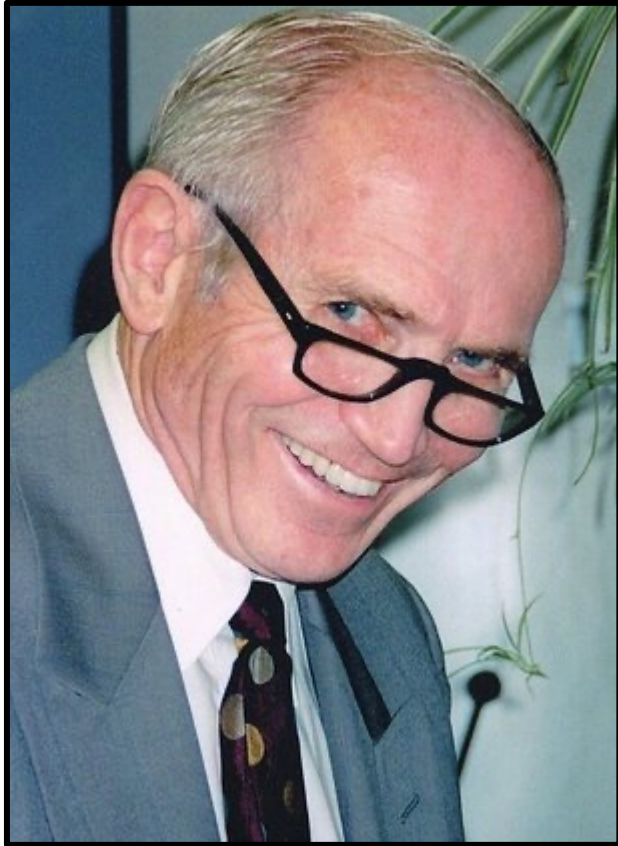


Solving The Problem of Type II Endoleaks



D. EUGENE STRANDNESS, JR. SYMPOSIUM
Diagnostic and Therapeutic Approaches
To Vascular Disease
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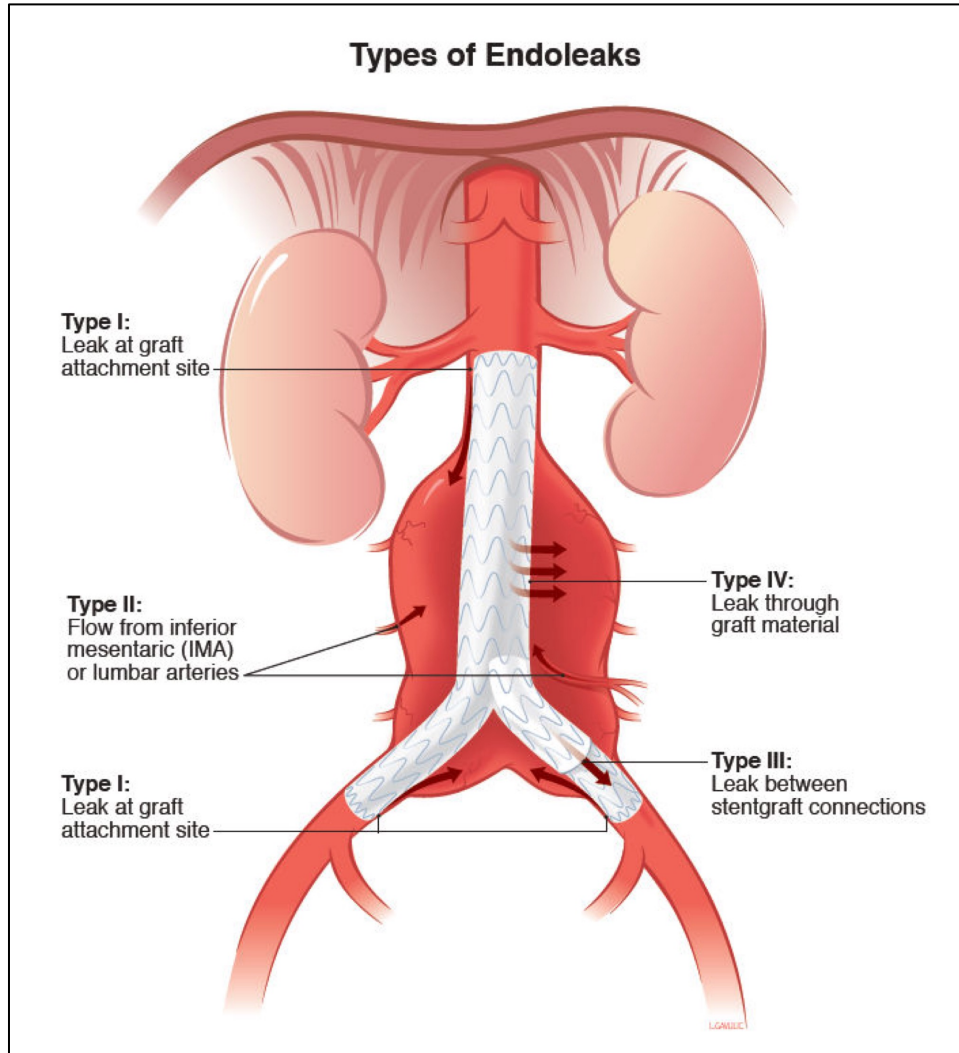
No Disclosures

Type II Endoleaks

Topics

- Diagnosis and classification of endoleaks
 - CTA, Duplex, arteriography
- Natural history of isolated Type II endoleaks
 - Effect of sac expansion on natural history
 - Other characteristics of T2EL that portend poor outcome
- Primary prevention of Type II endoleaks
- Treatment (secondary prevention) of Type II endoleaks
 - Endovascular
 - Surgical

Diagnosis and Classification of Endoleaks



EL Type	Sac	Management
I	Any	Intervention
II	Stable or shrinking	Observation
II	Expanding	Intervention
III	Any	Intervention
IV	Stable or shrinking	Observation
IV	Expanding	Intervention
No EL (V)	Expanding	Intervention

Diagnosis and Classification of Endoleaks

Non-Invasive Tests

- Triple phase CTA (t-CTA) is considered the “gold standard”
 - Superior to standard contrast-enhanced CTA
 - Non-contrast, arterial, and delayed phases
 - High specificity, moderately high (77%-88%) sensitivity
 - May miss low-flow endoleaks (e.g., low-flow type II)
 - Test bolus can improve timing and sensitivity
- Duplex scanning - standard (sDUS) and contrast-enhanced (ceDUS)
 - No radiation or iodinated contrast required
 - Provides dynamic data
 - Sensitivity ceDUS >> sDUS
 - Increased logistics in the VLB
 - Placement of IV, specialized probes, specific ultrasound software

Diagnosis of Endoleak

Duplex Ultrasound (DUS)

Standard Duplex (sDUS)

- High specificity
 - 90%-97%
 - Low false-positive rate
- **Low sensitivity**
 - **62% - 83%**
 - **High false-negative rate**

Contrast-Enhanced Duplex (ceDUS)

- Meta-analysis
- High specificity
 - 93% overall
 - 100% for types I and III
- **Higher sensitivity for all types**
 - **94% overall**
 - **97% for types I and III**
 - **Even for low-flow Type II**
- Better for 2nd gen contrast agents

Diagnosis and Classification of Endoleaks

Arteriography

Endoleak Type	Sensitivity	Specificity	Maneuvers to Increase Sensitivity
Ia	High	High	Multiple projections, distal balloon occlusion
Ib	High	High	Retrograde injection
II	Moderate	High	Selective SMA/internal iliac injection, delayed runs
III	High	High	Retrograde injection, proximal balloon occlusion
IV	Moderate	High	Distal balloon occlusion
Suspected V	Moderate	High	All of the above

Isolated Type II Endoleak

- Endoleak caused by patent vessels originating from the aneurysm sac
- Feeding vessels:
 - Most common: IMA, lumbar
 - Less common: median sacral, accessory renal, gonadal
- Most common type of endoleak
 - Identified in 10%-50% of post-EVAR patients
 - Approximately half of all detected endoleaks are Type II
- Approximately 30%-50% of T2ELs will resolve spontaneously
 - Particularly early-onset (<6 mos) T2EL's

Natural History of Type II Endoleak

Outcomes of Interest

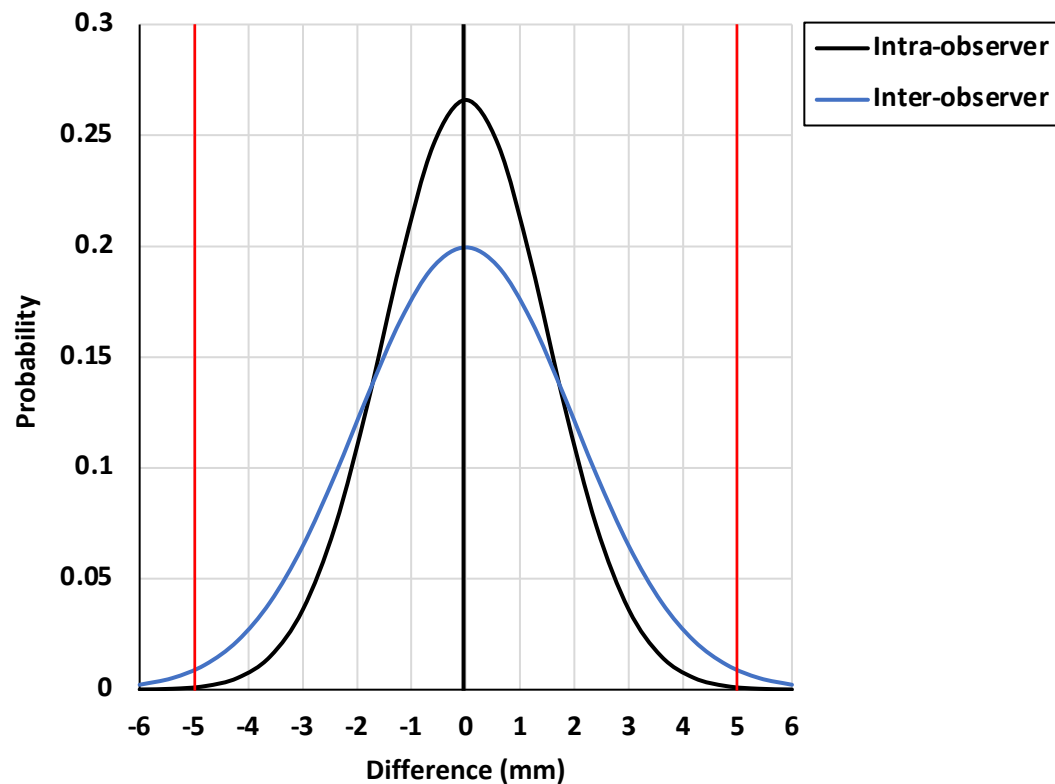
- **Surrogate outcomes**
 - *Sac expansion*
 - Elevated sac pressure
 - Endoleak duration/persistence/recurrence
- **Clinical outcomes**
 - Need for intervention
 - Rupture
 - Aneurysm-related death

More common
Often continuous
More statistical power
Less important



Less common
Often binary
Less statistical power
More important

Reliability of AAA Sac Diameter with Ultrasound



- Test –retest
 - Mean = 0 (no growth)
- Standard deviation
 - 0.7 - 1.5 mm intra-observer
 - 1.0 - 2.0 mm inter-observer
- Proportion with ≥ 5 mm change
 - >95% specificity
 - Assumes inter-observer SD = 2.0

Natural History of Type II Endoleak

Sac Expansion and Rupture

- Isolated T2EL and sac expansion
 - Patients with persistent, isolated T2EL are more likely to demonstrate sac expansion than patients without endoleak
 - But many sacs with persistent, isolated T2EL do not expand
- Sac expansion and rupture (in patients with isolated T2EL)
 - Controversial
 - Several large studies show an association
 - Several other large studies show *no* association
- Rupture in patients with isolated T2EL is rare (<1%)
 - Majority of post-EVAR ruptures are due to type I and III endoleak

Natural History of Type II Endoleaks

Risk Factors For Poor Outcome

Characteristics

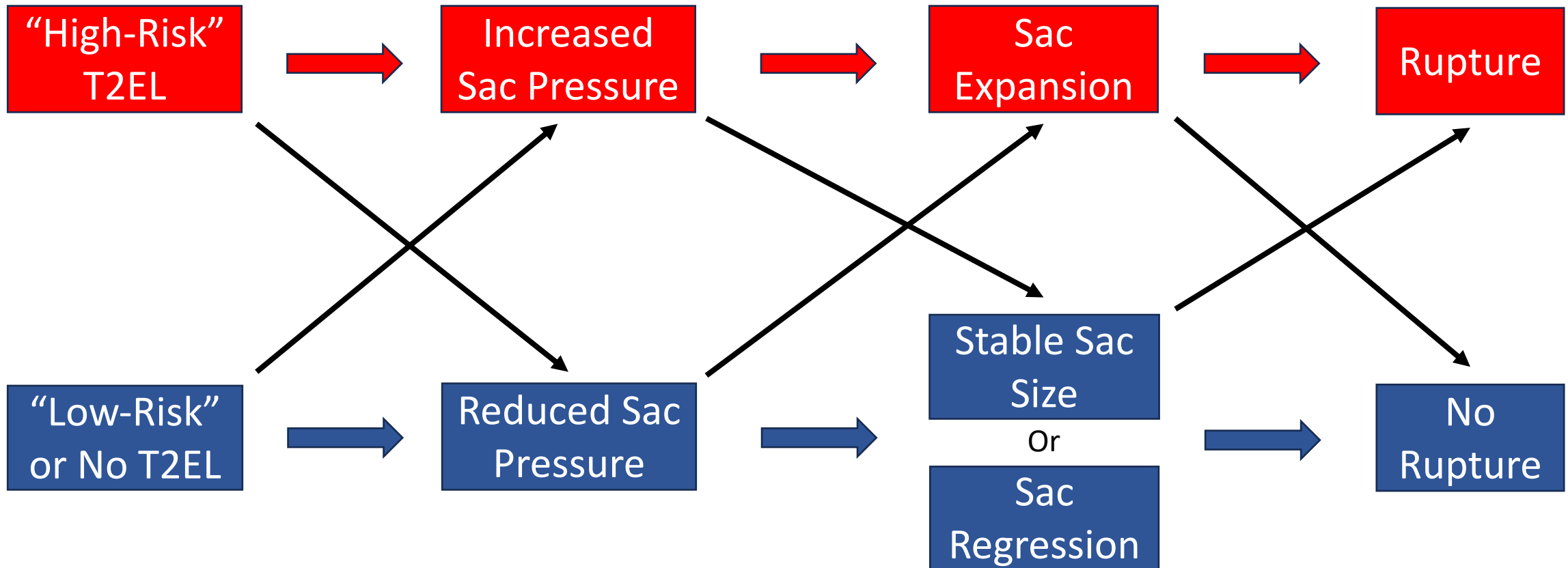
- Late (>6 mos) timing of endoleak appearance
- Small amount of mural thrombus
- Size of aneurysm sac (>6-7 cm)
- Presence and size of endoleak cavity or “nidus”
- Number and size of patent feeding vessels
- Need for long-term anticoagulation



“Surrogate” Outcomes

- Sac expansion
- Increased sac pressure
- Endoleak duration/persistence/recurrence

Natural History of Type II Endoleaks

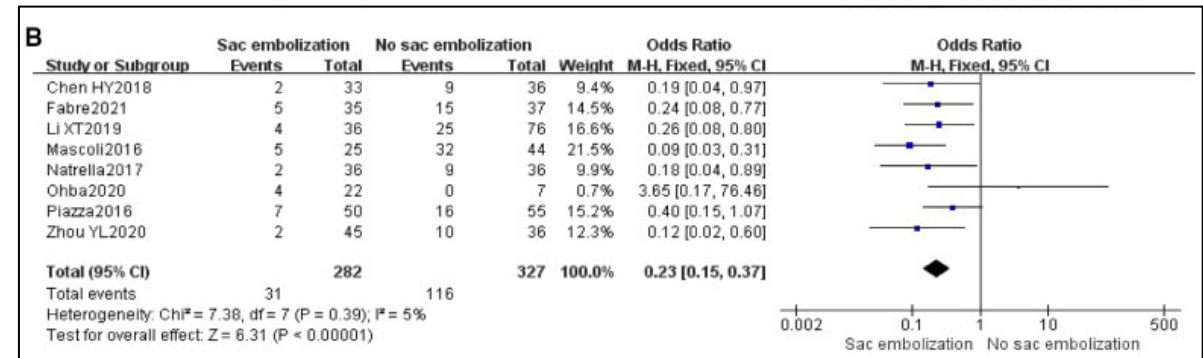


Prevention of Type II Endoleak

Sac Embolization During EVAR

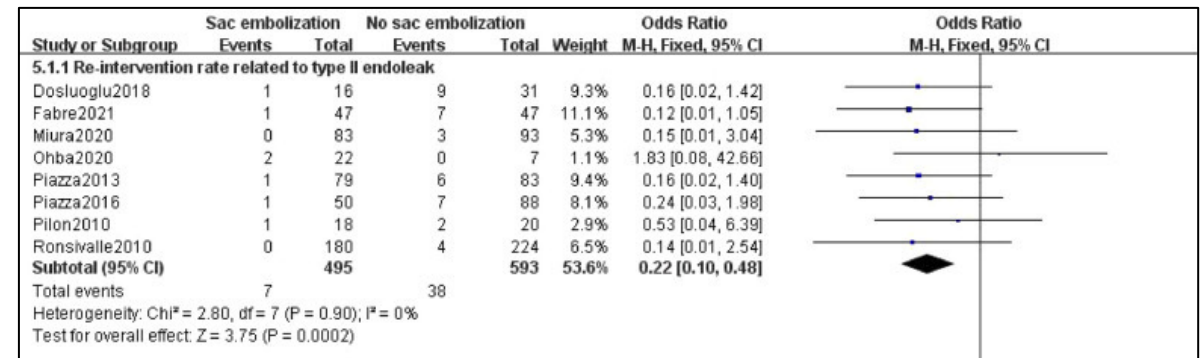
Type II Endoleak (12 Mos) (P <.05)

- Meta-analysis of 13 studies
 - 3 RCTs
 - 10 retrospective cohort studies
- 747 patients
 - 330 sac embolization
 - 417 standard EVAR



- Results:
 - Significant reduction in:
 - Endoleak at 12 mos (11.0% vs 35.5%)
 - Intervention (1.4% vs 6.4%)
 - No sub-group differences:
 - Coils only vs (coils + fibrin glue)
 - High-risk vs normal risk
 - No sig dif in operative mortality or time

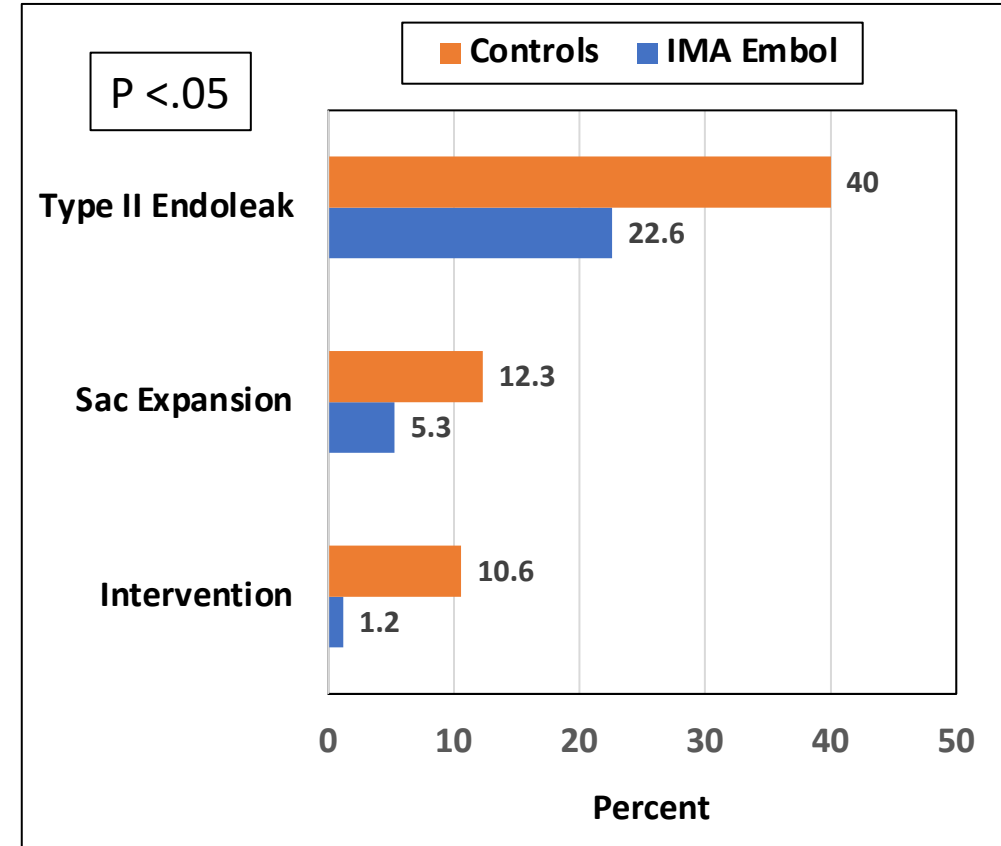
Endoleak Intervention (P <.05)



Prevention of Type II Endoleak

IMA Embolization Before/During EVAR

- Meta-analysis of 10 studies
 - 1 RCT, 1 large registry (VQI)
 - 8 Retrospective cohort studies
- 16,240 patients
 - 747 IMA embolizations
 - 15,493 controls
- Results (see chart)
 - Technical success = 85.3%
 - Average added op time = 20 min
- Rare complications
 - Distal embolization (<1%)
 - Transient abd pain (<1%)
 - Colon infarction (1 case),



Treatment of Isolated Type II Endoleaks

Which Patients and What Treatment?

- Patient selection
 - Sac expansion, how much?
 - Other markers of risk?
- Treatment modality
 - Endovascular
 - Trans-arterial vs direct sac puncture techniques
 - Surgical
 - Endograft preservation
 - Endograft explantation w/ replacement

Treatment of Type II Endoleaks

Guideline Recommendations

American Guidelines

- Intervention suggested for sac diameter growth >5 mm

Chaikof et al, *J Vasc Surg*, 2018

European Guidelines

- Intervention suggested for sac diameter growth >1 cm compared with pre-op diameter
- Growth of >5mm over 6 months

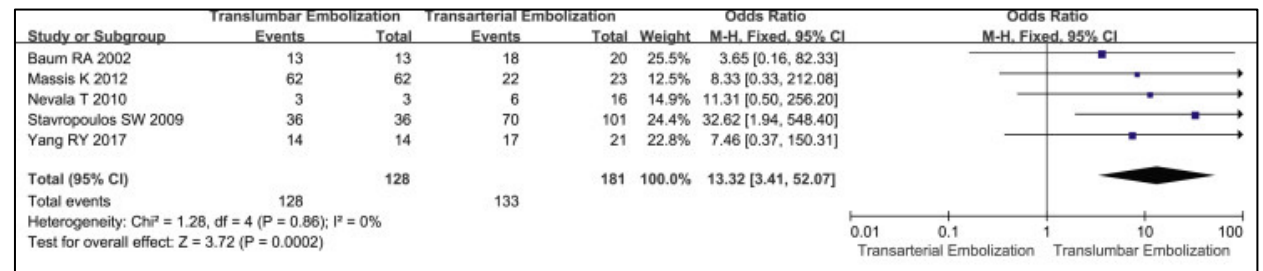
ESVS Guidelines Committee,
J Vasc Endovasc Surg, 2019

Treatment of Type II Endoleaks

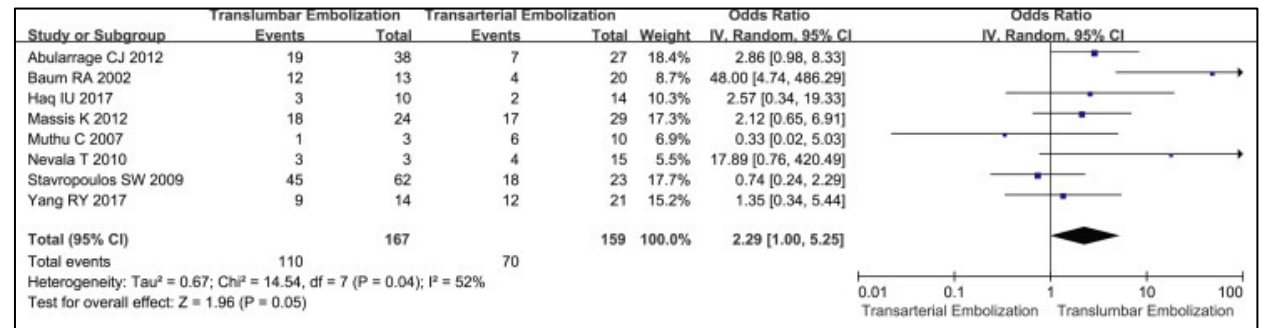
Trans-Arterial Vs Trans-Lumbar

- Meta-analysis of 9 studies
- 354 patients, 449 procedures
 - 259 trans-arterial
 - 190 trans-lumbar
- Results:
 - Technical success rate:
 - Trans-arterial 73%
 - Trans-lumbar 100%
 - Clinical success rate:
 - Trans-arterial 44%
 - Trans-lumbar 66%
 - Complications – no difference
 - 3.5% versus 3.3%

Technical Success Rate, P<.05



Clinical Success Rate, P <.05



Treatment of Type II Endoleaks

Surgical Repair

- Guidelines suggest surgery after 2-3 failed endovascular attempts
- Need for surgery is rare in patients with T2EL
- Laparoscopy
 - Promising results, but limited data
- Open surgery – 2 general approaches
 - Preservation of endograft
 - Endograft explantation with graft replacement
- Many important technical details
 - Be prepared for both approaches

Type II Endoleaks and Anticoagulation

- Multiple observational studies have shown an increased risk of endoleak persistence, sac expansion, and need for intervention in anticoagulated patients with isolated T2EL, compared with patients on anti-platelet Rx alone
- No difference comparing DOACs with Vit K antagonists (warfarin)
- No difference comparing DAPT with asa alone
- **Conclusion:**
 - Consider open repair in patients who will require long-term anticoagulation
 - In patients with persistent/recurrent T2EL after EVAR, especially in presence of sac expansion, re-evaluate the risks/benefits of continued anticoagulation

Conclusions

- Diagnosis and classification of endoleaks
 - Low-flow Type II endoleaks are difficult to diagnose
 - tCTA gold standard. ceDUS > sDUS.
- Natural history of isolated T2EL
 - Sac expansion important but imperfect marker of risk
 - Multiple other markers for risk identified
- Prevention of T2EL
 - Sac and/or IMA embolization during EVAR are promising
- Treatment of T2EL
 - Direct sac puncture ? superior to trans-arterial embolization
 - Surgical repair suggested after 2-3 failed endovascular attempts
 - Anticoagulation is important