

Optimal Imaging for Endoleaks after EVAR



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No conflicts of interest

- Disclosure – CEUS for endoleak is an off-label application

Introduction

- Endovascular Aneurysm Repair (EVAR) first introduced in 1991 as alternative to surgical repair
- Complication rate of 30-40%
- Endoleak most common complication 15-45%

Imaging Techniques for Endoleak Detection

- CT is primary imaging modality (“gold standard”)
- Ultrasound increasingly used
 - Sens 62-83%
 - Spec 90-97%
- Contrast-enhanced ultrasound (CEUS) newer technique for endoleak detection

Duplex Ultrasound as Sole Long-Term Surveillance Method Post EVAR: A Safe Alternative for Stable AAA

- 184 patients with annual DUS (1-112 months)
- Residual sac < 4 cm then stable sac size for 2 years
- 3 new endoleaks detected, 1 enlargement (2 Type II and 1 Type I)
- 2 required limb extension, 1 death

Considered safe and effective early after treatment

Cost savings and avoiding complications related to CT

Duplex Ultrasound Surveillance After Uncomplicated EVAR

- 266 patients over 3.2 years
- **DUS primary with CTA backup**
- 57 endoleaks (7 Type 1, 50 Type II)
- **7 discordant results with CTA**
 - 4 false (-)
 - 3 false (+)
- One developed AAA rupture and death
- PPV 0.88

Systematic Review and Meta-analysis of Duplex Ultrasonography, CEUS & CT for Surveillance After EVAR

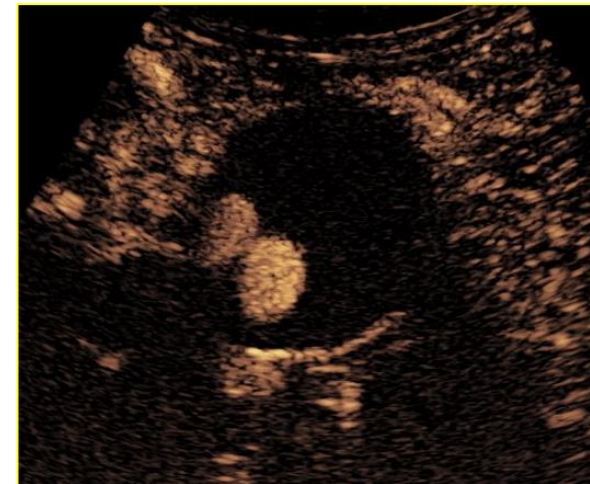
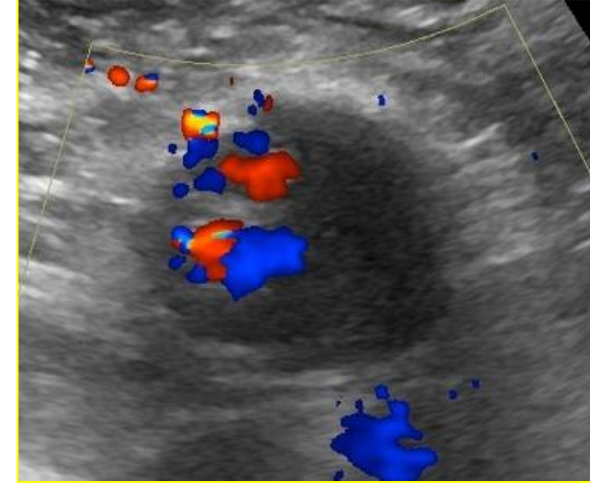
- 25 studies compared DUS with CT for all endoleaks
 - Pooled sensitivity was 0.74
 - Pooled specificity was 0.94
- For Type 1 and 3 Endoleaks for DUS
 - Pooled sensitivity was 0.83
 - Pooled specificity was 1.00

Systematic Review and Meta-analysis of Contrast-Enhanced Ultrasonography (CEUS) & CT for Surveillance After EVAR

- 11 studies compared CEUS with CT for all endoleaks
 - Pooled sensitivity was 0.96
 - Pooled specificity was 0.85 (**why would this be lower than DUS?**)
- For Type 1 and 3 Endoleaks for CEUS
 - Pooled sensitivity was 0.99
 - Pooled specificity was 1.00

DUS vs CEUS for Endoleak

- Compared to CTA
- Non-contrast US sensitivity 77%
- CEUS sensitivity 98%



CEUS vs CDUS in EVAR: Endoleaks

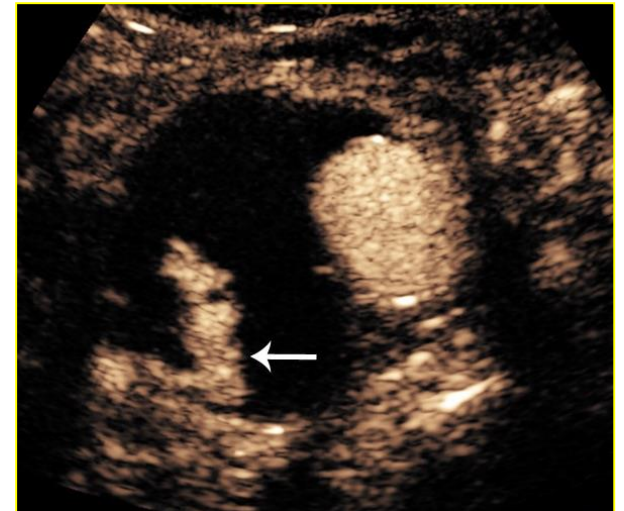
Compared to CTA:	CEUS	CDUS
Sensitivity	100%	61%
Specificity	100%	80%
Accuracy	100%	66%

- Retrospective analysis of 74 patients who underwent CEUS and/or CDUS for follow-up of AAA sp EVAR
- 76% male, 24% female , 46-93 years of age
- **CEUS** was well tolerated without complication
 - 78% were diagnosed with endoleak
 - Identified all endoleaks found at CTA
 - No false positive or false negative endoleaks at CEUS
 - CEUS defined the source of endoleak in 100% of cases compared to 46% on CTA
 - **CEUS demonstrated sensitivity 100%, specificity 100% and accuracy 100%.**
- **CDUS:**
 - 57% were diagnosed with an endoleak
 - 2 false positives and 11 false negatives
 - **Sensitivity 61%, specificity 80% and accuracy 66% compared to CTA.**

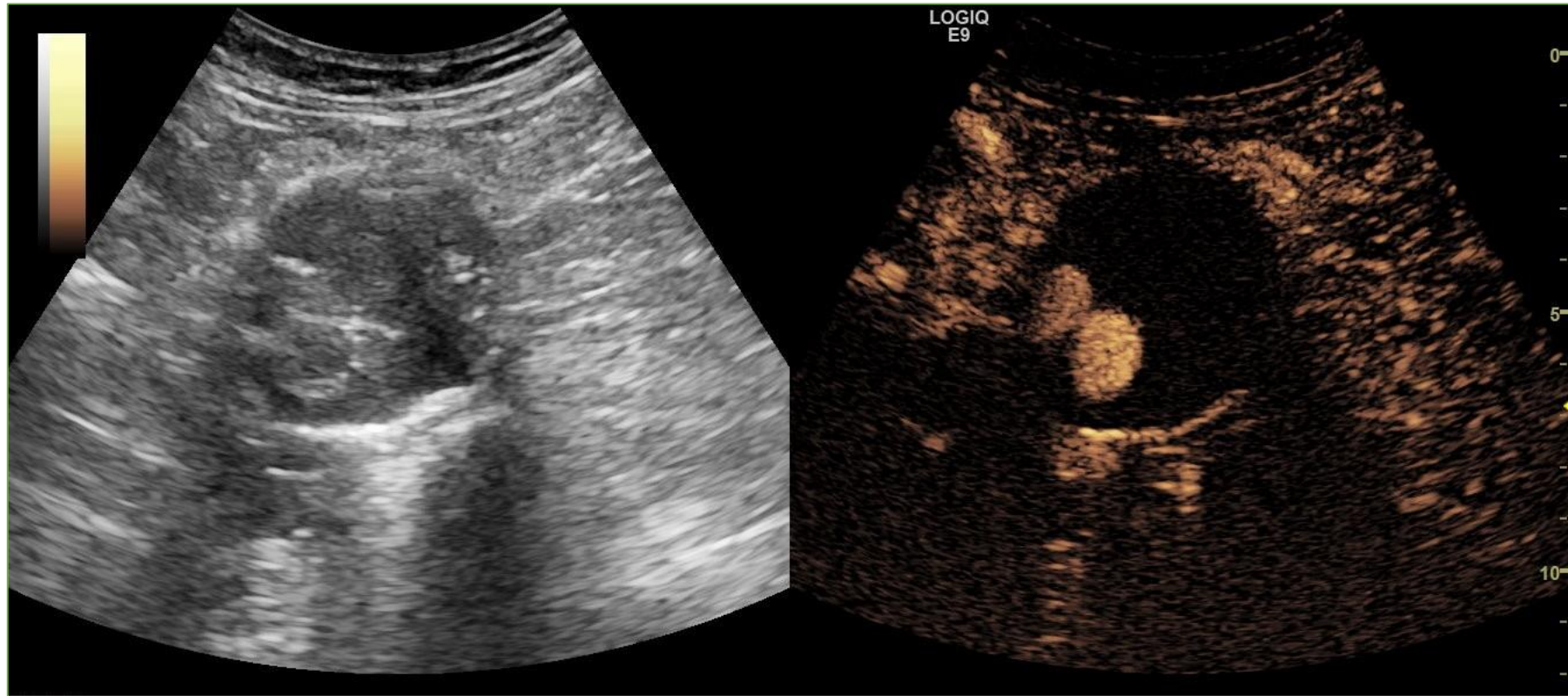
CEUS for Endoleak

- Can detect low-flow endoleaks
- Classify types of endoleak
- Visualize specific hemodynamics
- Avoids iodinated contrast and ionizing radiation

Type II Lumbar Endoleak

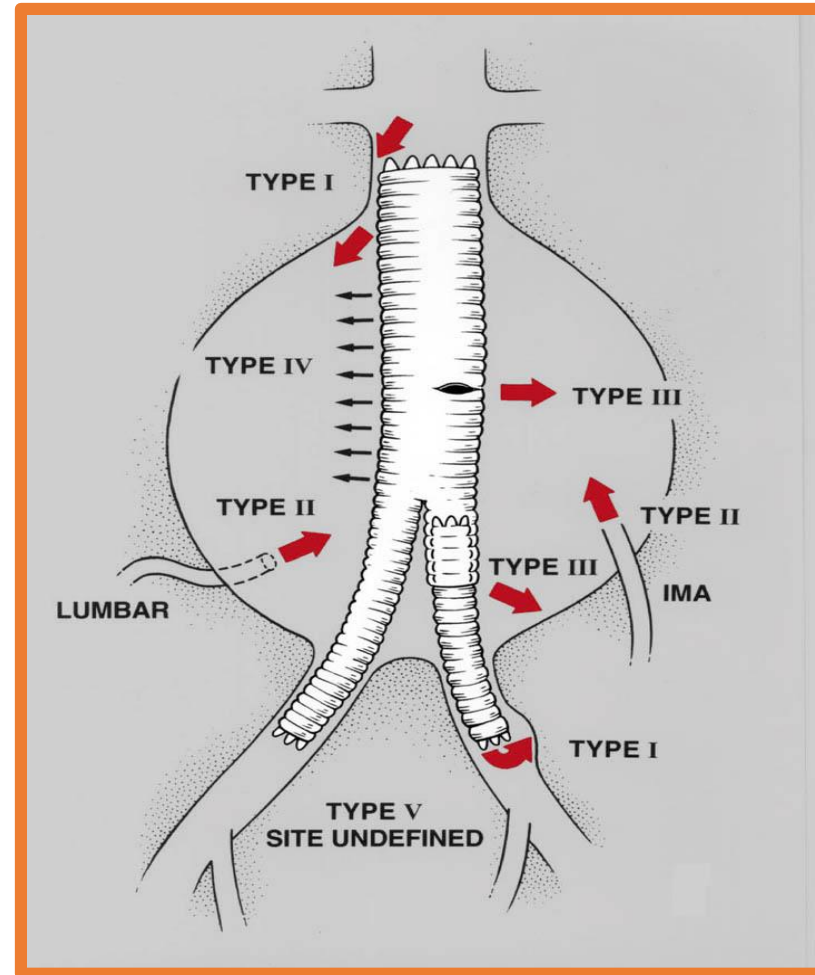


Normal Endograft No Endoleak

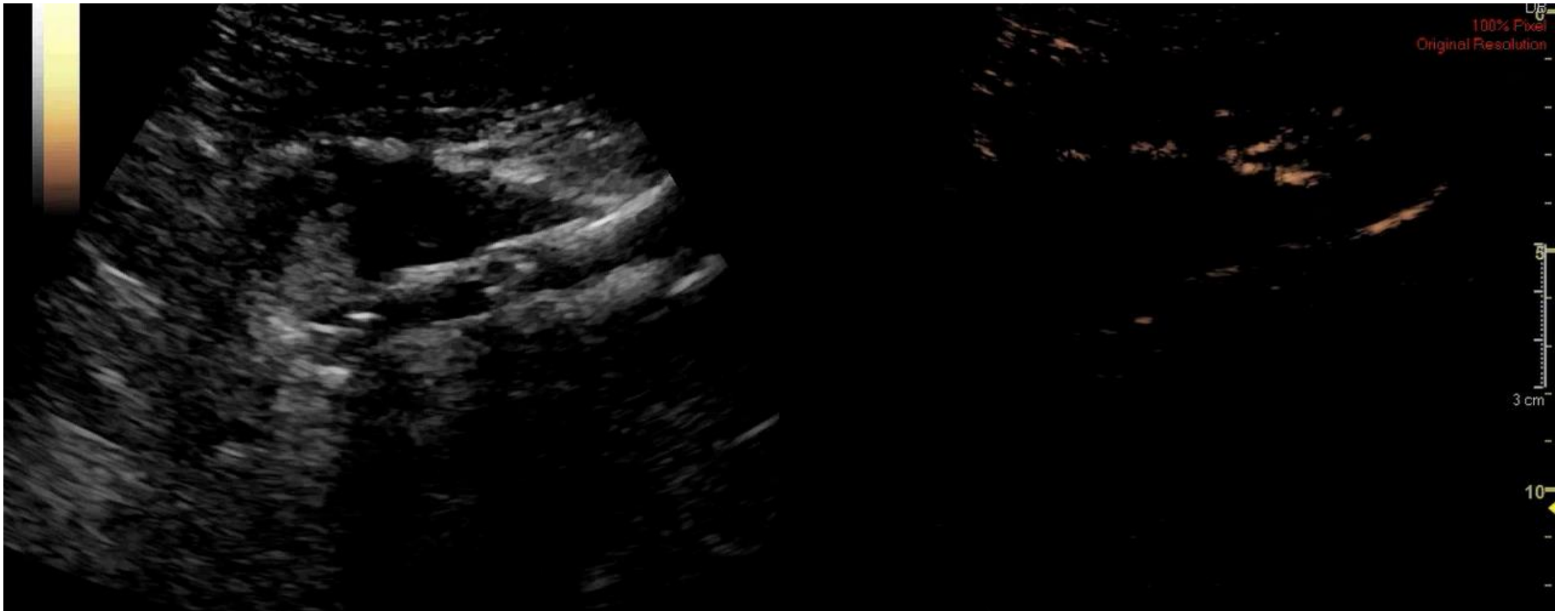


Endoleaks

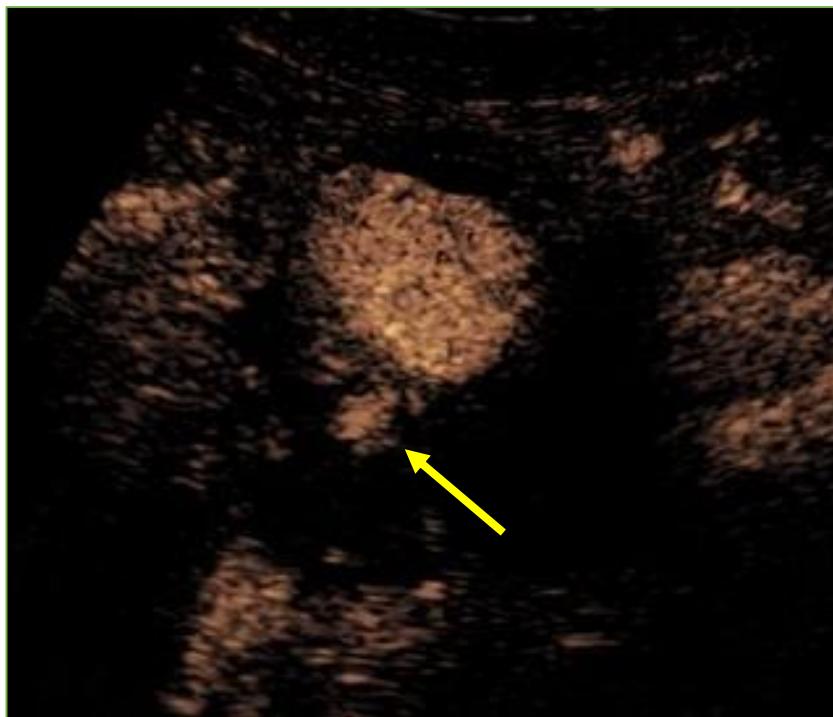
- I Attachment leak
- II Branch leak
- III Graft defect
- IV Graft porosity
- V Endotension



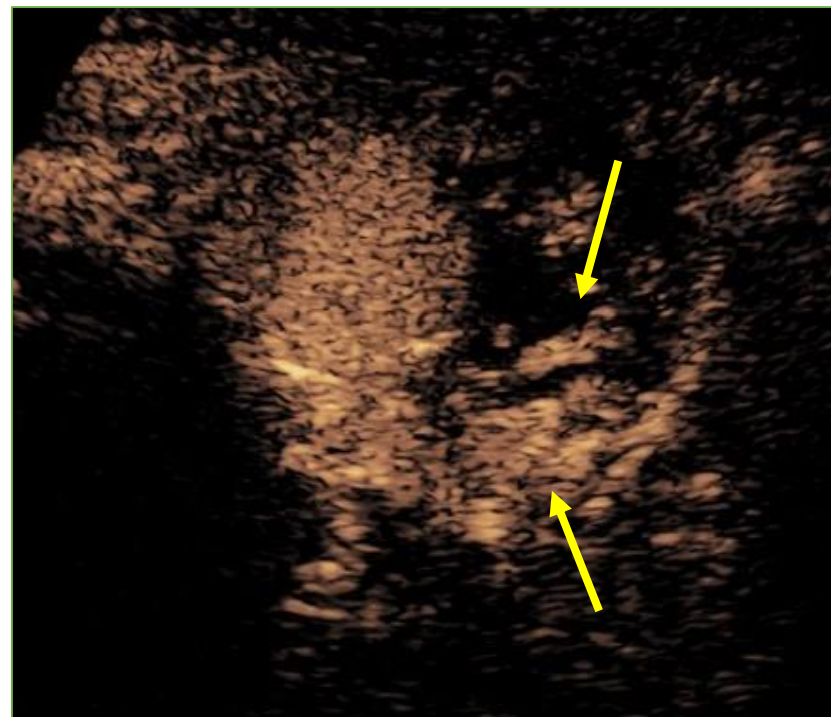
Type II IMA Endoleak



Type I and III Endoleaks

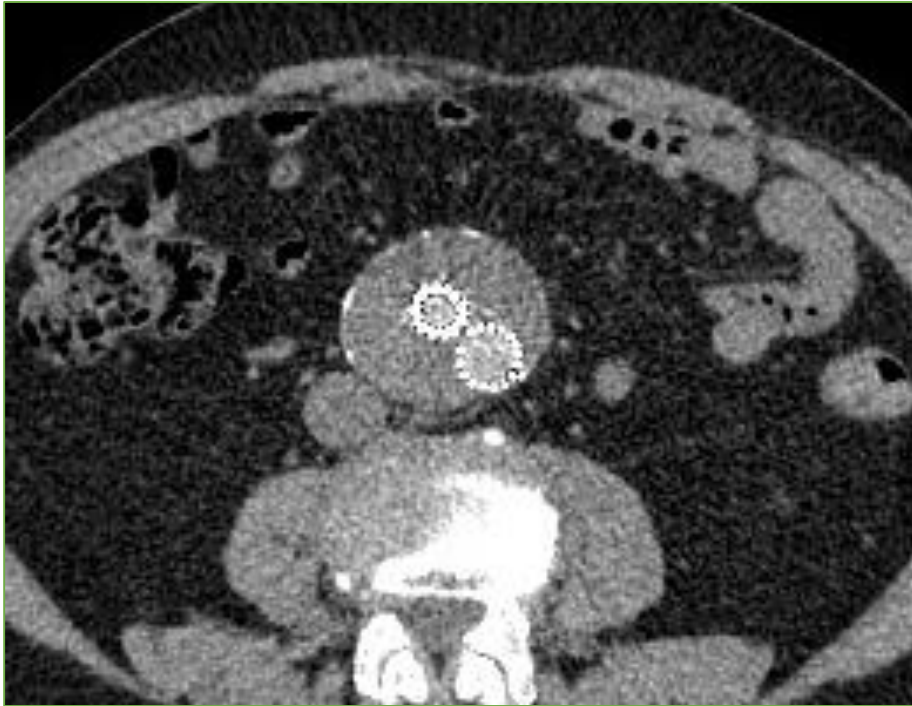


Type I Endoleak

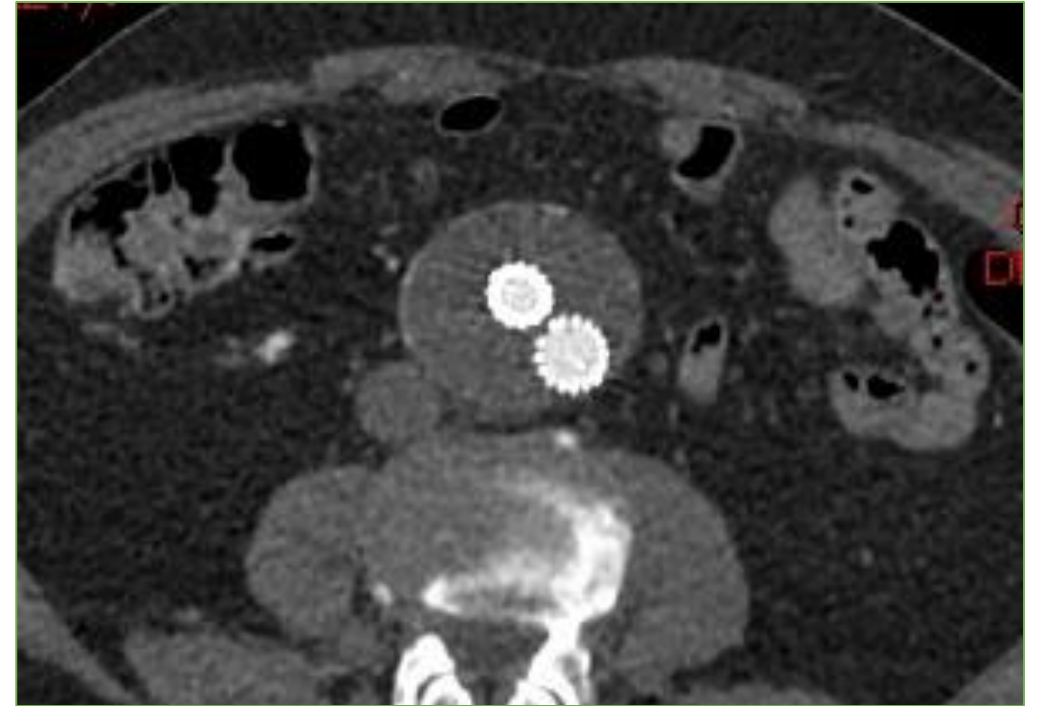


Type III Endoleak

77 yo with AAA sp EVAR in 2014
No Endoleaks Seen

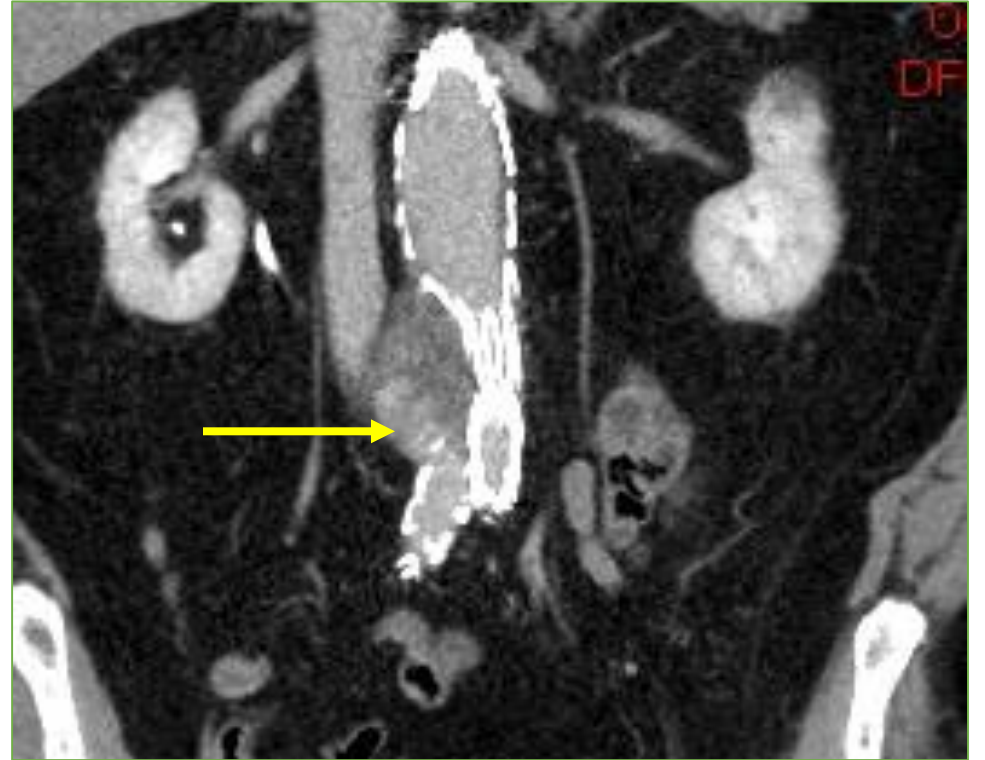
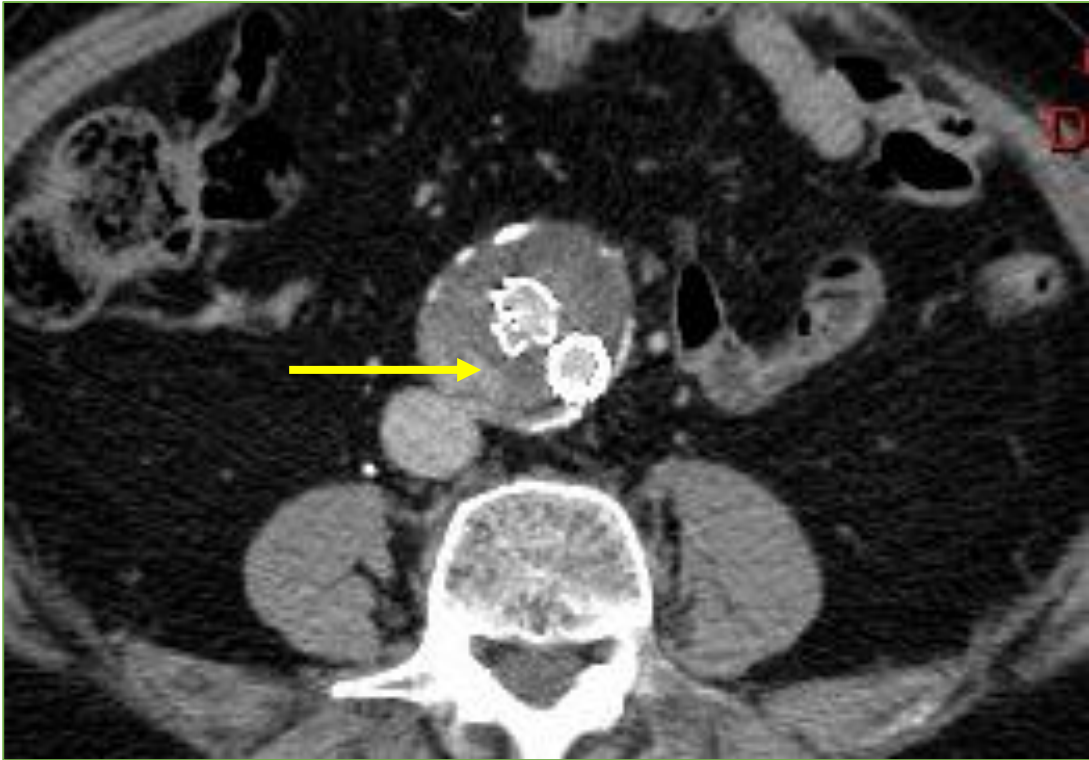


Sept 2021

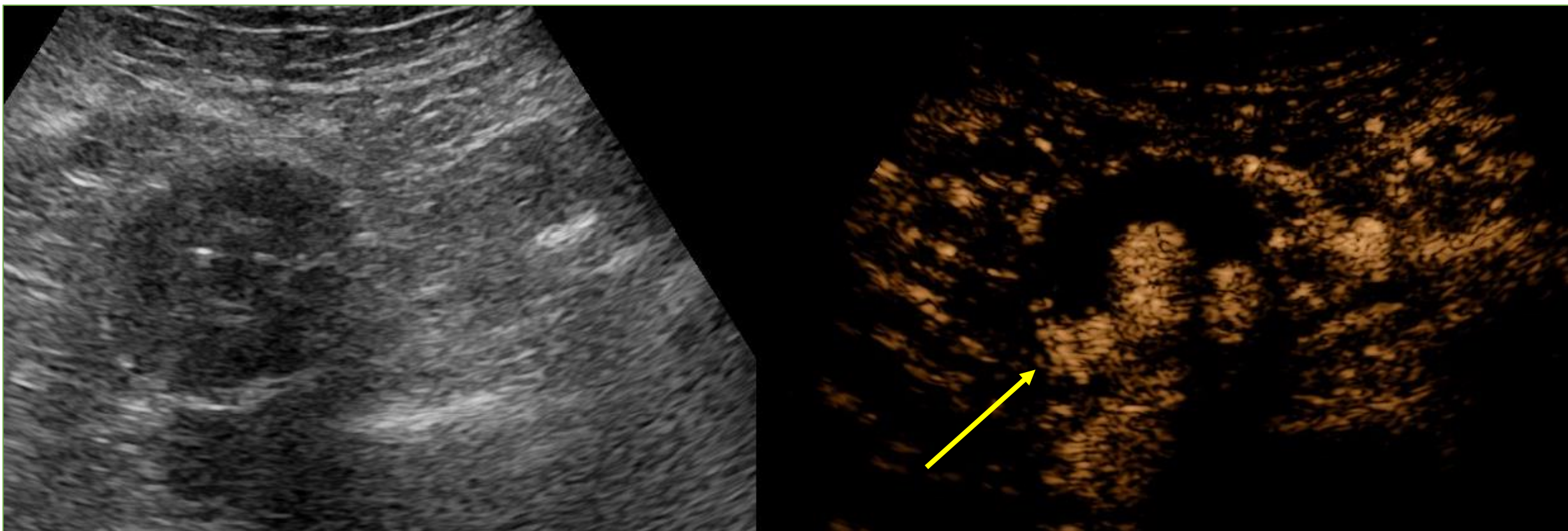


Jan 2022

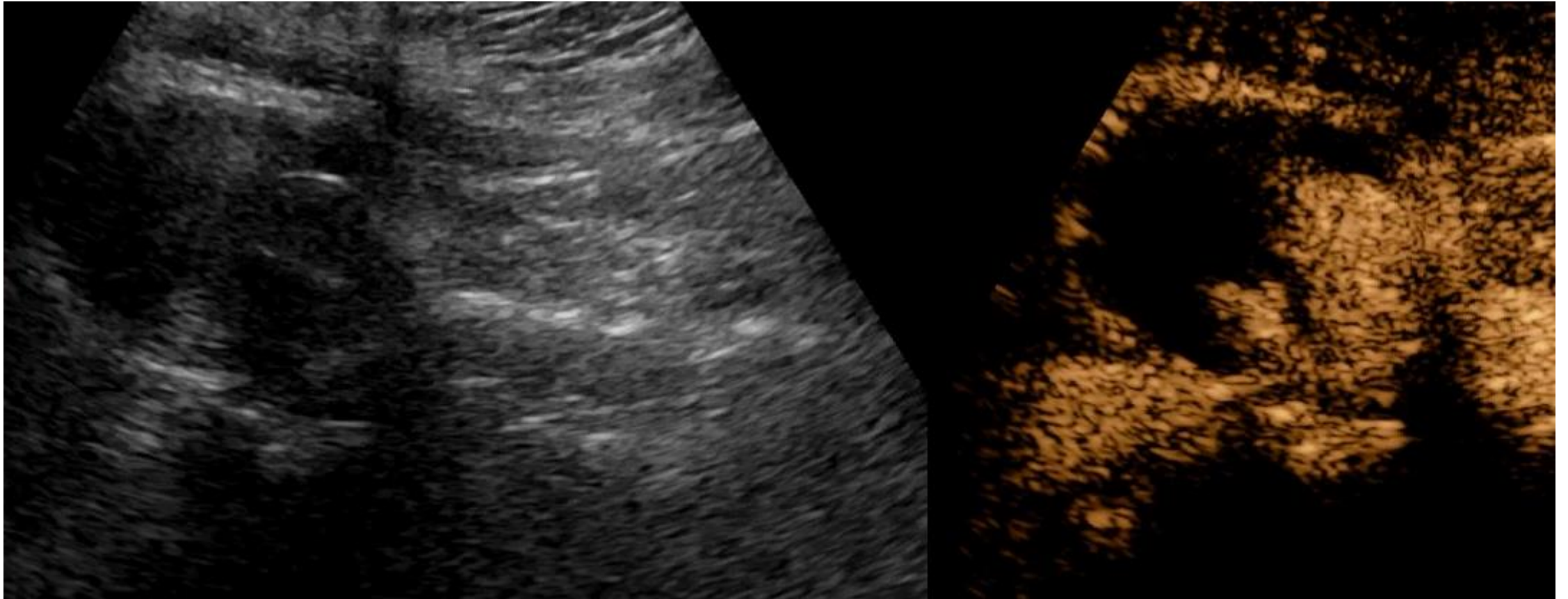
CTA March 2022 Type III Endoleak?



CEUS



Type II Endoleak



Meta-analysis of CEUS for Detection of Endoleak after EVAR

- 26 studies in 2217 patients
- Comparing CEUS vs CT angiography
- CEUS has high sensitivity (94%) and specificity (93%) compared to CTA for all types
- Sens 97% and spec 100% for types I and III

Advantages of CEUS over CTA

- No nephrotoxicity from iodinated contrast
- No radiation-induced cancer risk
- Lower cost
- Can determine direction of blood flow (Type II)

“Pitfalls”

- “False-positive” rate of CEUS may be related to improved detection of low-flow Type II endoleaks
- Additional endoleaks discovered with CEUS were Type II
- Several confirmed at angiography with coil embolization

Limitations of CEUS

- Obese patients
- Wall calcification
- Bowel gas
- Ascites
- Operator dependent
- Requires special software (Tissue Harmonic Imaging)

Conclusions

- DUS, CTA and CEUS all demonstrate value for endoleak surveillance
- CTA and CEUS offer higher diagnostic accuracy for detection of endoleak
- High sensitivity and specificity for type I and III endoleaks
- DUS and CEUS can identify source of endoleak
- CEUS detects endoleaks not detected with CT
- Offers significant advantages over CTA