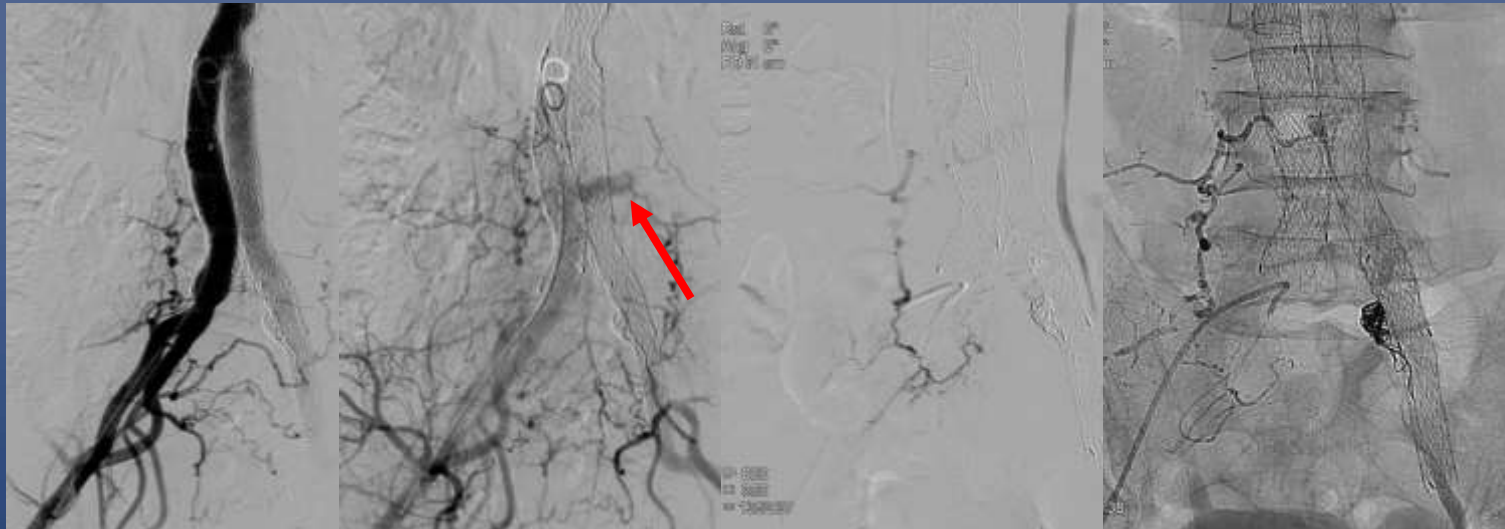
- Usually endoleak at the anterior portion of the sac
- Catheterization from SMA via marginal artery of Drummond or arc of Riolan



Transarterial Approach



- Usually endoleak at the posterior portion of the sac
- Catheterization from hypogastric artery via iliolumbar branches



Transarterial Approach

Target arteries

- Inferior mesenteric artery
- Lumbar arteries

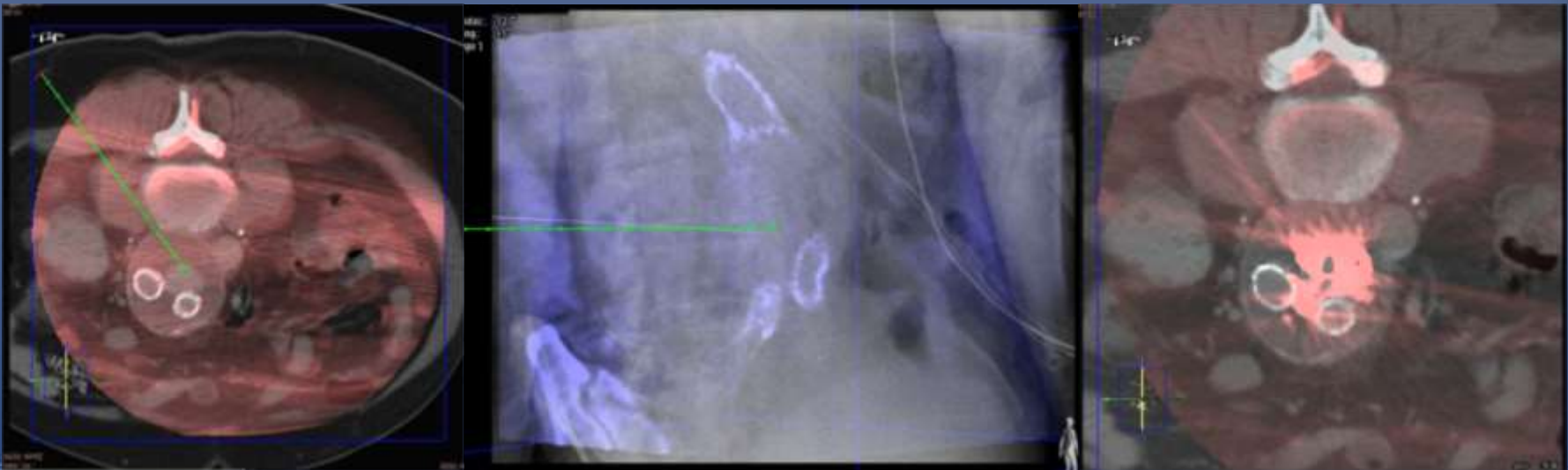
Limitations

- Difficult catheterization due to tortuous collaterals
- Vessel rupture or dissection during catheterization
- Previous feeding artery coiling

Direct Sac Puncture

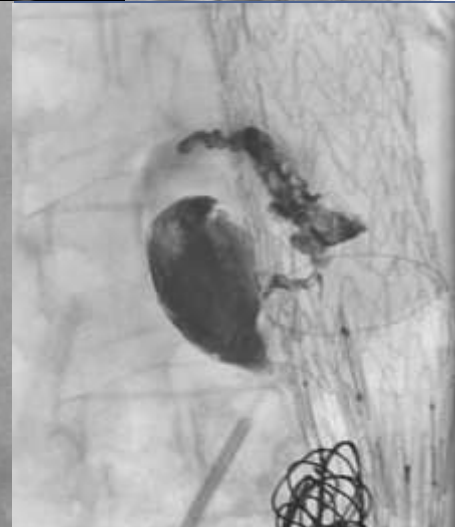
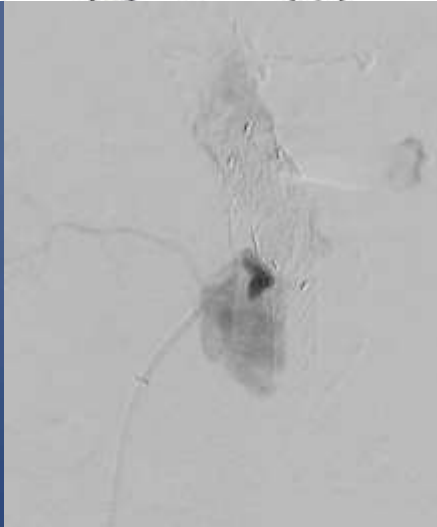
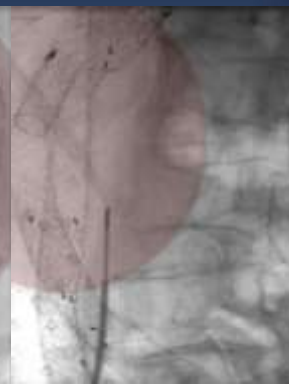
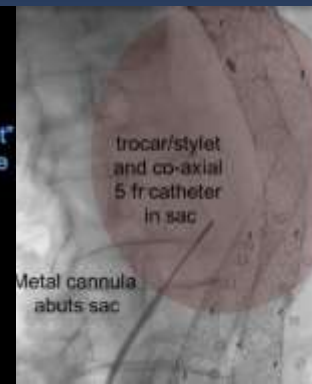
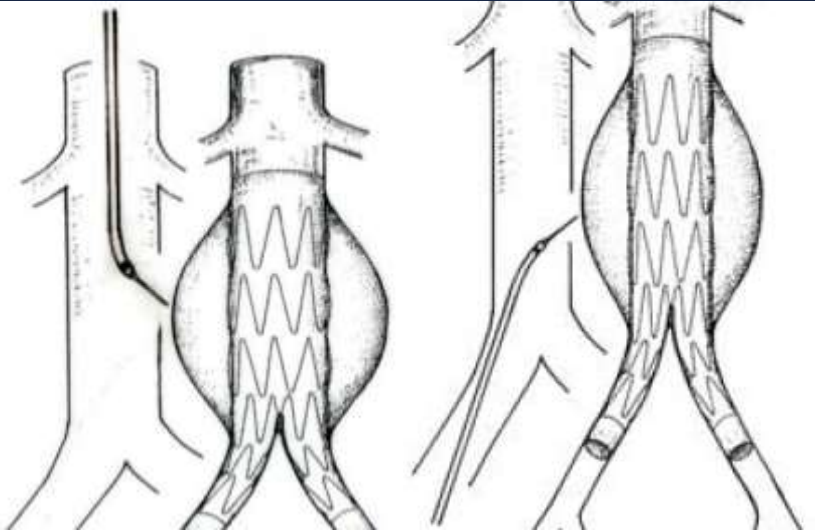
Techniques

- CT-guided or C-arm CT-guided
- Usually prone position (“Translumbar Approach”)
- 21G Chiba needle
- Ideal pathway : through the lumbar & psoas muscles
- Embolization materials: microcoils, glue or Onyx



Transcaval Sac Puncture

- TIPS or transseptal needle
- Under fluoroscopy guidance



Transealing Approach

Transealing: A Novel and Simple Technique for Embolization of Type 2 Endoleaks Through Direct Sac Access From the Distal Stent-graft Landing Zone

G. Coppi, G. Saitta, G. Coppi^{*}, S. Gennai, A. Lauricella, R. Silingardi

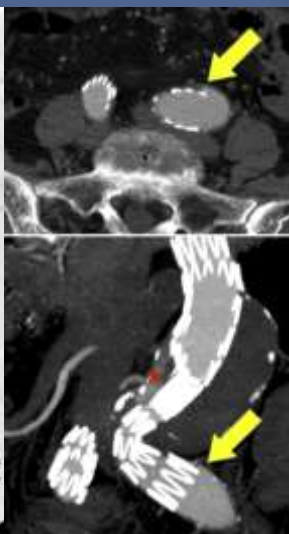
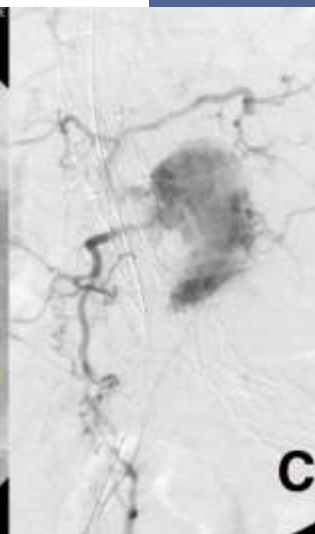
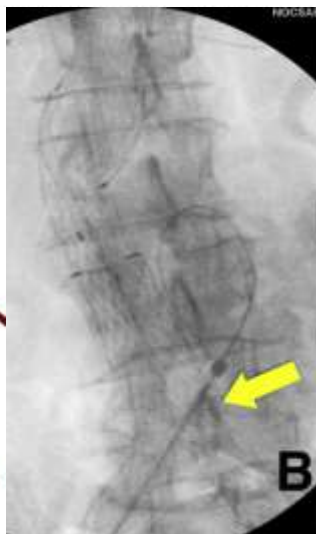
Department of Vascular Surgery, Nuovo Ospedale Civile S. Agostino-Estense, Baggiovara — University of Modena and Reggio Emilia, Modena, Italy

Objective: Type 2 endoleak (T2EL) is the Achilles' heel of endovascular abdominal aortic aneurysm repair. Experience with transealing, an alternative technique for the treatment of T2ELs, is described.

Methods: The outcome of a group of patients treated with transealing has been reviewed. Femoral access was obtained with a 9-Fr sheath. A super-stiff guide wire and a stiff hydrophilic wire were placed inside the stent-graft and a Piton GC catheter inserted. The stiff hydrophilic wire was retrieved to allow the catheter to regain its curvature and the catheter tip was placed against the iliac wall, at the edge of the stent-graft. The hydrophilic wire was then forced between the stent-graft and arterial wall into the sac. A 5/6-Fr introducer was inserted inside the sac and angiography was performed to evaluate the leak. Coils, cyanoacrylate, or fibrin glue were deployed. After removal of the catheters, the iliac limb was ballooned.

Results: Seventeen patients were treated between aneurysm in 16/17 attempts. One patient treated with an intraoperative secondary type 1b endoleak was treated. Three months of follow-up were completed in 14 patients. The success rate was 45%. During the study period, there was no need for a re-embolization procedure. The remaining leaks remained stable.

Conclusions: This study shows that transealing is a safe and effective technique for the treatment of Type 2 endoleaks. The advantages of this technique are mainly its low cost and the possibility of performing it in an outpatient setting.



When Treatment for Type 2 Endoleak?

Practice Guidelines by European Society of Vascular Surgery (2011)

Type II endoleaks without increased sac diameter can be observed. Level 2b, Recommendation B.

Endovascular or laparoscopic treatment is recommended for Type II endoleaks with increased sac diameter ≥ 10 mm, with conversion to open surgery in case of failure. Level 2b, Recommendation B.

Practice Guidelines by Society of Vascular Surgery (2018)

We suggest treatment of type II endoleaks associated with aneurysm expansion.	
Level of recommendation	2 (Weak)
Quality of evidence	C (Low)
We recommend surveillance of type II endoleaks not associated with aneurysm expansion.	
Level of recommendation	1 (Strong)
Quality of evidence	B (Moderate)

*aneurysm expansion ≥ 5 mm

Treatment Indication for Type 2 Endoleak

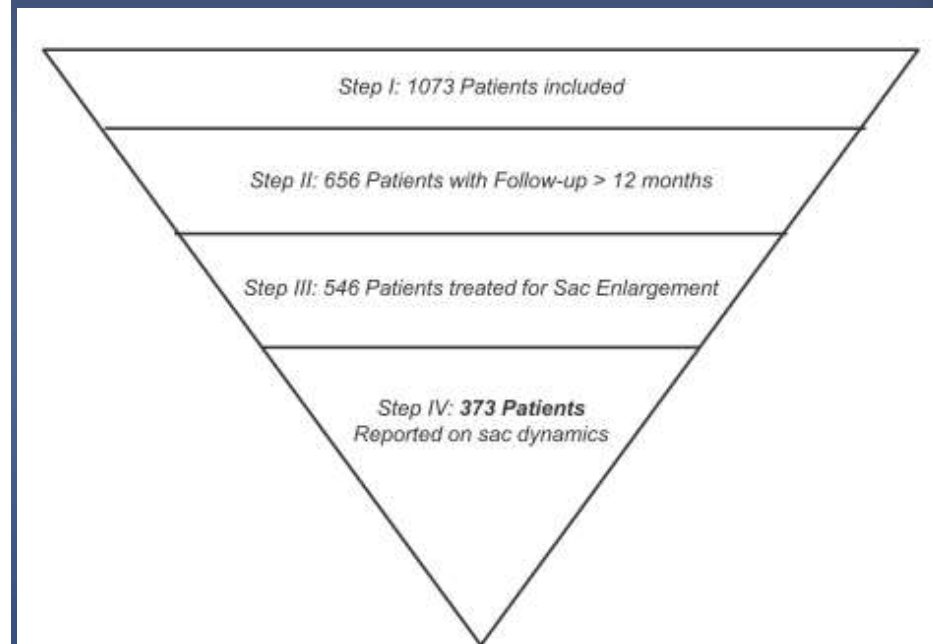
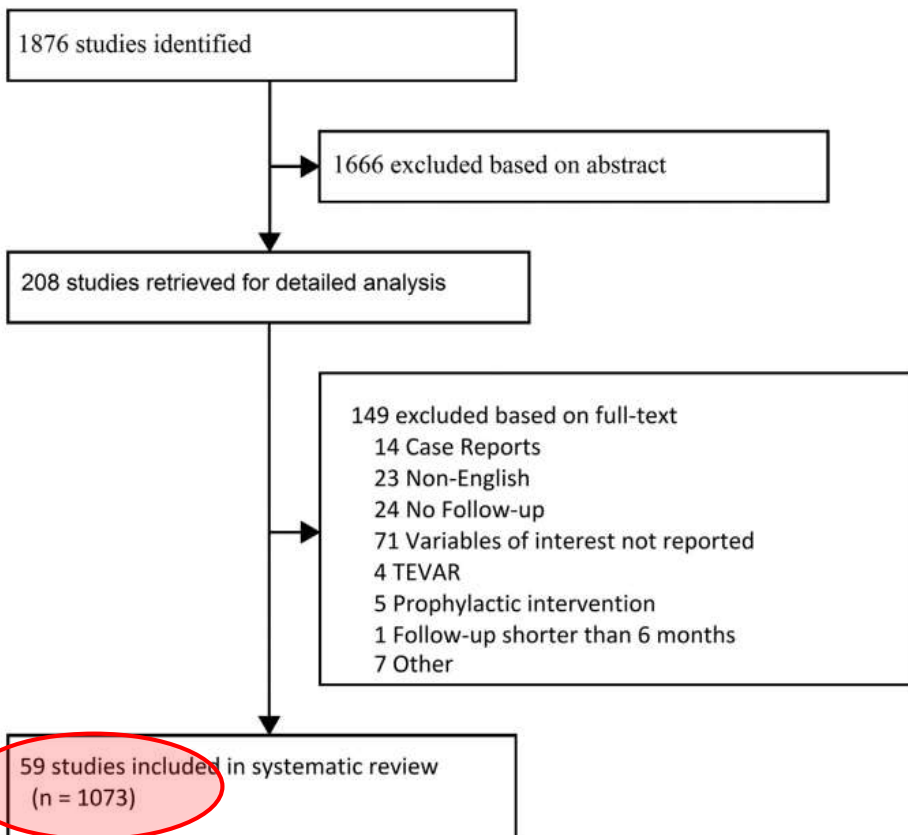
- **Sac expansion** is most important indication to treat type 2 endoleak.
- Sac expansion means high aneurysmal sac pressure, possibly resulting in aneurysmal rupture.
- Little evidence supporting threshold of aneurysmal expansion for type 2 endoleak treatment (≥ 5 mm vs ≥ 10 mm).
- Other suggested indications
 - Any new type 2 endoleak “delayed”
 - Any increase in amount of endoleak
 - Any persistent type 2 endoleak more than 6 months.

**Type 2 endoleak should be treated
only in cases of sac expansion.
(by practice guideline or experts consensus)**

Reintervention vs Observation in Type 2 Endoleak

REVIEW

Editor's Choice – Systematic Review and Meta-Analysis of the Outcome of Treatment for Type II Endoleak Following Endovascular Aneurysm Repair



Reintervention vs Observation in Type 2 Endoleak

REVIEW

Editor's Choice — Systematic Review and Meta-Analysis of the Outcome of Treatment for Type II Endoleak Following Endovascular Aneurysm Repair

- Treatment indications : sac expansion (74%)
- Technical success : 88%
- Clinical success (sac stabilization) : 78%
- Second reintervention : 15%
- Aneurysm rupture: 1.5% (almost same with general EVAR registry)
- AAA-related mortality after type 2 endoleak treatment : 1.8%
- Perioperative complications : 4%
 - Cardiac complications, colonic ischemia, contrast nephropathy

Reintervention vs Observation in Type 2 Endoleak

REVIEW

Editor's Choice — Systematic Review and Meta-Analysis of the Outcome of Treatment for Type II Endoleak Following Endovascular Aneurysm Repair

- There is little evidence supporting the efficacy of secondary intervention for type 2 endoleaks after EVAR.
- Although generally safe, the lack of evidence supporting the efficacy of type 2 endoleak treatment leads to difficulty in assessing its merits.

Observation > Reintervention even in case of sac expansion ?

Reintervention vs Observation in Type 2 Endoleak

REVIEW

Editor's Choice — Systematic Review and Meta-Analysis of the Outcome of Treatment for Type II Endoleak Following Endovascular Aneurysm Repair

- Technical success : 88% ???

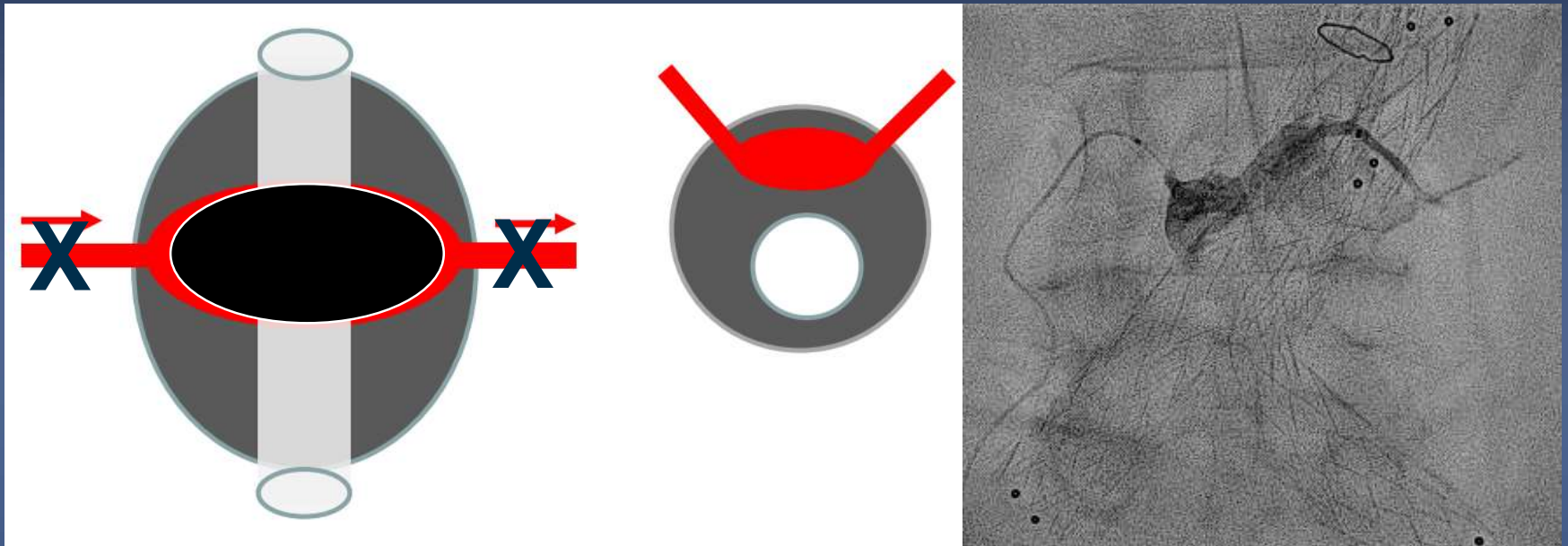
Reintervention vs Observation in Type 2 Endoleak

REVIEW

Editor's Choice — Systematic Review and Meta-Analysis of the Outcome of Treatment for Type II Endoleak Following Endovascular Aneurysm Repair

- Technical success : 88% ???
- Transarterial embolization : 84% vs Translumbar embolization 98%
- Type 2 endoleak mimics behavior of complex arteriovenous malformation; nidus + multiple feeding/draining branches.

Treatment Principle in Type 2 Endoleak

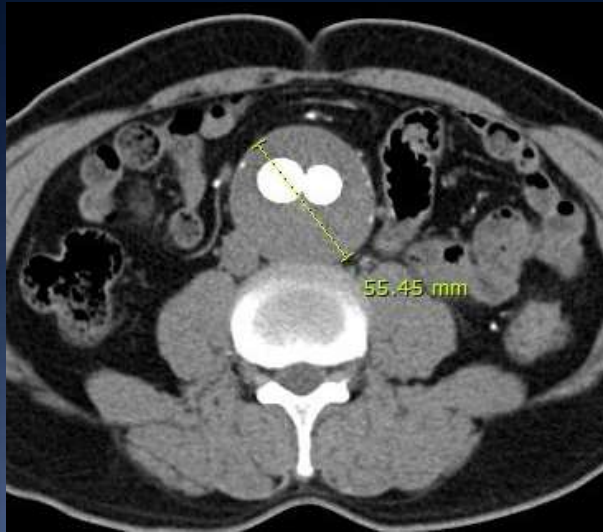


Reintervention vs Observation in Type 2 Endoleak

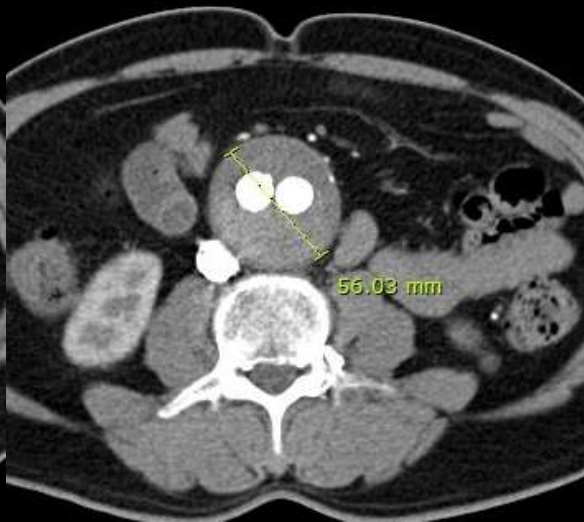
REVIEW

Editor's Choice — Systematic Review and Meta-Analysis of the Outcome of Treatment for Type II Endoleak Following Endovascular Aneurysm Repair

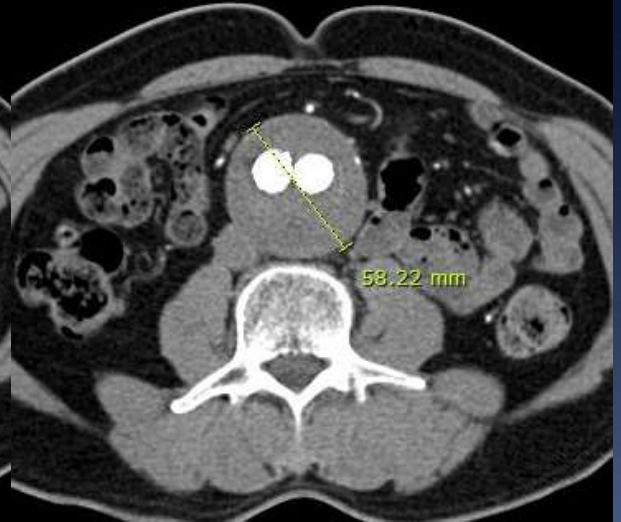
- Technical success : 88% ???
- Transarterial embolization : 84% vs Translumbar embolization 98%
- Type 2 endoleak mimics behavior of complex arteriovenous malformation; nidus + multiple feeding/draining branches.
- **Treatment principle:**
 - all feeding/draining branches interruption
 - all persistent aneurysmal sac (nidus) thrombosis



Post-EVAR 1 month
55 mm



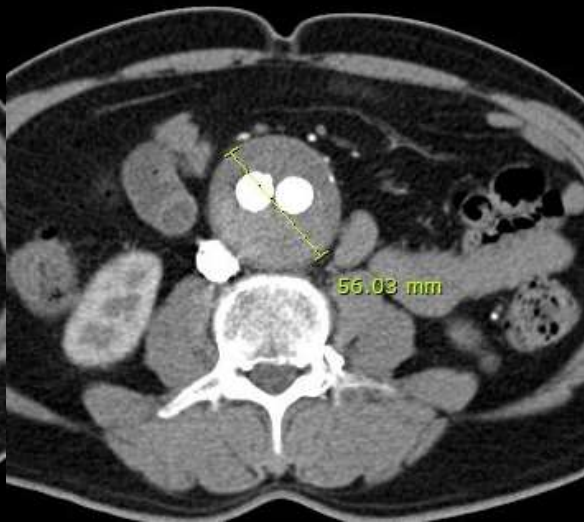
6 month FU
56 mm



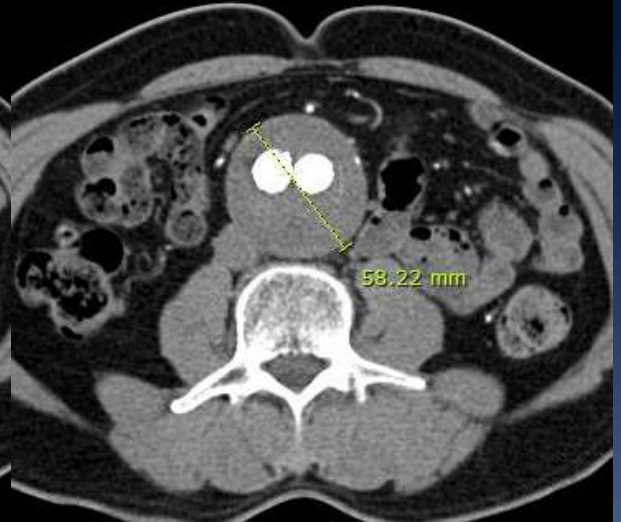
12 month FU
58 mm



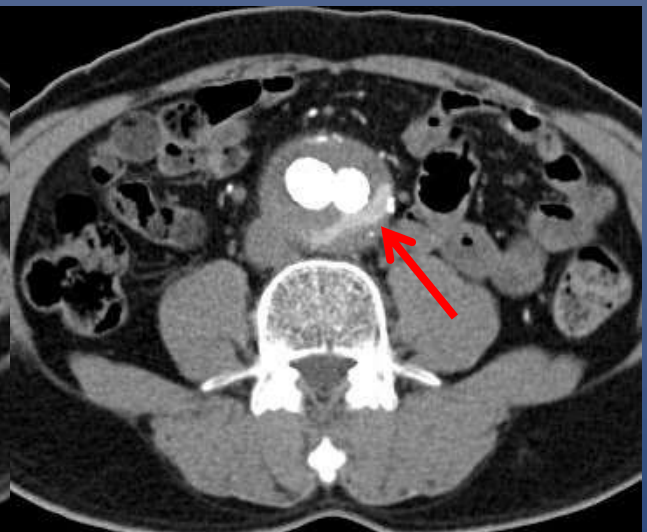
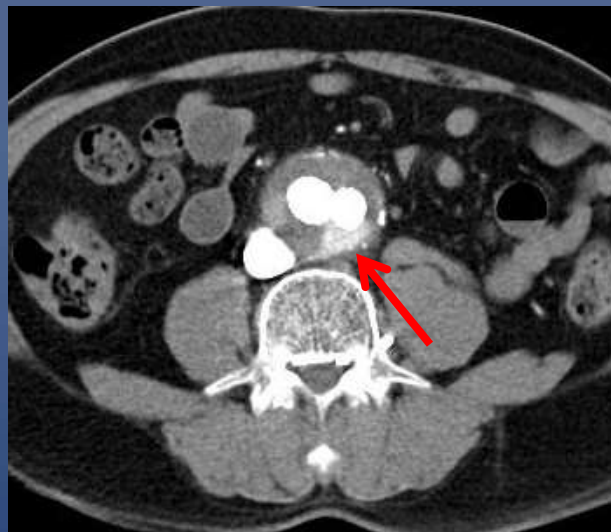
Post-EVAR 1 month
55 mm



6 month FU
56 mm



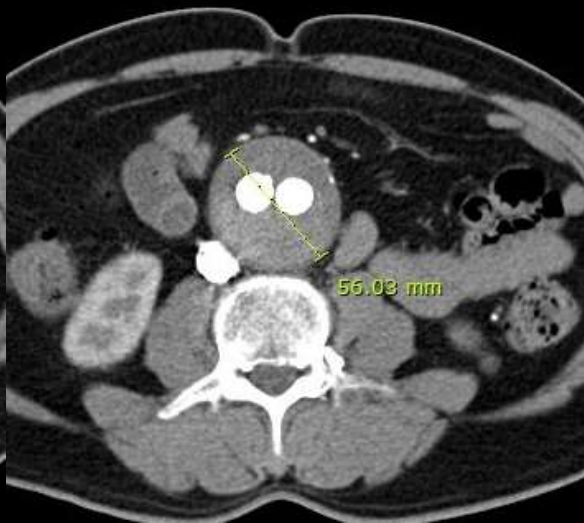
12 month FU
58 mm



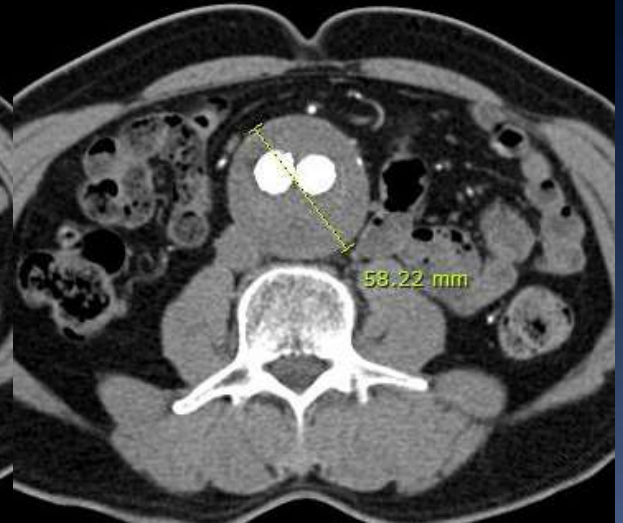
increased amount of endoleak



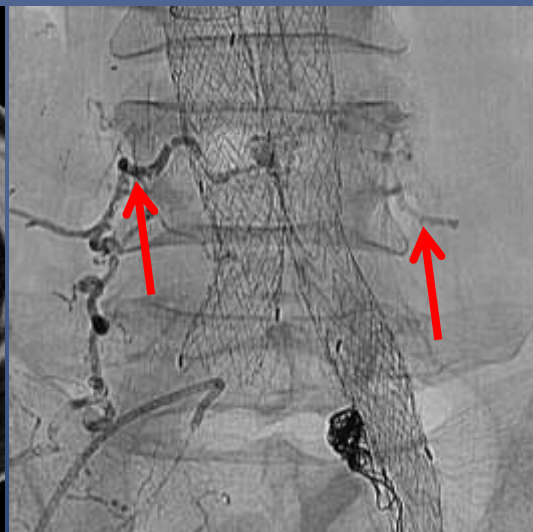
Post-EVAR 1 month
55 mm



6 month FU
56 mm



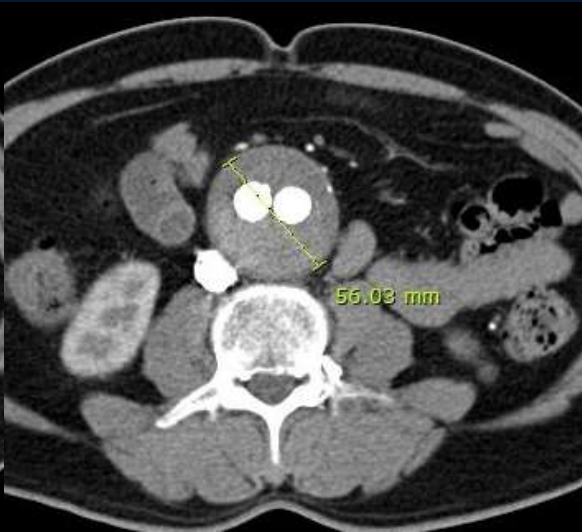
12 month FU
58 mm



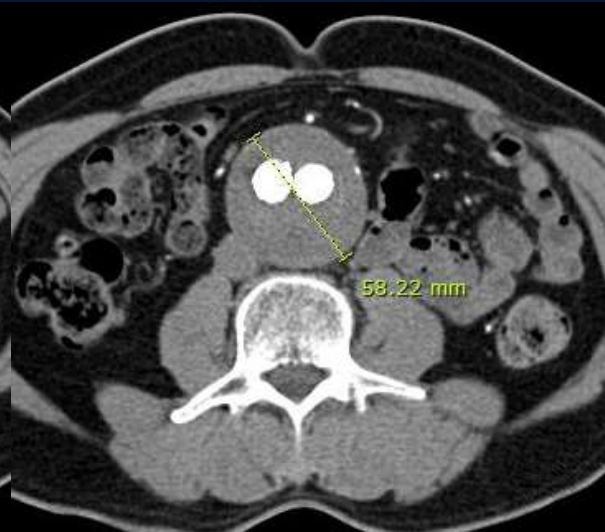
Glue embolization



Post-EVAR 1 month
55 mm



6 month FU
56 mm



12 month FU
58 mm



Post-embo 3 month



6 month FU



12 month FU

Type 2 endoleak should be treated with complete embolization of nidus as well as all feeding and draining branches.

Reintervention vs Observation in Type 2 Endoleak

REVIEW

Editor's Choice — Systematic Review and Meta-Analysis of the Outcome of Treatment for Type II Endoleak Following Endovascular Aneurysm Repair

- Clinical success (sac stabilization) : 78%
- Aneurysm rupture: 1.5% (almost same with general EVAR registry)
- **Was every type 2 endoleak really isolated or pure ???**

Occult Type 1 or 3 Endoleak



Type 2 from IMA

Occult Type 3

Occult Type 1 or 3 Endoleak



Occult Type 3



Additional BMS
/balloon PTA

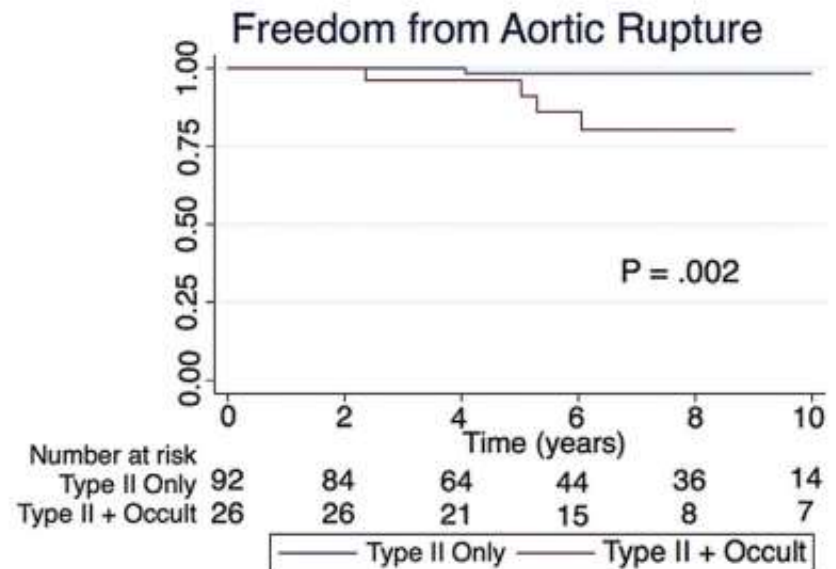
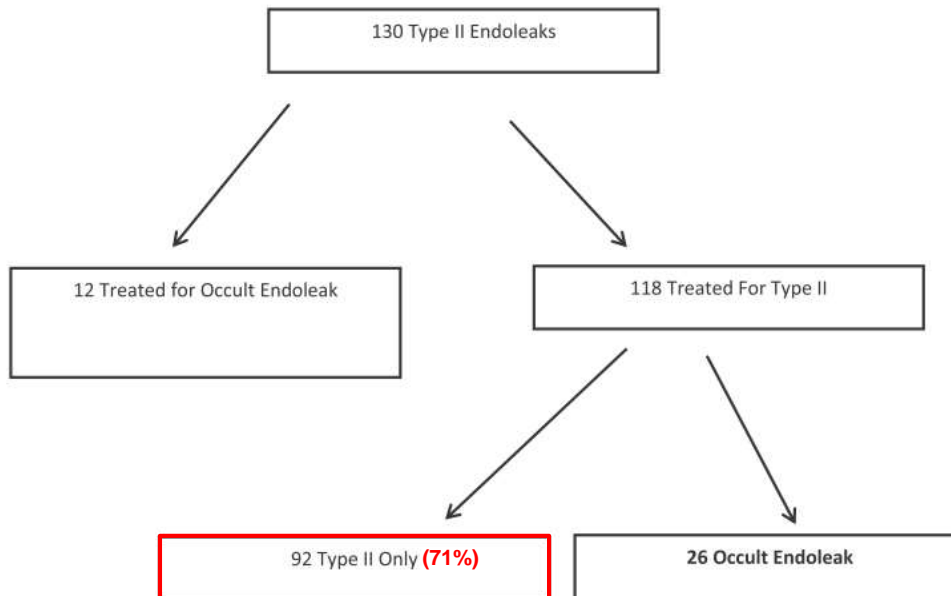


No Residual
endoleak

Occult Type 1 or 3 Endoleak

Occult type I or III endoleaks are a common cause of failure of type II endoleak treatment after endovascular aortic repair

Michael C. Madigan, MD, Michael J. Singh, MD, Rabih A. Chaer, MD, Georges E. Al-Khoury, MD, and Michel S. Makaroun, MD, Pittsburgh, Pa



**Type 2 endoleak should be treated
after occult type 1 or type 3 endoleak is excluded
on conventional angiography.**

Reintervention vs Observation in Type 2 Endoleak

REVIEW

Editor's Choice — Systematic Review and Meta-Analysis of the Outcome of Treatment for Type II Endoleak Following Endovascular Aneurysm Repair

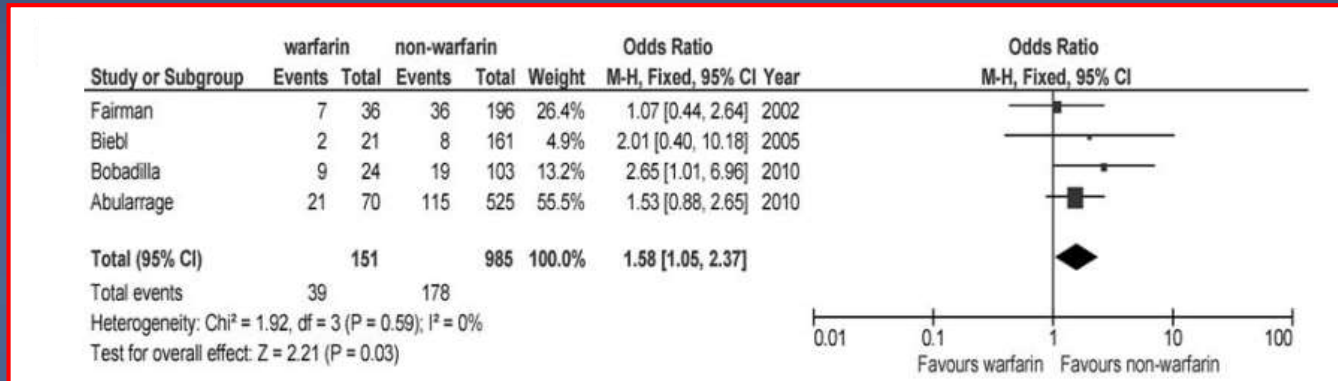
- Clinical success (sac stabilization) : 78.4%
- Secondary aneurysm rupture: 1.5%
- **Were there any patients with long-term anticoagulation or anti-platelet therapy ???**

Anticoagulation & Type 2 Endoleak

◆ META-ANALYSIS ◆

Impact of Long-Term Warfarin Treatment on EVAR Durability: A Meta-Analysis

Miltos K. Lazarides, MD, FEBVS; George S. Georgiadis, MD; Dimitrios G. Charalampidis, MD; George A. Antoniou, MD, PhD; Efstratios I. Georgakarakos, MD; and George Trellopoulos, MD



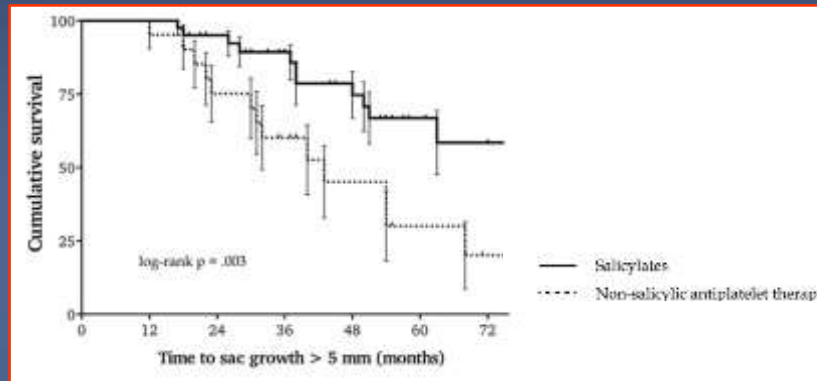
- Long-term anticoagulation in EVAR patients was associated with a statistically significant increase in any endoleak (p=0.001) and persisting type 2 endoleaks (p=0.03).

Antiplatelet Therapy & Type 2 Endoleak

Effect of antiplatelet therapy on aneurysmal sac expansion associated with type II endoleaks after endovascular aneurysm repair



Francisco Álvarez Marcos, MD, MSc,^a José Manuel Llana Coto, MD, PhD,^b
Francisco José Franco Mejjide, MD,^a Ahmad Amer Zanabali Al-Sibbai, MD,^b Jorge Vilariño Rico, MD, PhD,^a
Manuel Alonso Pérez, MD, PhD,^b and Santiago Caeiro Quinteiro, MD,^a A Coruña and Oviedo, Spain



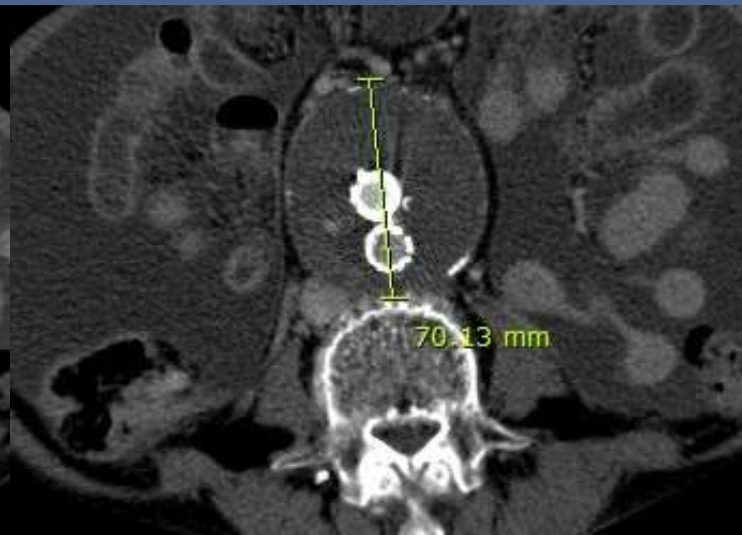
- Antiplatelet therapy with salicylates appears to be linked to a decreased risk of sac expansion > 5 mm in patients with type 2 endoleaks. → Other antiplatelet therapy may be more closely related to sac expansion.



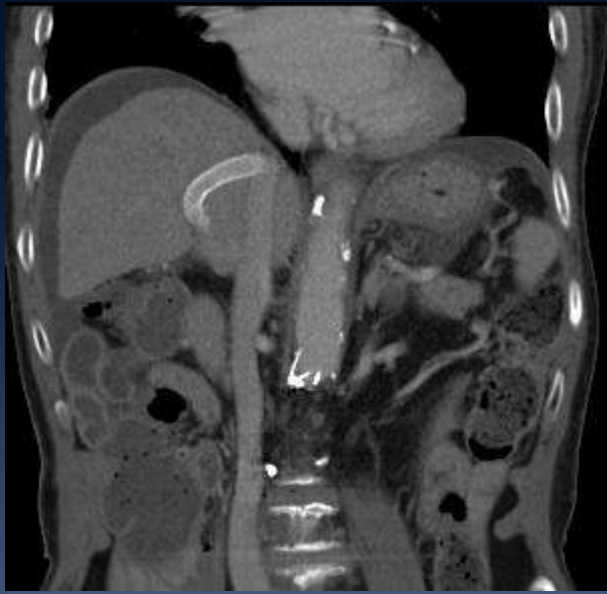
Liver Cirrhosis Patients with TIPS stent
Dual antiplatelet therapy



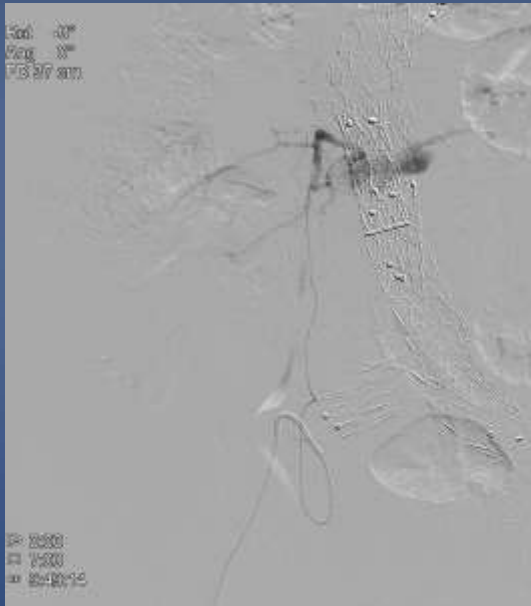
Pre-EVAR
65 mm



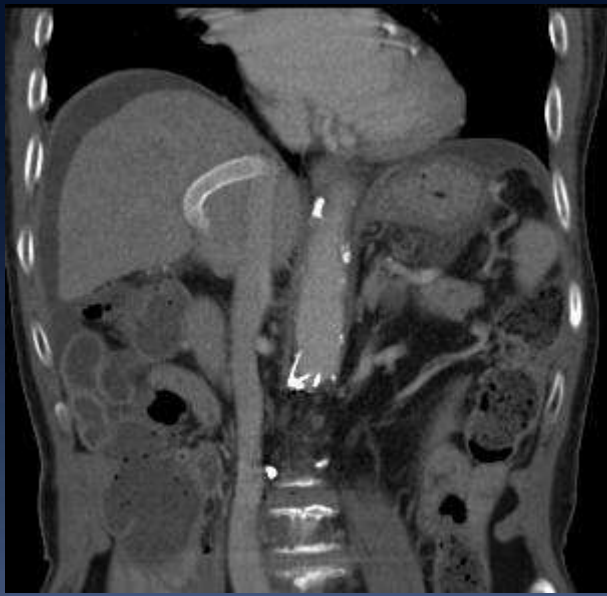
Post-EVAR 1 month
70 mm



Liver Cirrhosis Patients with TIPS stent
Dual antiplatelet therapy



Glue embolization



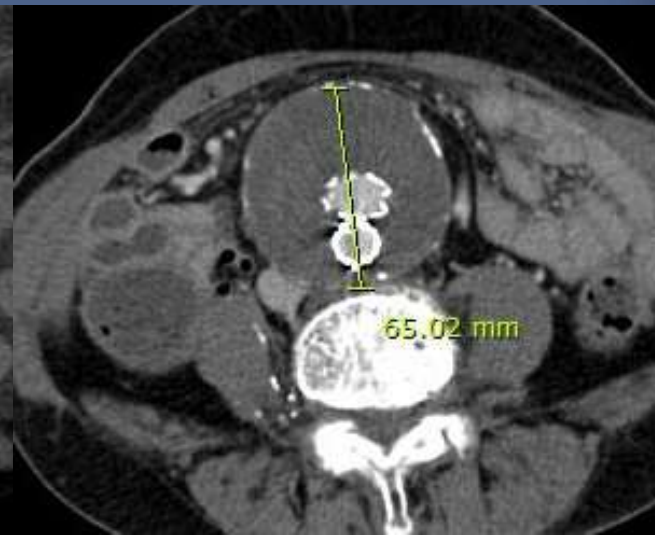
Liver Cirrhosis Patients with TIPS stent Dual antiplatelet therapy



Pre-EVAR
65 mm



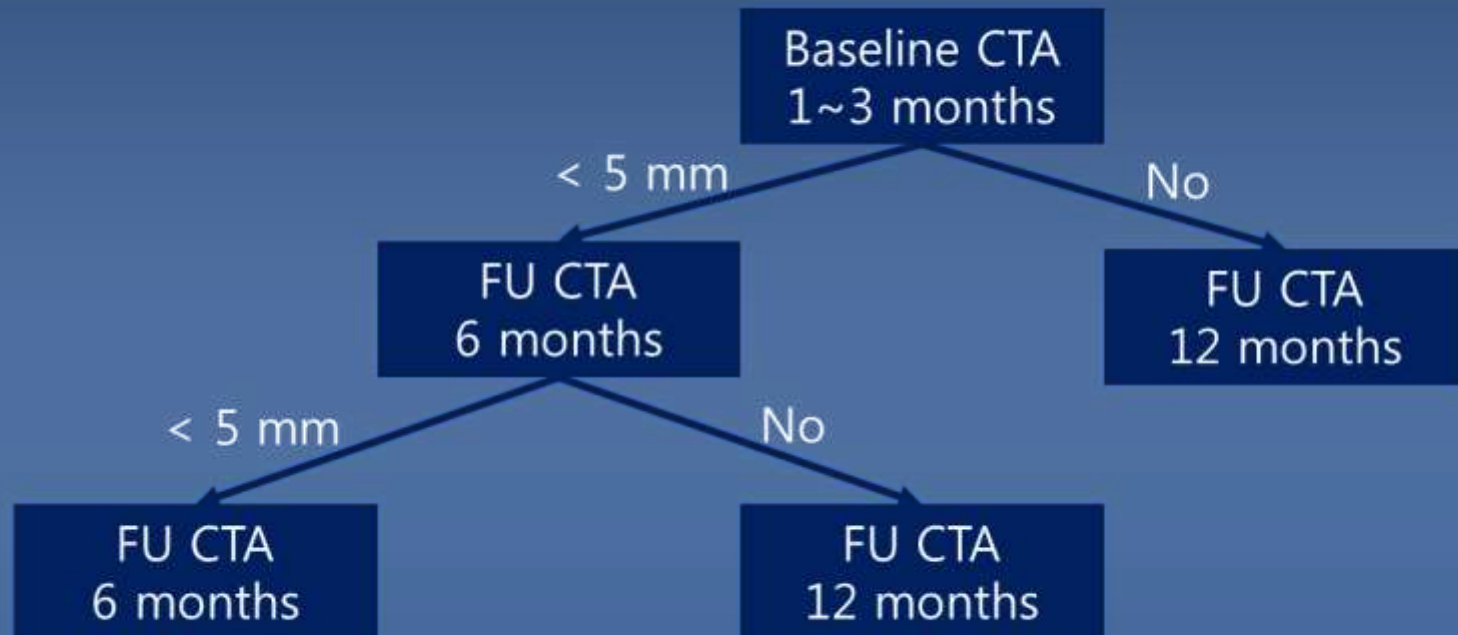
Post-EVAR 1 month
70 mm



Post-Embo 3 month
65 mm

**Type 2 endoleak treatment should be considered
in patients with treated with long-term
anticoagulation or antiplatelet therapy**

Suggested Treatment Algorithms for Type 2 Endoleak



Suggested Treatment Algorithms for Type 2 Endoleak

- Any type 2 endoleak with no or < 5 mm expansion
→ close FU CTA every 6 months
- Any sac expansion ≥ 5 mm, any new endoleak or any increase in amount → conventional angiography for excluding occult type 1 or 3 endoleak and/or direct embolization of type 2 endoleak

Suggested Treatment Algorithms for Type 2 Endoleak

- Any type 2 endoleak with no or < 5 mm expansion
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- No more endoleak → routine annual FU CTA or Doppler US

Suggested Treatment Algorithms for Type 2 Endoleak

- Any type 2 endoleak with no or < 5 mm expansion
→ close FU CTA every 6 months
- Any sac expansion ≥ 5 mm, any new endoleak or any increase in amount → conventional angiography for excluding occult type 1 or 3 endoleak and/or direct embolization of type 2 endoleak
- No more endoleak → routine annual FU CTA or Doppler US
- Any persistent type 2 endoleak in patients treated with long-term anticoagulation or antiplatelet therapy → consider treatment

Summary

Type 2 endoleak should be treated

- only in cases of sac expansion more than 5 mm in diameter.
- with complete embolization of nidus as well as all feeding and draining branches.
- after occult type 1 or type 3 endoleak is excluded on conventional angiography.
- Type 2 endoleak treatment should be considered particularly in patients treated with long-term anticoagulation or antiplatelet therapy.

Thank You for Your Attention !