

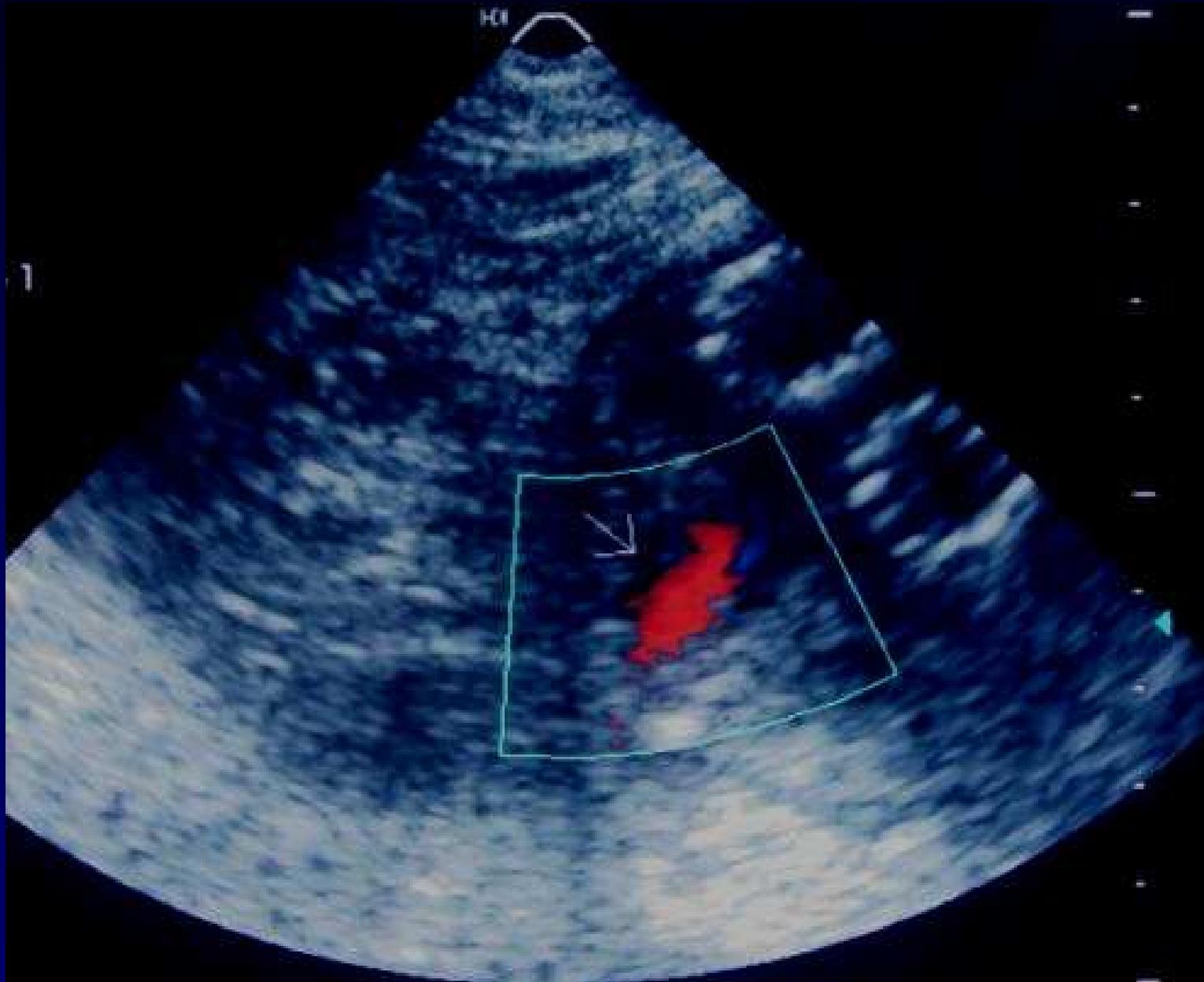
Vascular ultrasound in aortic endoleaks

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After EVAR up to 30% of patients develop endoleaks



Classification Scheme for Endoleaks

I. Attachment site leaks

- A. Proximal end of endograft
- B. Distal end of endograft
- C. Iliac occluder (plug)

II. Branch leaks

- A. Simple or to-and-fro (from only 1 patent branch)
- B. Complex or flow-through (with 2 or more patent branches)

III. Graft defects

- A. Junctional leak or modular disconnect
- B. Fabric disruption (midgraft hole)
 - Minor (<2 mm; e.g. suture holes)
 - Major (\geq 2 mm)

IV. Graft wall (fabric) porosity

(< 30 days after graft placement)

V. Endotension

Candidate for open or endograft treatment



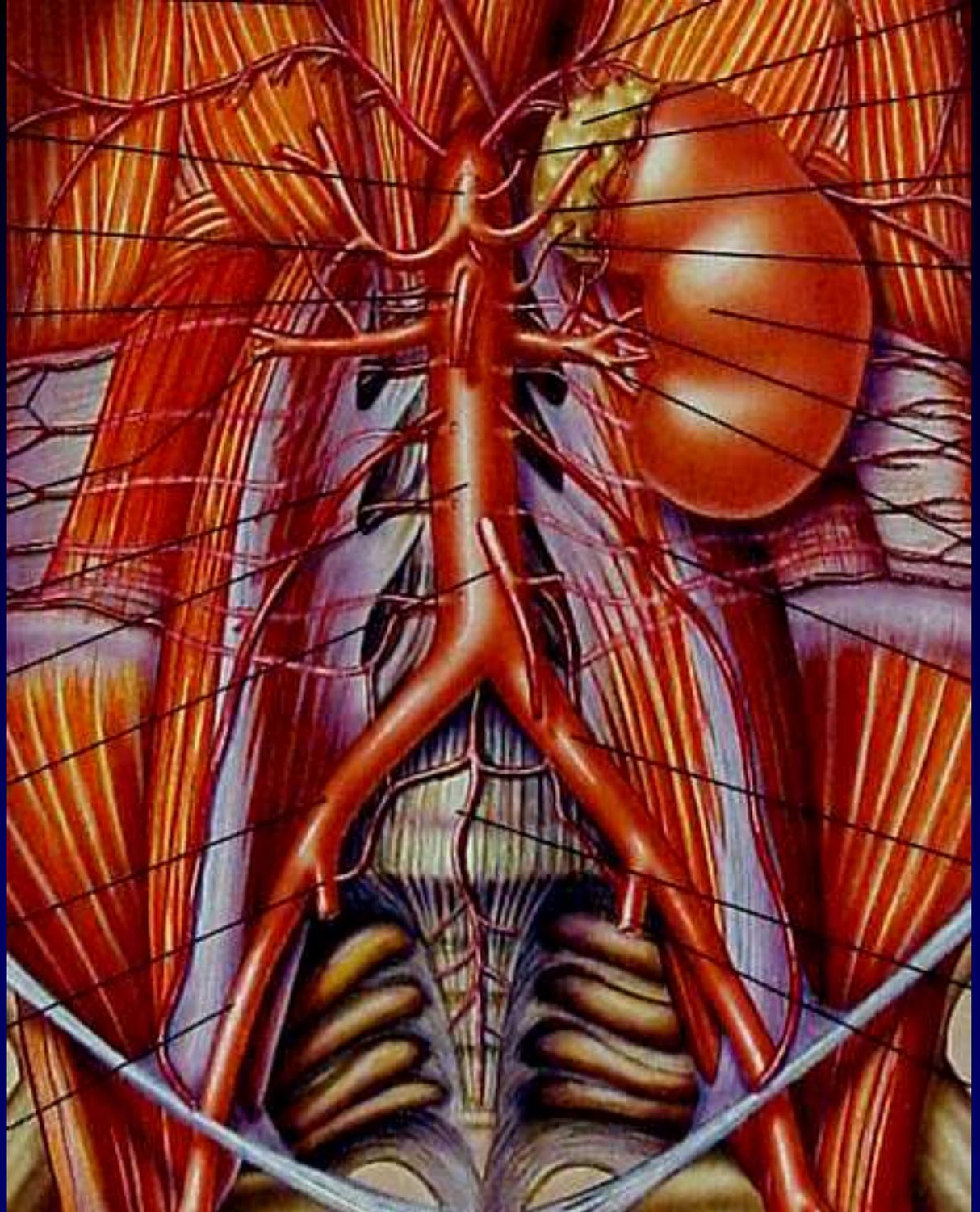
Very small amount of thrombus in AAA. High risk for

bleeding with open repair. Endograft preferred.

Type II 10-25%

Source for endoleaks

- Accessory renal**
- IMA**
- Lumbar**
- Internal iliac
branches**



Endoleak Detection

| Imaging

- CT
- MRA
- Angiography
- Duplex ultrasound
- Contrast enhanced ultrasound
- Implanted pressure sensors

| Enlargement Criteria

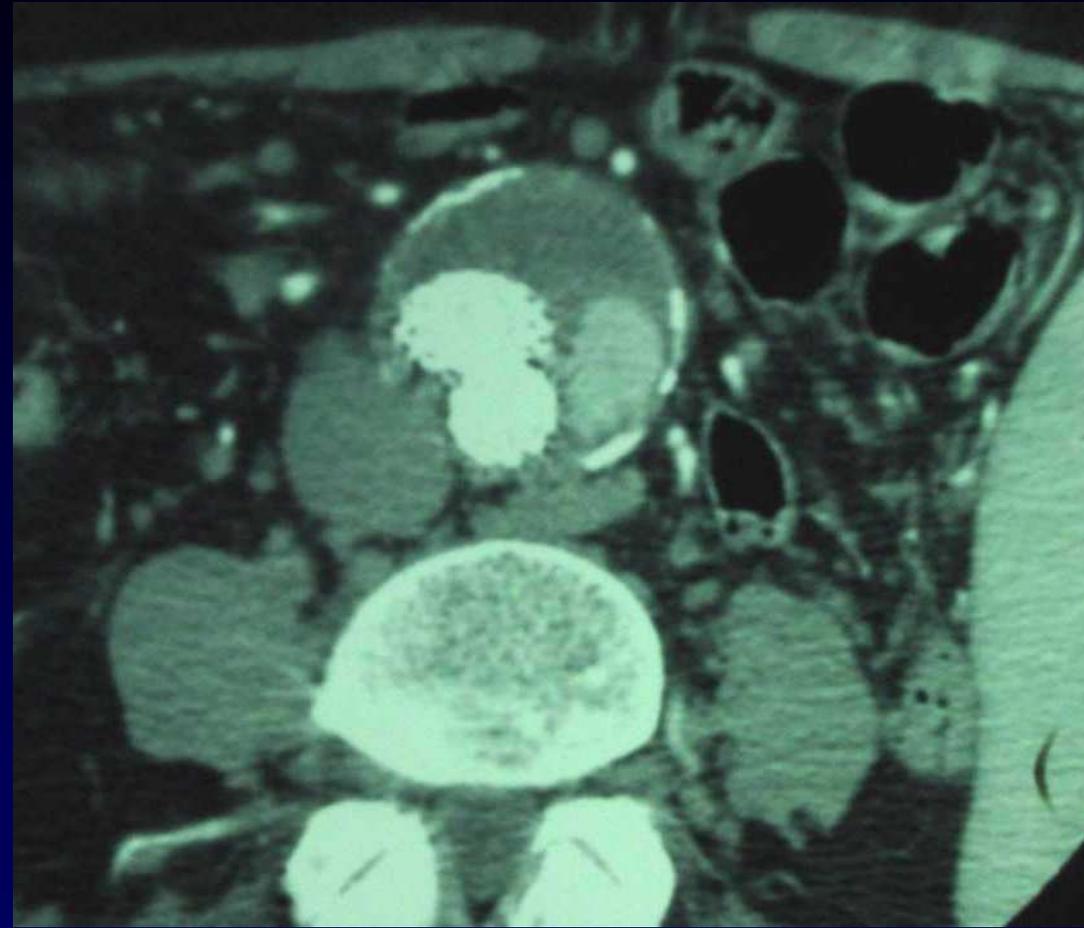
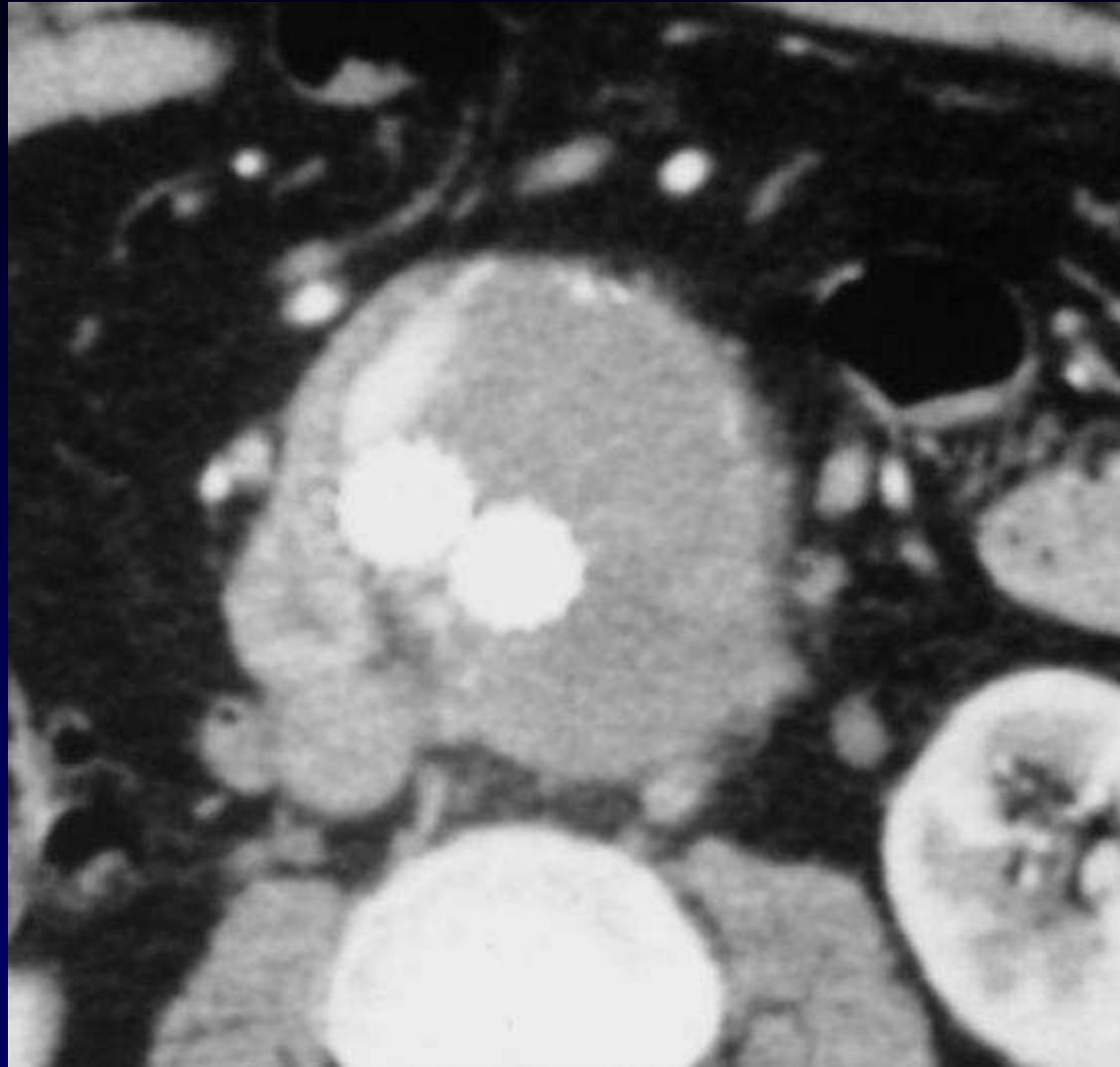
- Diameter vs. volume

Endoleaks

- | **Not all leaks seen with any technique**
- | **Increased pressure can be transmitted through the thrombus**
- | **Aneurysm pulsatility correlates poorly with endoleaks & endotension**
- | **An enlarging aneurysm after EVAR mandates surgical or interventional treatment**

Baum J Vasc Surg 2002

CT imaging



The standard method for following up EVAR procedures

CT imaging

Concerns with

- Radiation**
- Contrast**
- Cost**

**MRI Versus Helical CT for Endoleak Detection After
Endovascular Aneurysm Repair
Pitton MB, et al. Am J Roentgenol 2005;185:1275-81**

MRI is significantly superior to CT for endoleak detection.

MRI shows a significant number of endoleaks in cases with negative CT findings and may help illuminate the phenomenon of endotension.

Endoleak rates reported after endovascular aneurysm repair substantially depend on the imaging techniques used.

All techniques are operator depended. An optimal MRI is going to be better than a non optimal CT.

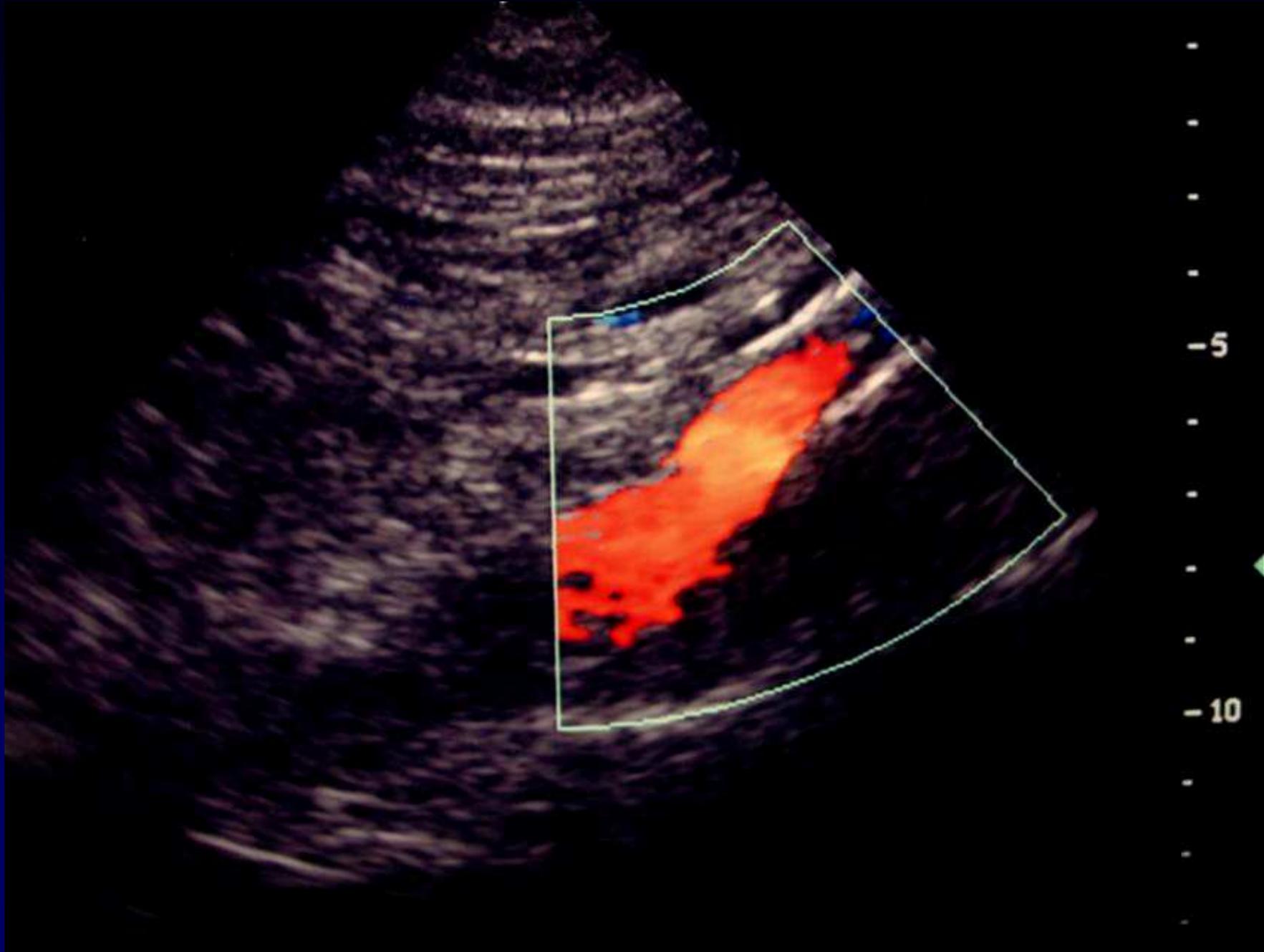
Duplex Ultrasound

Good alternative

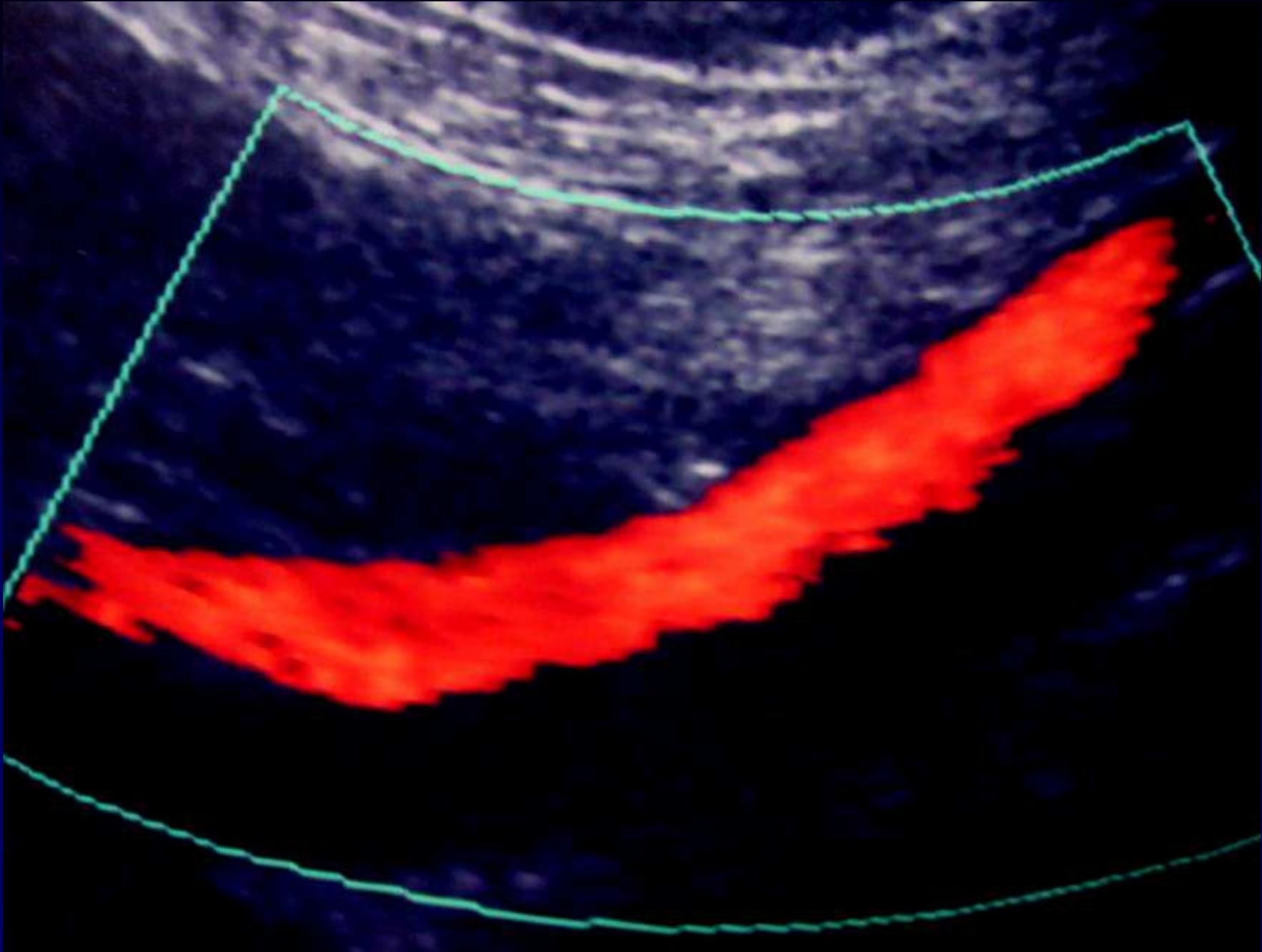
- Lower cost**
- No side effects**
- Portable**
- Easily repeatable**

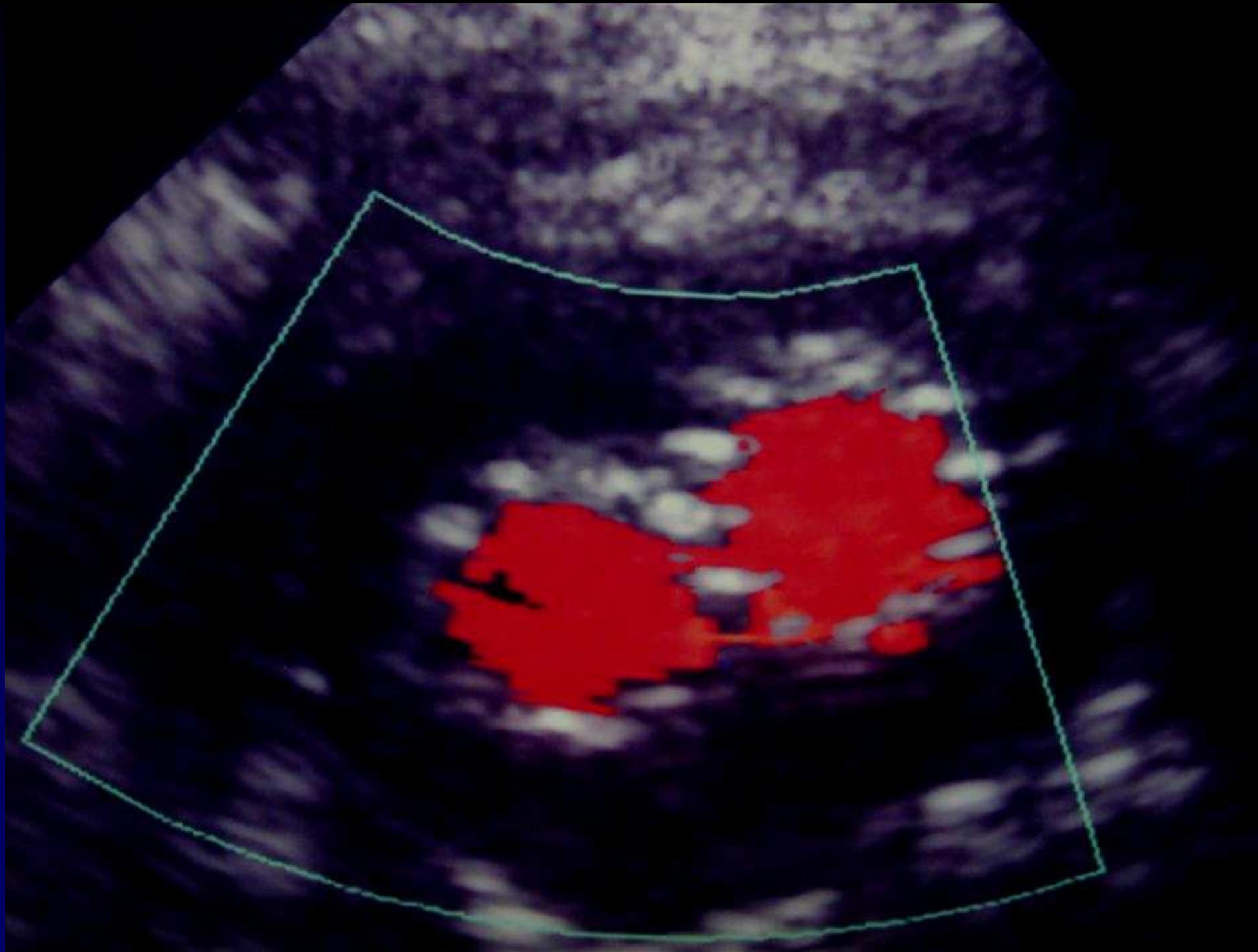


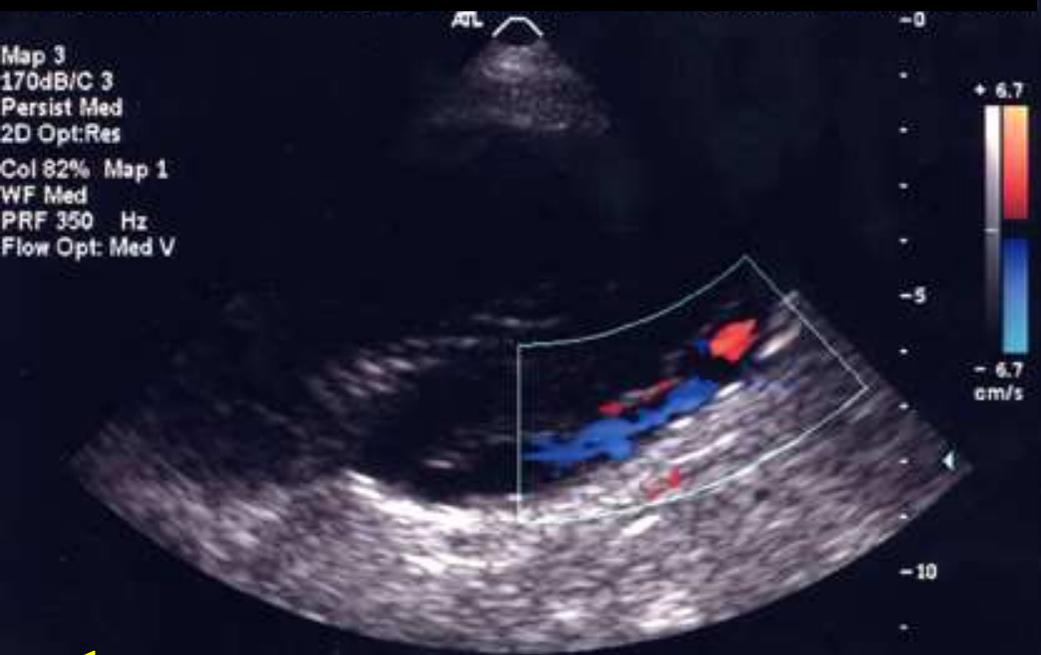
Proximal attachment



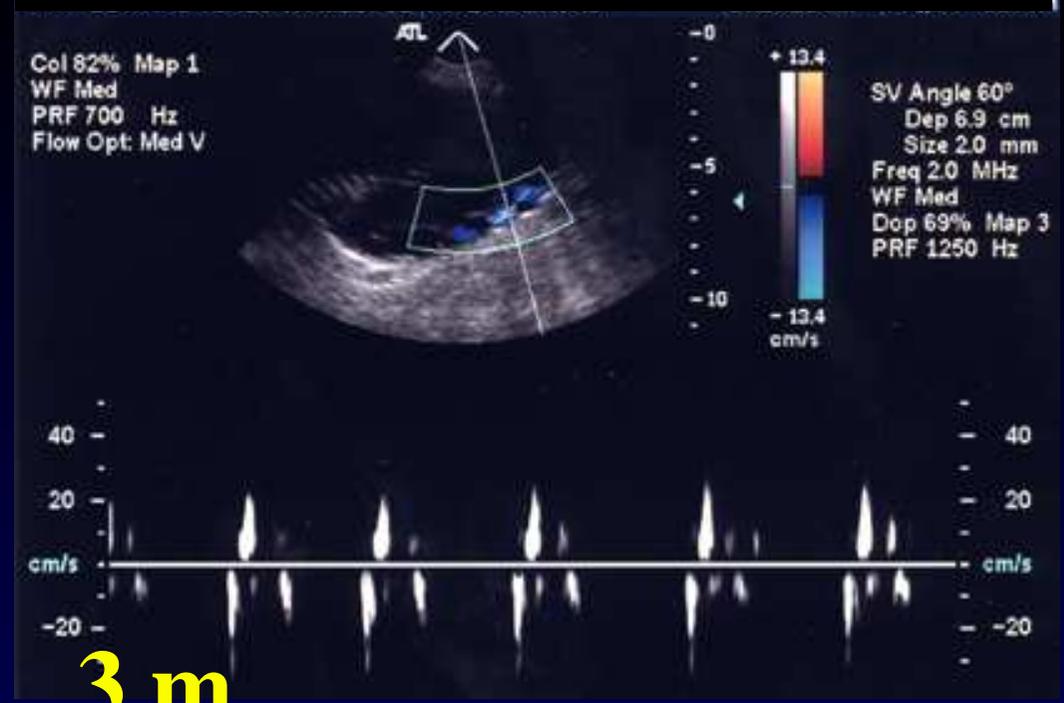
Distal attachment







1 m



3 m

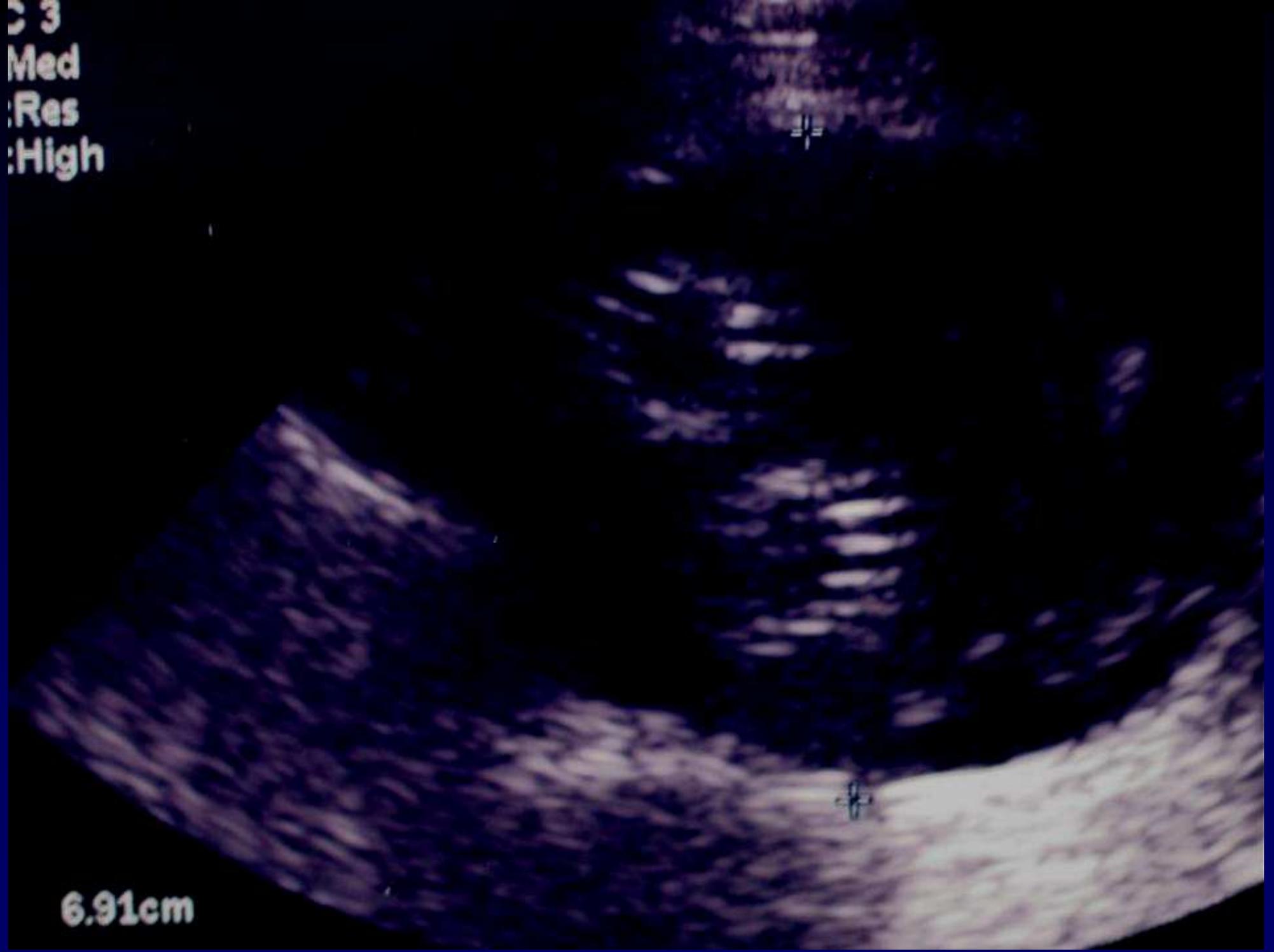


6 m



12 m

3
Med
Res
High



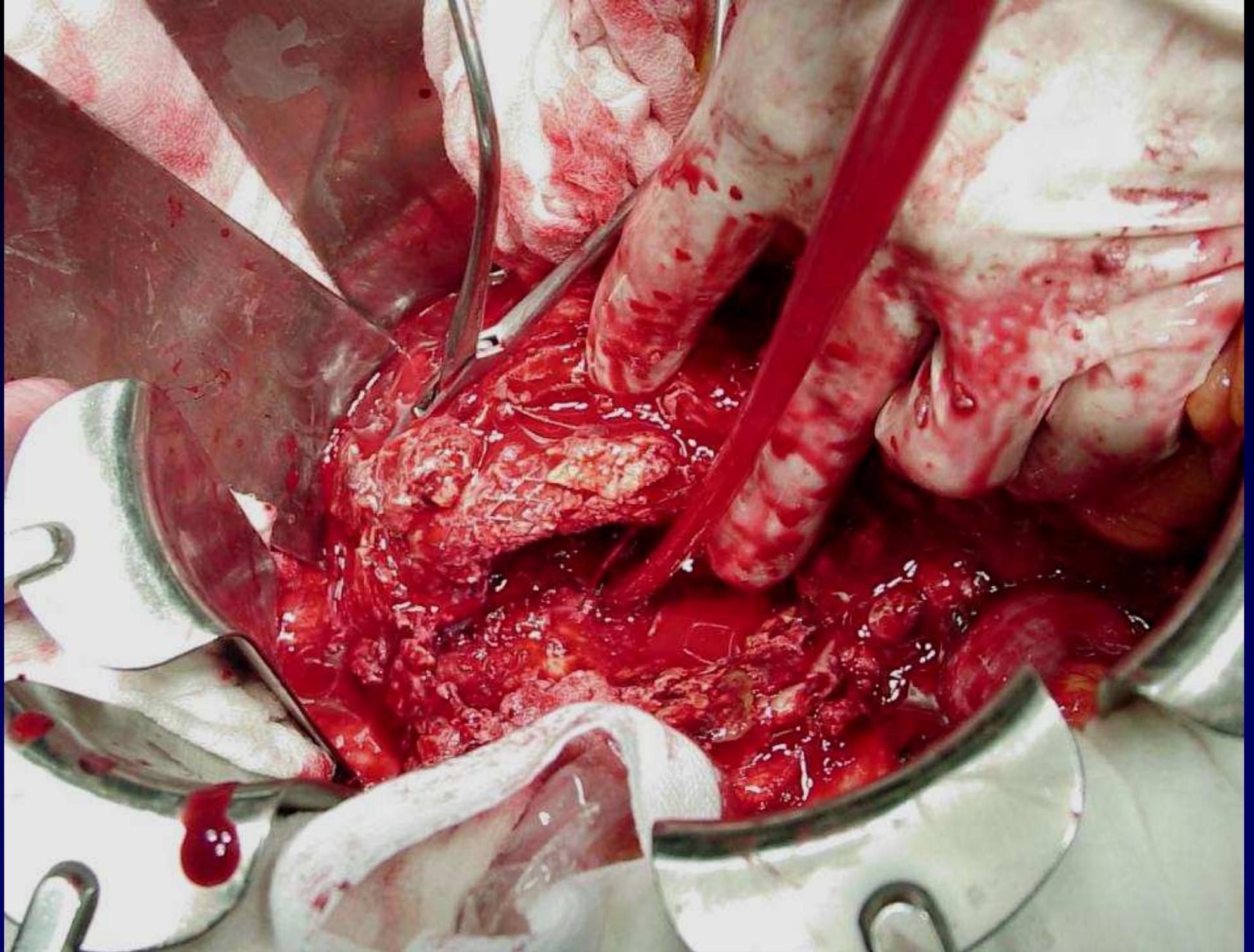
6.91cm

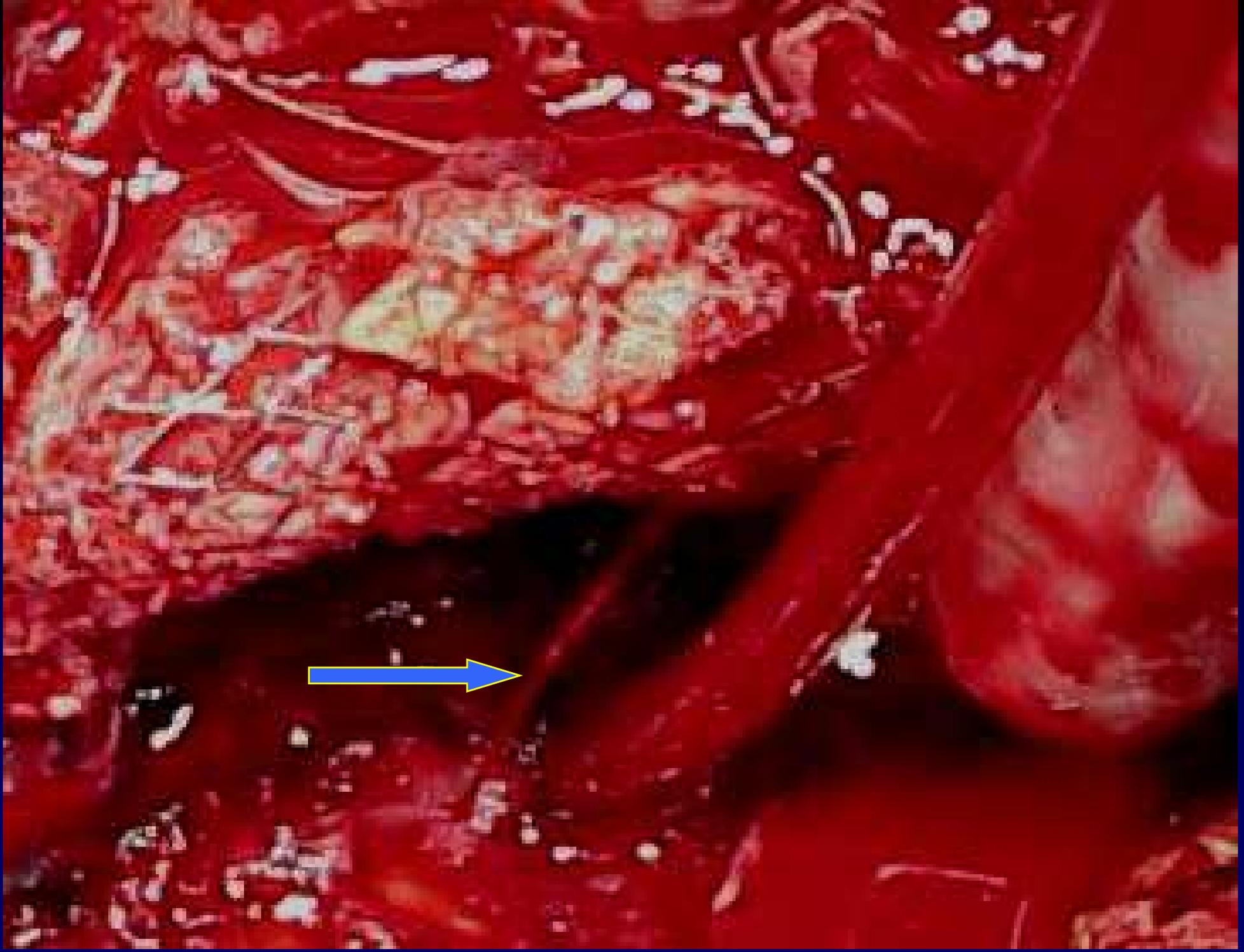


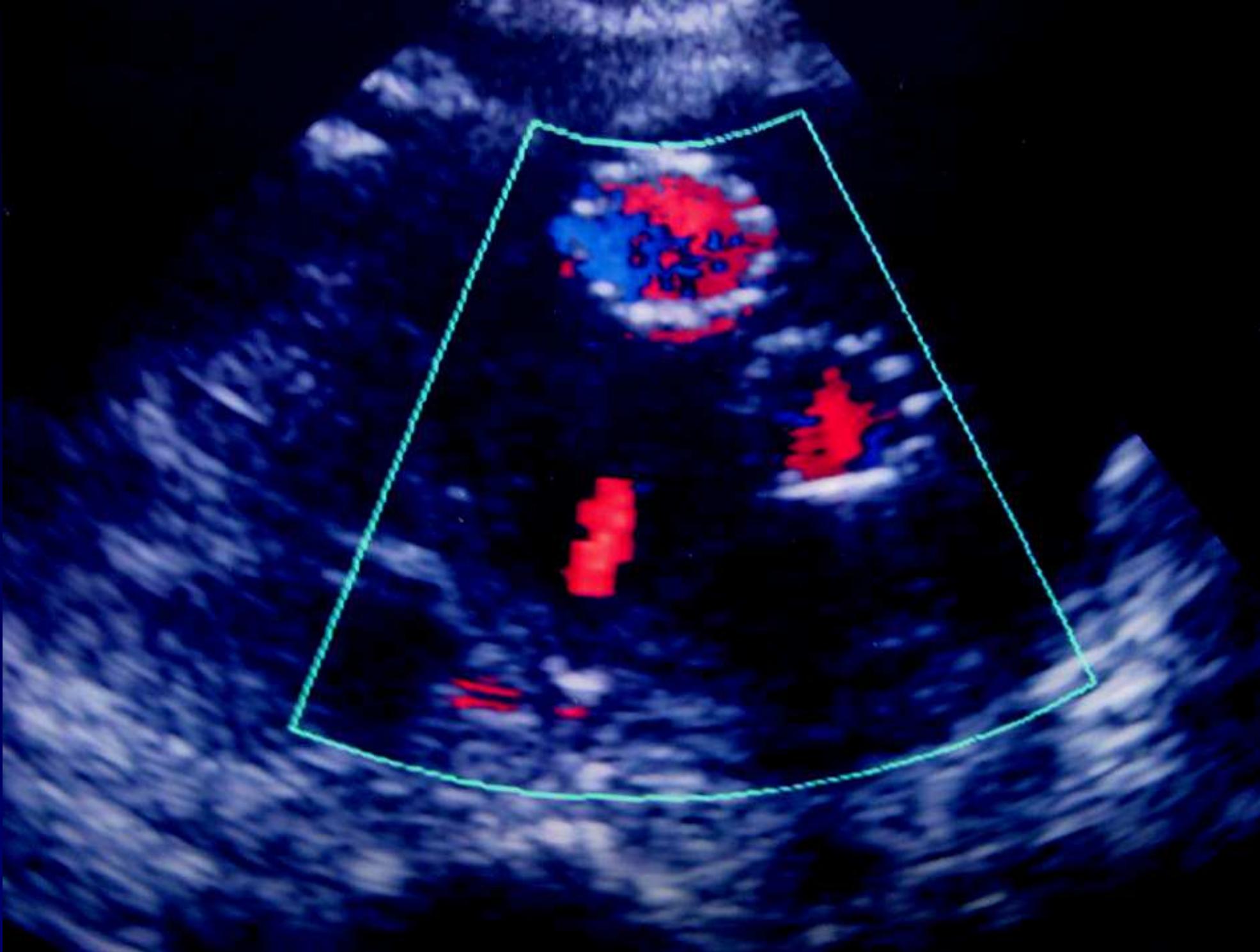
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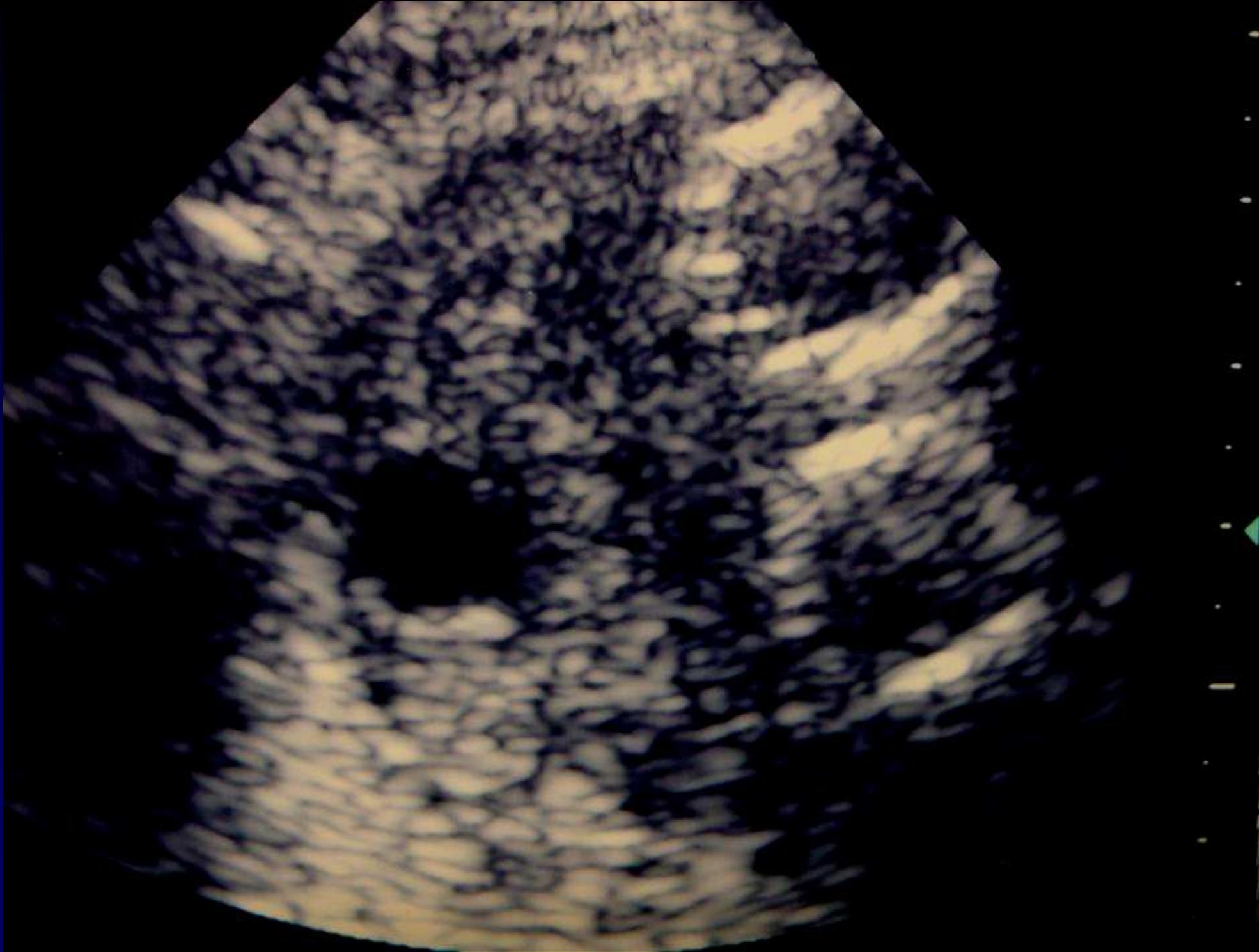


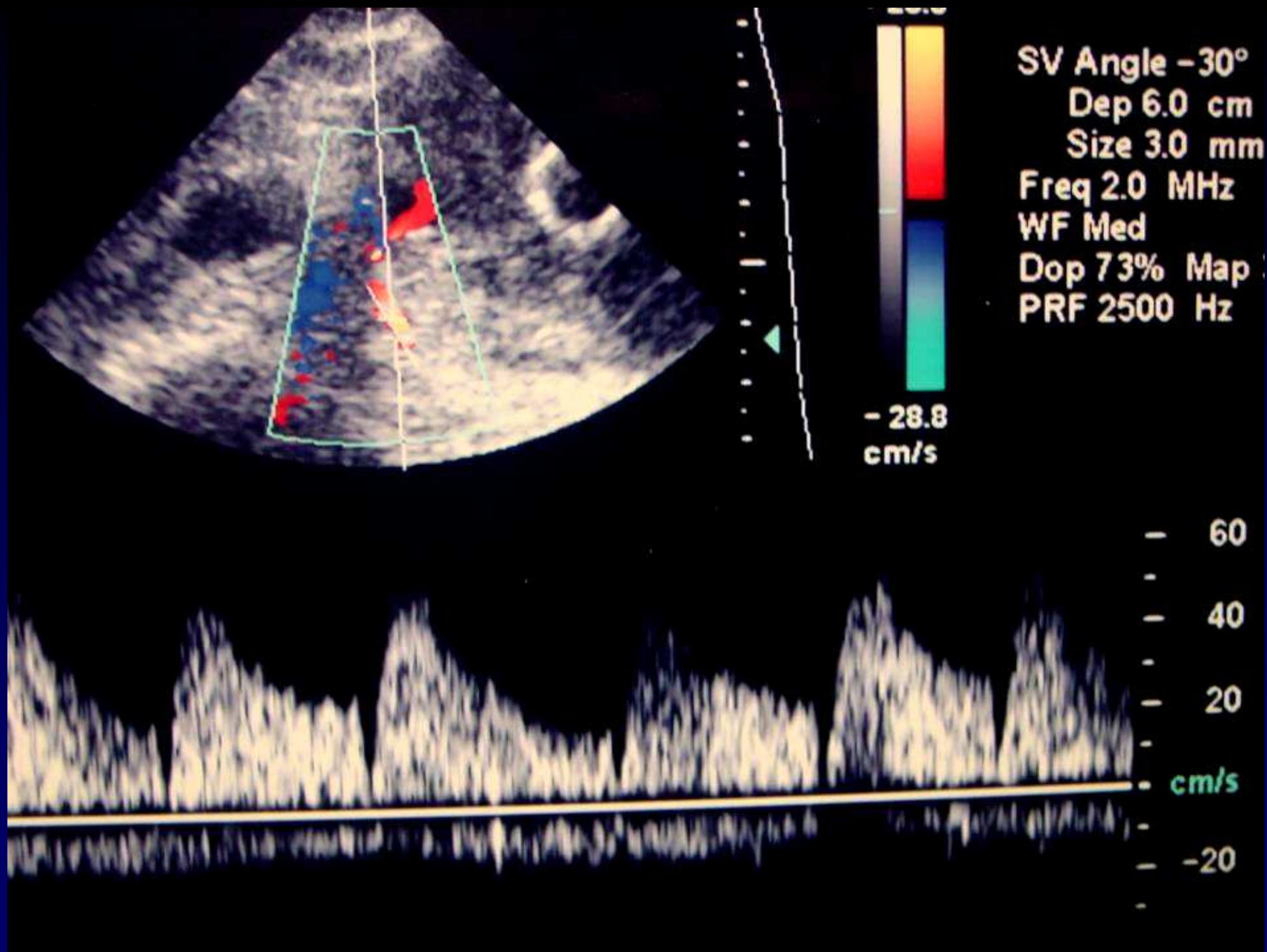
8.29cm

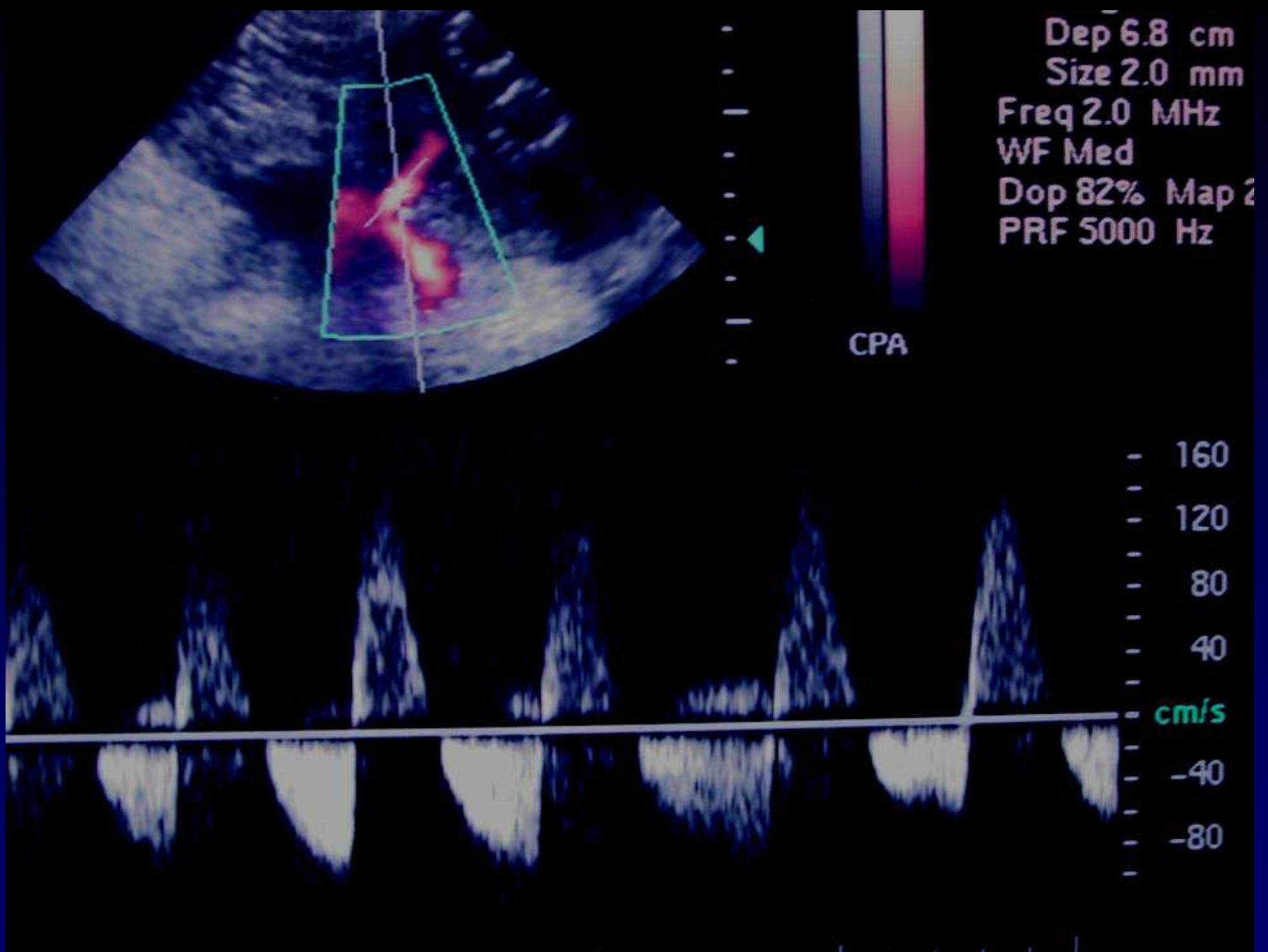




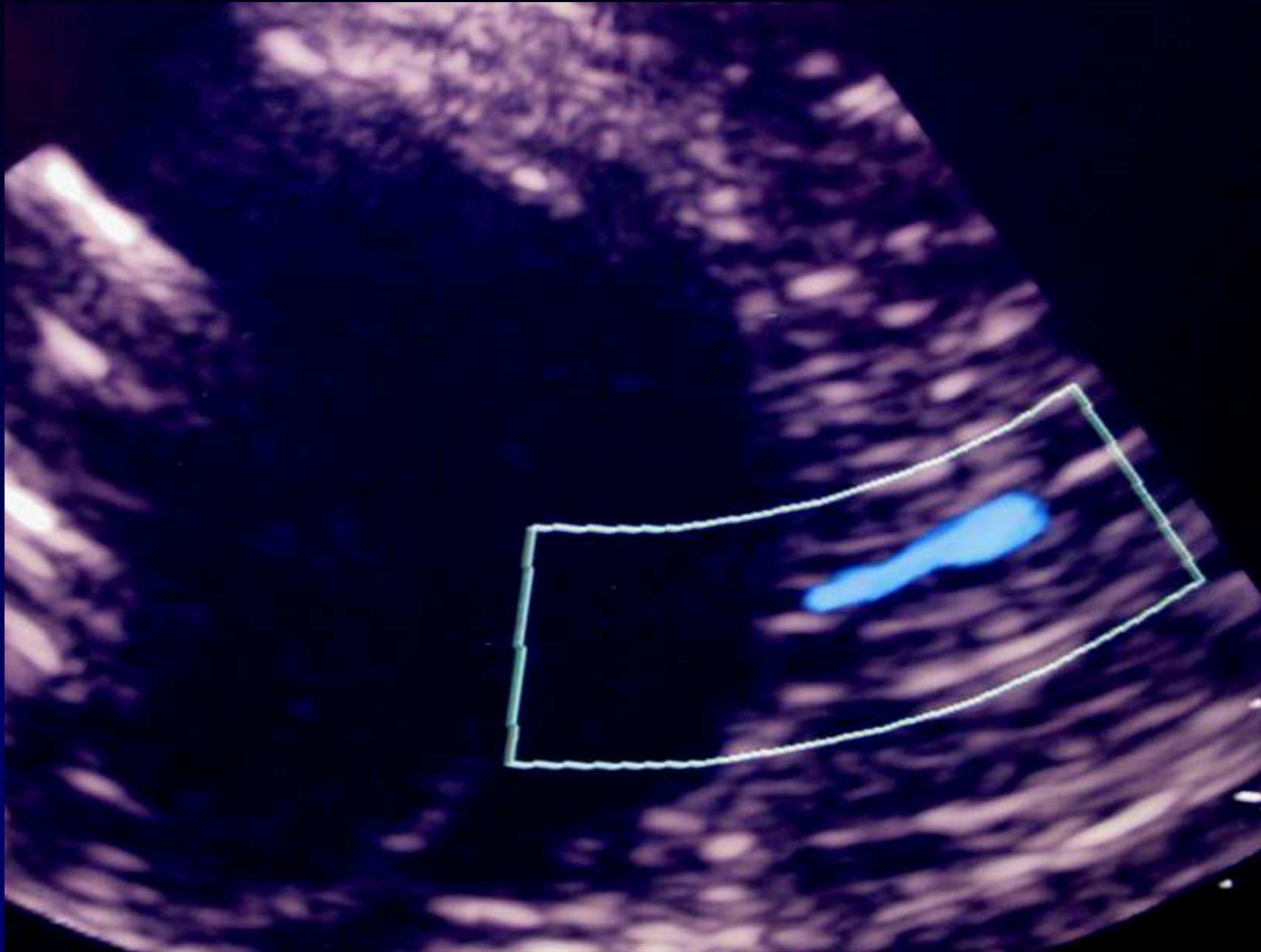








Lumbar artery feeding thrombus in AAA sack



Mirror artifact seen as endoleak



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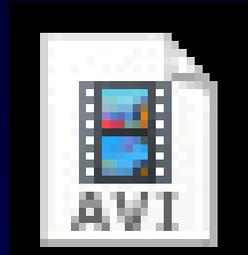
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Suspected endoleak

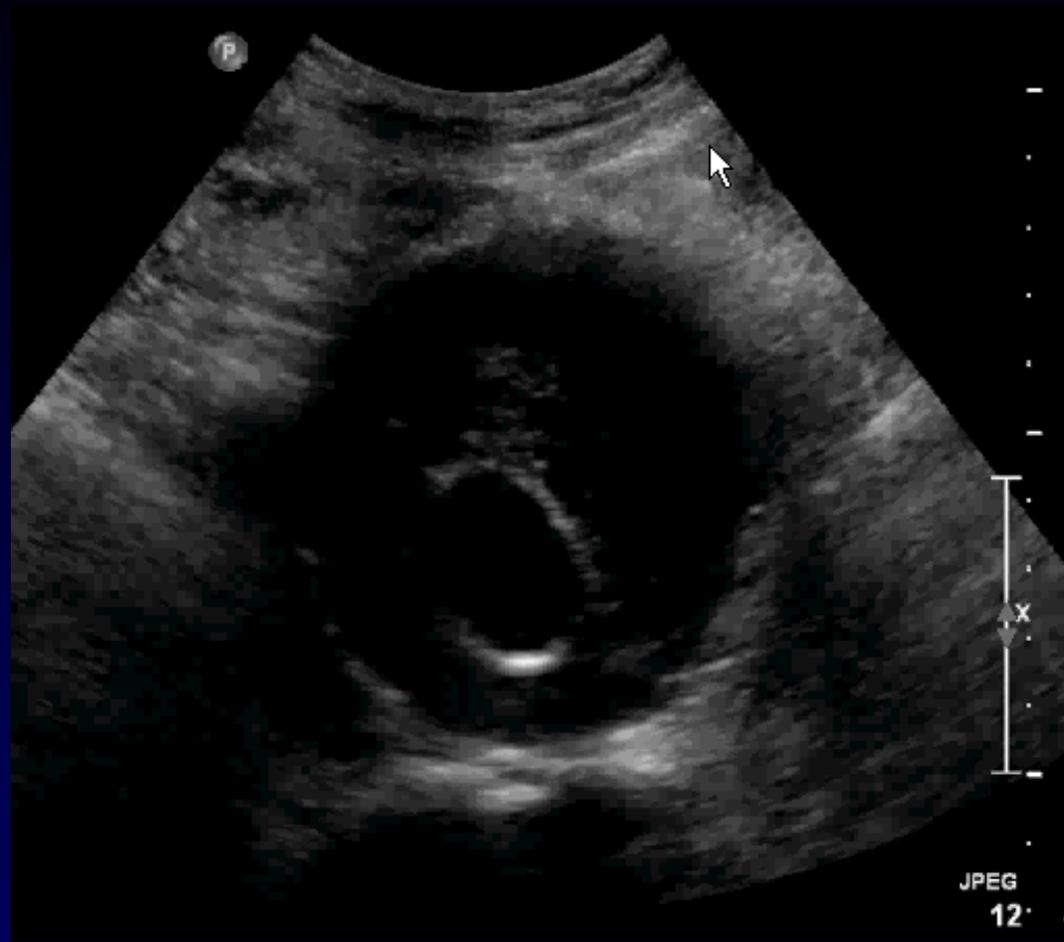
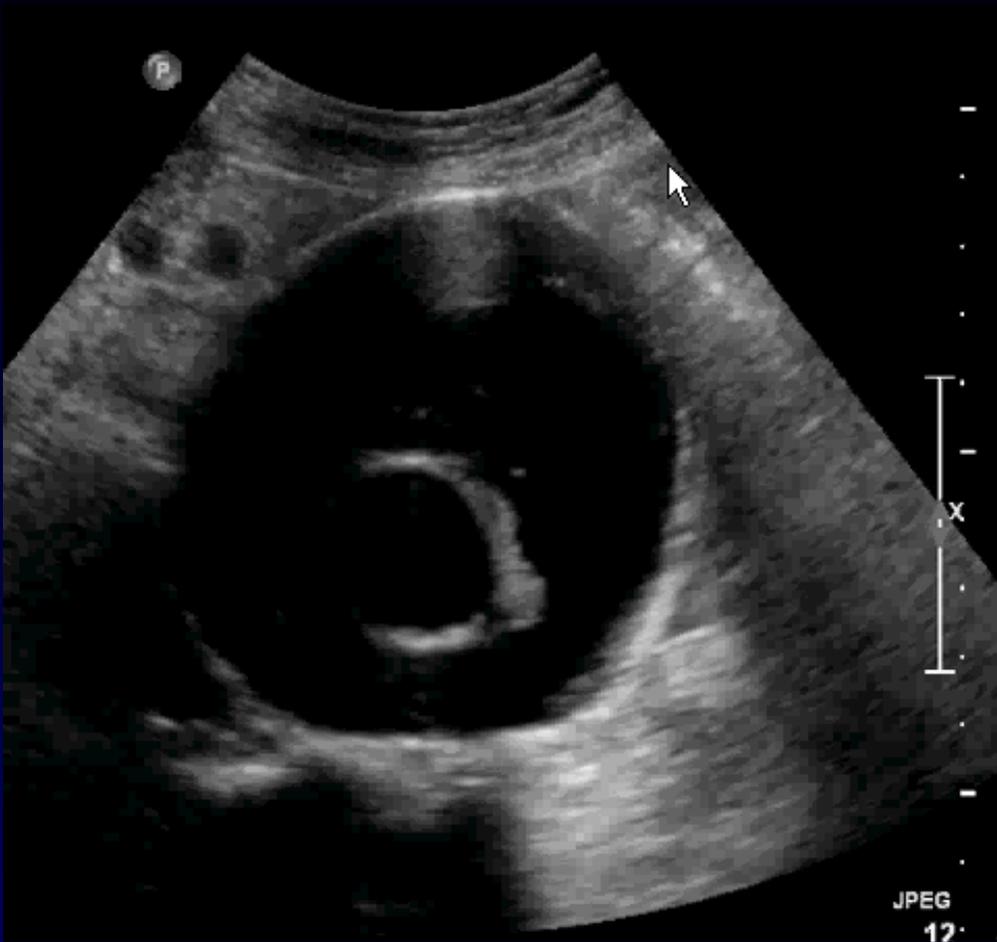


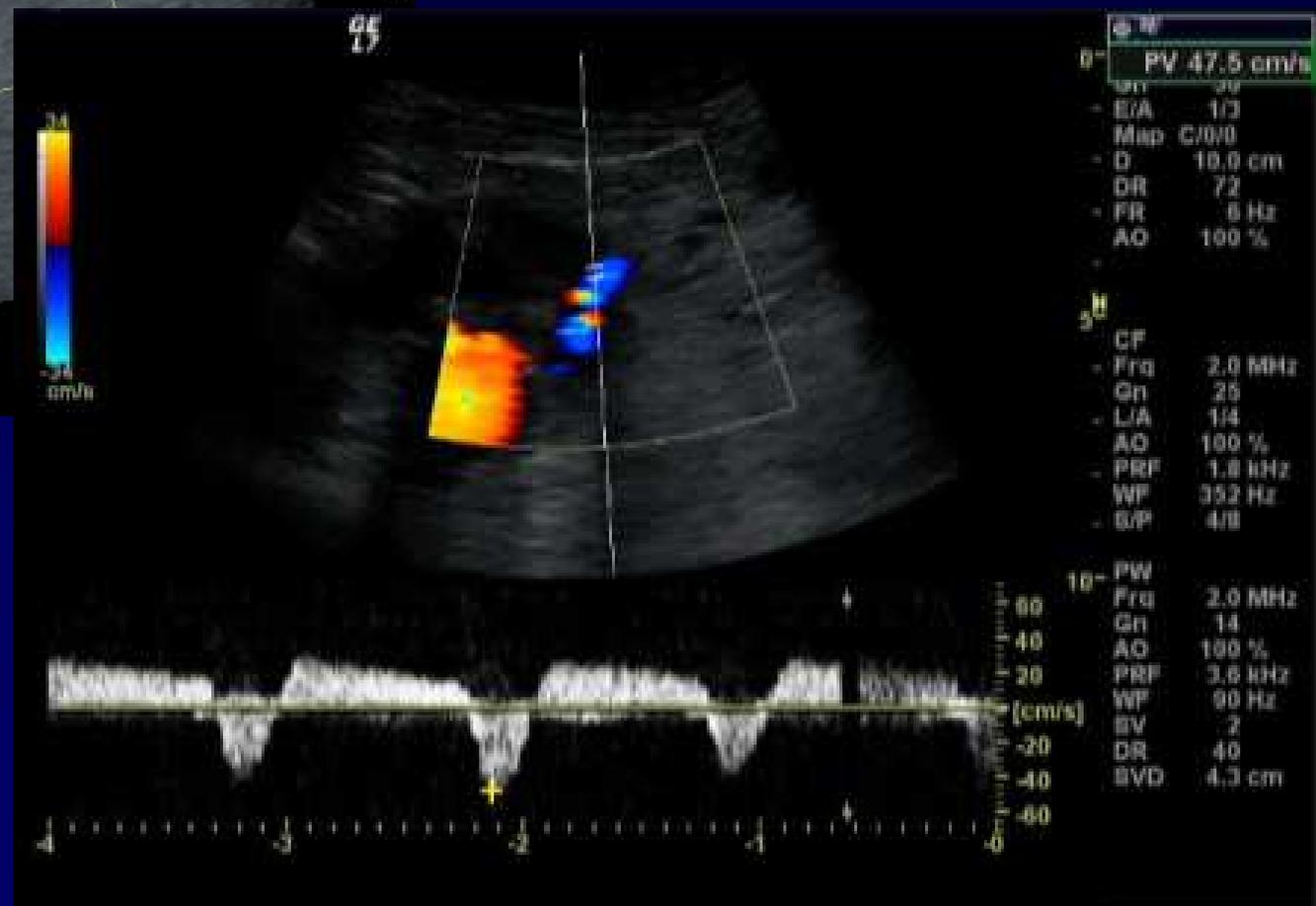
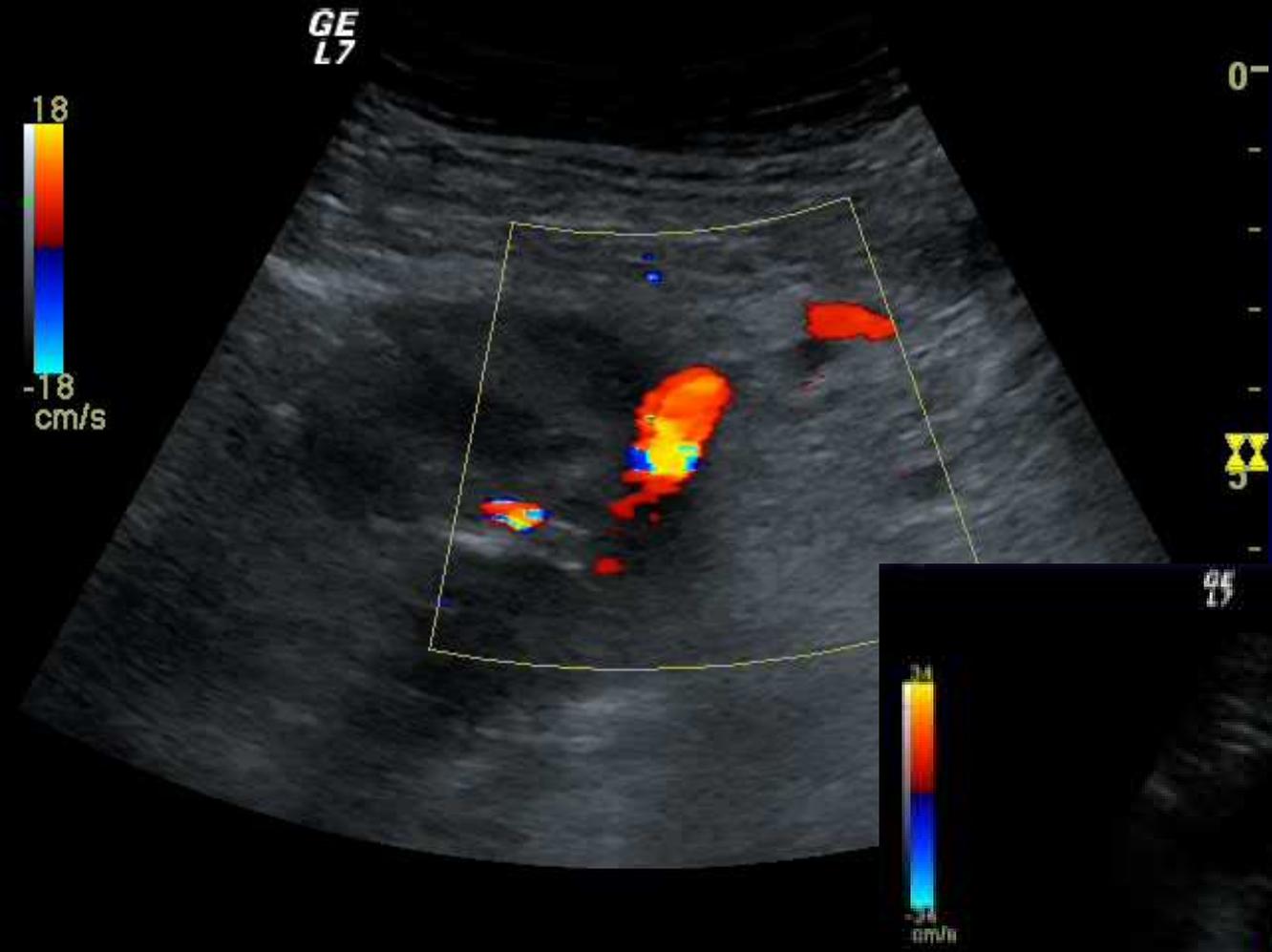
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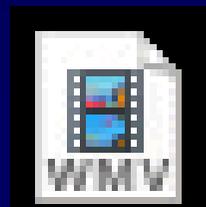
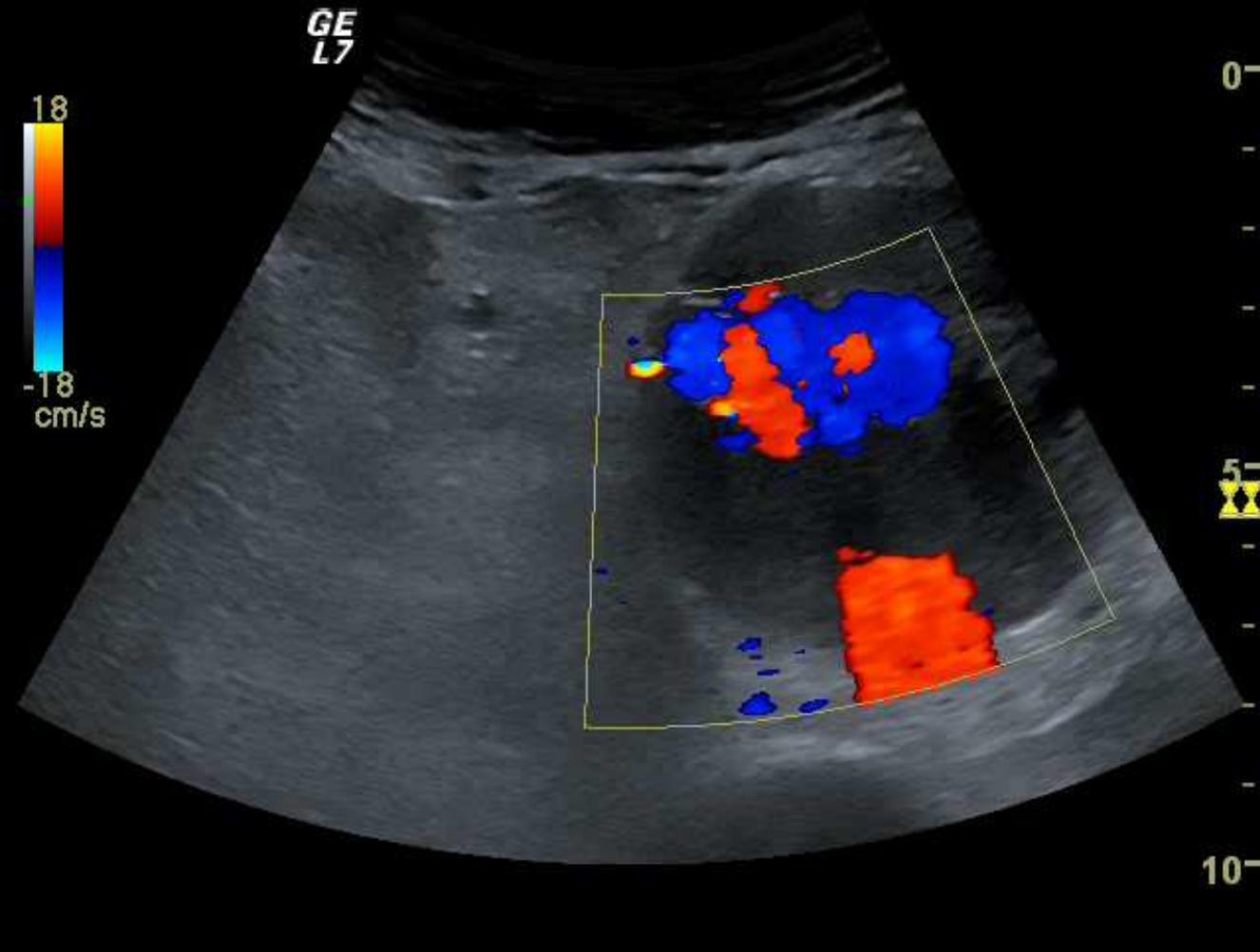
Type II endoleak from a lumbar artery



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m9.wmv

Lezzi R, et al. J Vasc Surg 2009;49:552-60

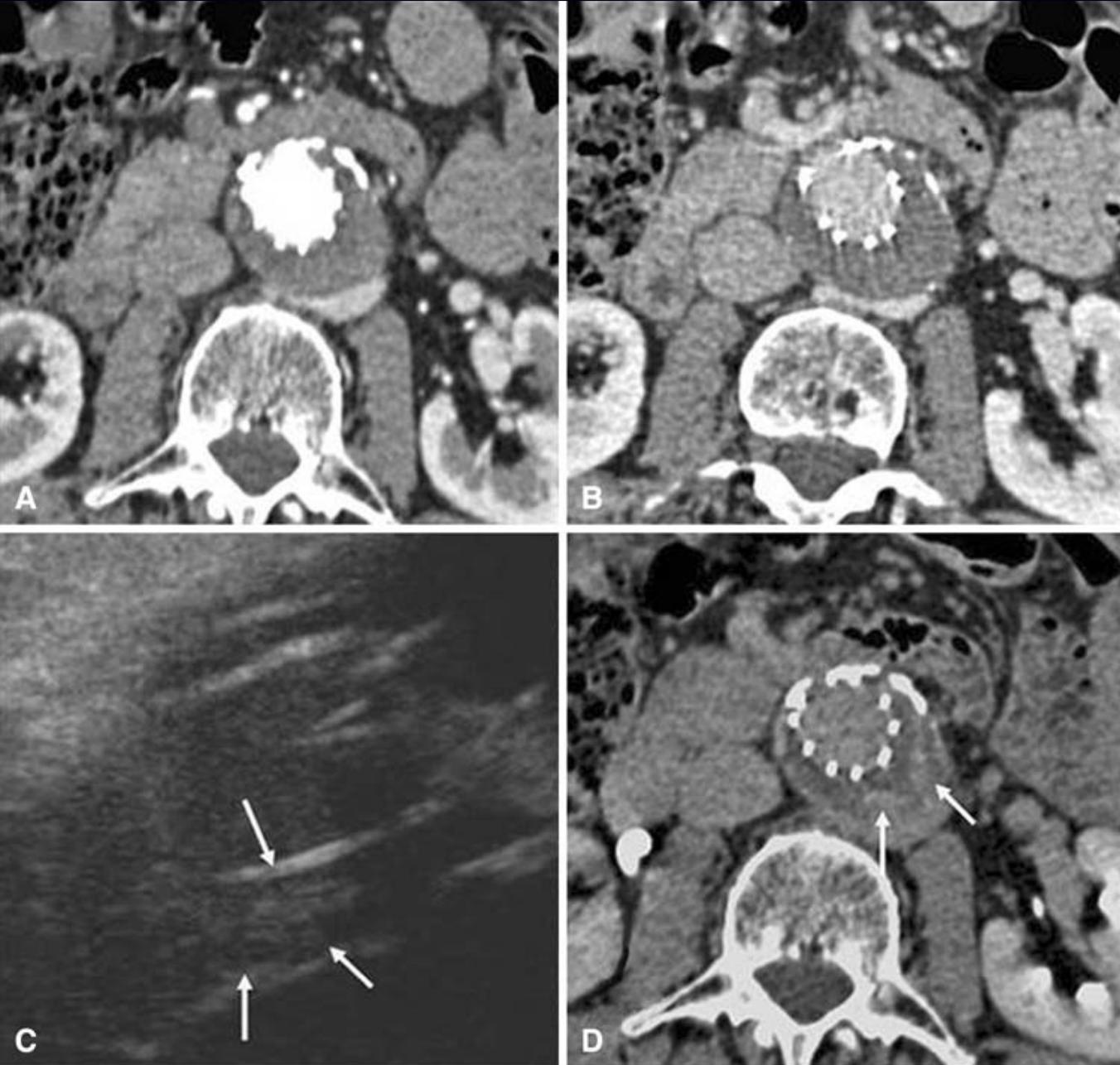
CEUS significantly improved the diagnostic performance of unenhanced US studies in the detection of endoleaks

Sensitivity 97.5% vs. 62.5%

Specificity 81.8% vs. 63.6%

NPV 97.3% vs. 65.1%

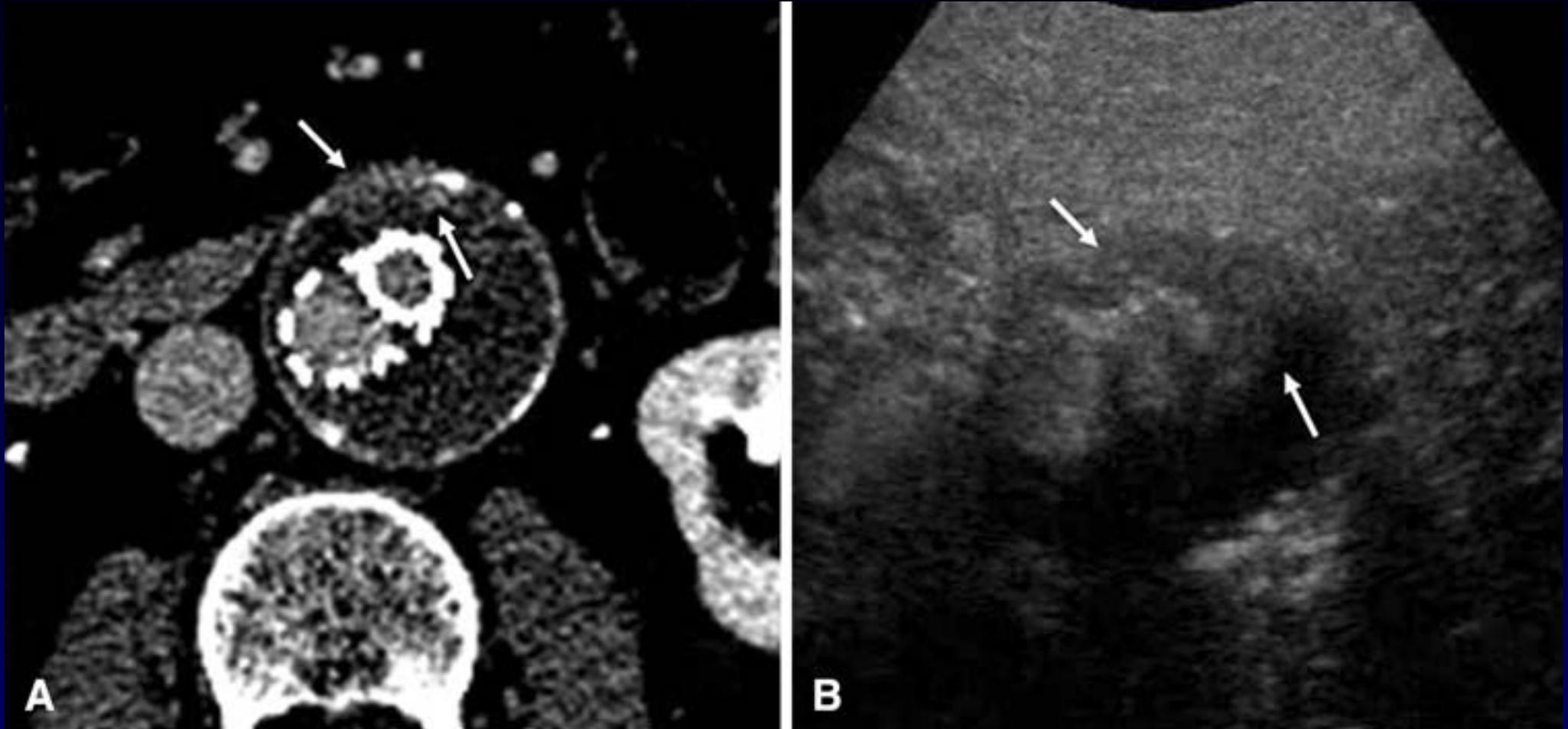
No adverse events were recorded during the study.



Aneurysm sac enlargement.
No endoleak on arterial and
60-s delayed (B) phase
Diagnosis: endotension

Endoleak on CEUS

Low-flow endoleak was
confirmed by a delayed
phase image performed



CEUS detected a small endoleak with diffuse spreading of contrast agent into the thrombus in which the lack of concentration in a defined and confined region of the sac could reduce CTA detection capability.

Beeman BR, et al J Vasc Surg 2010. Duplex ultrasound factors predicting persistent type II endoleak and increasing AAA sac diameter after EVAR

T2 ELs 14% (38/278)

In 14 patients T2ELs resolved, sac diameter decreased or remained the same IFVm 42cm/s, SDW monophasic 5, biphasic/bidirectional 7/2, many T2ELs 0.

12 patients had T2ELs that persisted, but sac diameter decreased or remained the same: IFVm 47cm/s SDW monophasic 1, biphasic 5, bidirectional 5, any T2ELs 2.

12 had persisted T2ELs and were associated with increased sac diameter IFV 43cm/s, SDW monophasic 1, biphasic 2, bidirectional 9, many T2ELs 9.

None of the 38 patients treated for enlarging sac diameters (11/12) experienced a ruptured aneurysm.

Chaer RE, et al. J Vasc Surg 2009;49:845-9. Duplex ultrasound as the sole long-term surveillance method post-endovascular aneurysm repair: A safe alternative for stable aneurysms

184 patients followed with CDU for 1 to 4y

Criteria were applied to a consecutive series of **200** EVAR patients, **97%** would have been eligible for CDU only surveillance by 3 years postoperatively.

CDU only surveillance post-EVAR is safe and can be initiated early after treatment in patients with shrinking or stable aneurysms. This policy should result in cost savings advantage and avoid the complications associated with CT.

Sampaio SM, et al. Ann Vasc Surg 2005;19:302-9. Aneurysm sac thrombus load predicts type II endoleaks after endovascular aneurysm repair.



Proportion of maximum **AAA area occupied by thrombus** may be a useful way to identify patients at high risk of a persistent type II endoleak. Patients with **low preoperative sac thrombus load** should be followed with a high degree of suspicion.

Imaging Surveillance

More common

	1 month	3 months	6 months	1 year	Yearly
CT Scan	+	+	+	+	+
Duplex ultrasound	+	+	+	+	+
Abdominal plain film	+	+	+	+	+

Evidence for changing imaging surveillance

Reduced at 1 month and 1year

Sternbergh WC, et al. J Vasc Surg 2008;48:2278-84

Redefining postoperative surveillance after endovascular aneurysm repair: recommendations based on 5-year follow-up in the US Zenith multicenter trial.

Absence of endoleak at 30 and 365 days predicted improved long-term freedom from ARM compared with early endoleak.

No early endoleak, 6-month surveillance is eliminated, and DU is suggested for long-term surveillance >1y.

In most patients, this reduced surveillance regimen would be appropriate and could improve patient safety by reducing the cumulative deleterious effects of intravenous contrast and radiation exposure while also reducing health care costs.

Beeman BR, et al. J Vasc Surg 2009;50:1019-24. Duplex ultrasound imaging alone is sufficient for midterm endovascular aneurysm repair surveillance: a cost analysis study and prospective comparison with computed tomography scan.

250 patients with EVAR

CT and DU imaging every 6 months during the first year and then annually if no problems were identified (**group 1**).

Aneurysm sac size, presence of endoleak, and graft patency between the two scanning modalities were compared.

DU imaging as the sole surveillance study unless a problem was detected (**group 2**).

CT, DU imaging charges for each regimen were compared using health system pricing and Medicare reimbursements.

DU and CT were **equivalent** in determining aneurysm sac diameter after EVAR. Each was as likely to falsely suggest or miss an endoleak.

Using DU alone would have reduced cost by **29% (\$534,356)** in group 1.

Cost savings of **\$1595 per patient per year** in group 2 by eliminating CT.

None of the group 2 patients had an adverse event such as rupture, graft migration, or limb occlusion for having DU alone as the sole follow-up modality.

Thank you

