

Strengths and Weaknesses of
CT and Duplex Scanning
for EVAR Endoleaks and Limb Stenosis

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SVS Guidelines EVAR Surveillance

< 1 month: CT-A and DU

If no endoleak or sac enlargement, then...

Annually: CT-A *or* DU

(Chaikof et al. J Vasc Surg 2018;67: 1-77)



Let's Play...

Cliff Sales Jeopardy!!!

(free trip to the Caribbean!)



Cliff Sales Jeopardy

Question #1

What are *advantages of CT-A* vs DU
for EVAR surveillance?



CT-A Strengths vs. DU

- Shows endoleaks better
- More definitive to plan Rx
- More reliable in certain cases
(obese, lot of gas, inexperienced tech)



Cliff Sales Jeopardy
Question #2

What are *weaknesses of CT-A* vs. DU
for EVAR surveillance?



CT-A Weaknesses vs. DU

Costs

Radiation

Claustrophobia

Allergic reactions

Contrast nephropathy

Metal (clips) – artifact may hide leak



CT-A vs DU

Sac Diameter, Costs, Endoleak

Surveillance: 1 week, 6 mos, 12 mos, annually

< July 1, 2004: **Group 1** = CT+DU (82 pts)

> July 1, 2004: **Group 2** = DU only (117 pts)

(Beeman, Calligaro, et al. J Vasc Surg 2009;50:1019-24)



Results: Sac Diameter

DU and CT scans
equivalent in determining
aneurysm sac diameter post-EVAR
($p < 0.001$)



Results

Endoleaks: False positives and negatives

1% (5) DU vs 0.5% (2) CT
($p = 0.683$)

False positives (not really there)

1% (5) DU vs 4% (11) CT
($p < 0.01$)

False negatives (missed endoleak)

(Beeman, Calligaro, et al. J Vasc Surg 2009;50:1019-24)



ID:
PENN VASCULAR ASSOCIATES
C3 40R
SPTAd 27M10.7
50DB C6 E4
HDI

9:34
CINELoop (R) REVIEW
COLOR 87 %
VEL
MAP 4 CS10
WF 200 P4
PRF 1750
2D RS D2

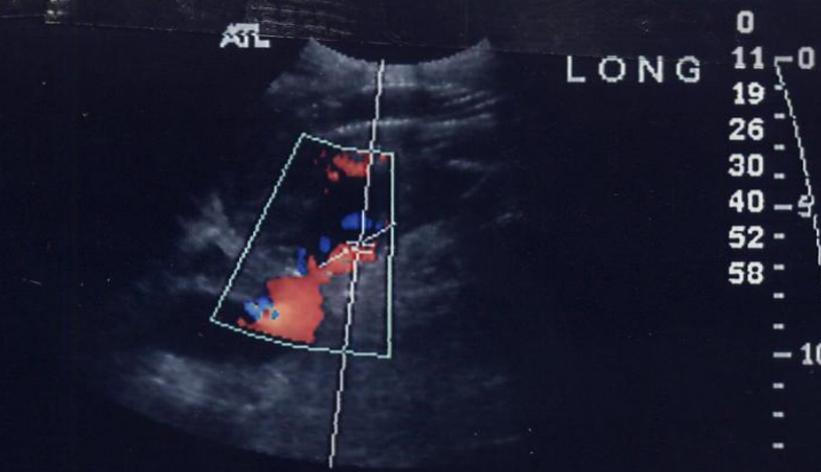
AO



POSS. ENDOLEAK
1. 7.28 cm 4.22 cm²
2. 4.24 cm 15.55 cm²

LUMBAR A.

Col 75% Map 1
WF Med
PRF 2500 Hz
Flow Opt: Med V
BW 1 Pg 0
Col 7 Pg 0



SV Angle 50°
Dep 6.4 cm
Size 2.0 mm
Freq 2.5 MHz
WF Med
Dop 75% Map 2
PRF 8333 Hz



ENDOLEAK

Results:

Costs

If Group 1 used DU alone
(eliminated CT scans):
would have reduced charges
for EVAR surveillance
by 29% (\$534,356)

In Group 2, eliminating CT scan surveillance:
cost savings of \$1,595 per patient



Results

*None of Group 2 patients had adverse event
(rupture, limb occlusion)*

*as a result of having DU performed
as sole follow-up modality*



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Question #3

What DU criteria suggests

Type II endoleak will not resolve?



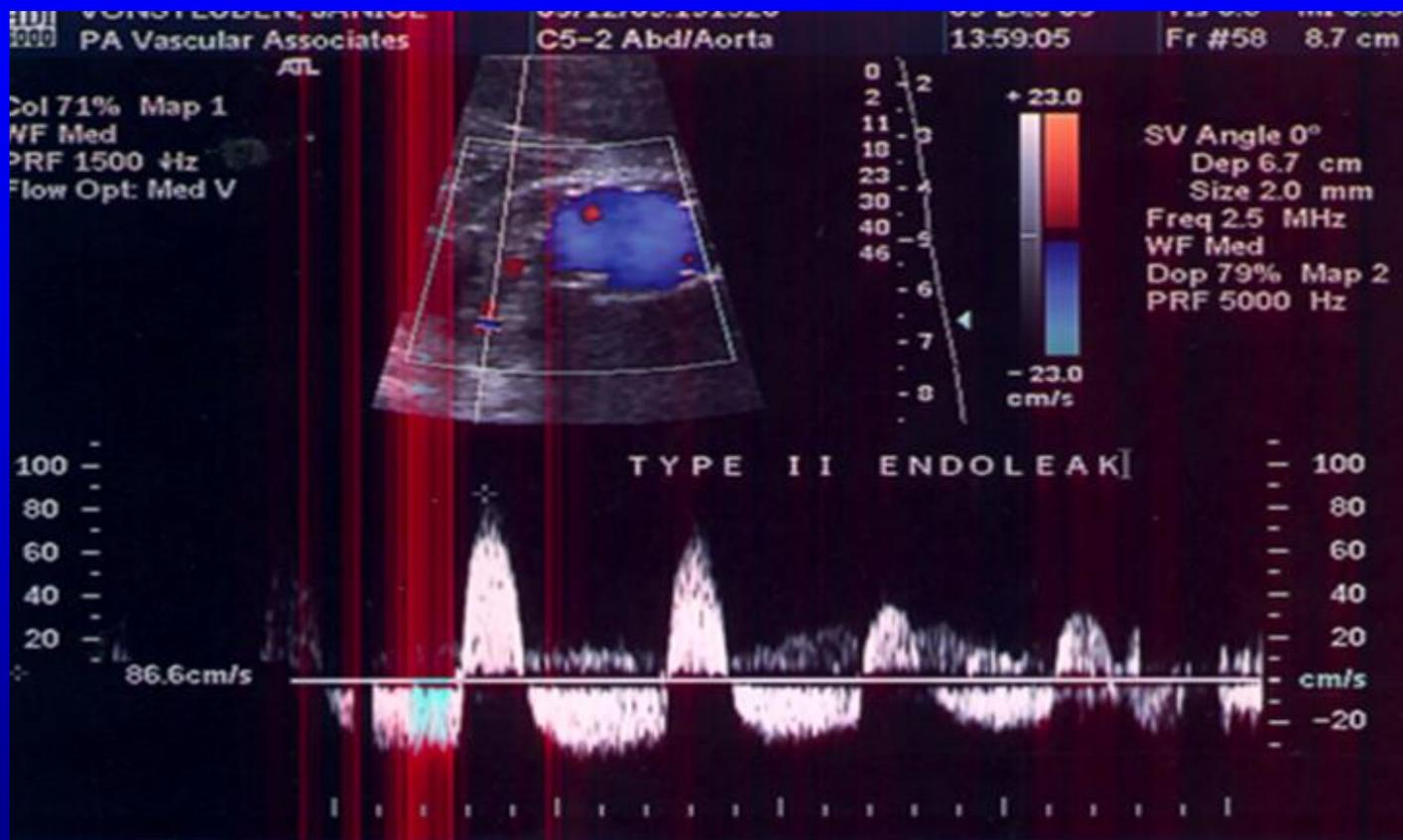
DU criteria Type II endoleaks

- Others suggested PSV > 80 cms/sec correlated with persistent Type II endoleak
- 1998-2009: 278 EVAR patients with DU
- Only predictors for sac enlargement = multiple T2EIs & *To-and-Fro* Doppler flow

(Beeman BR, Murtha K, Doerr K, McAfee-Bennett S, Dougherty MJ, Calligaro KD. J Vasc Surg 2010;52:1147)



Predictors of sac expansion



To and Fro Doppler flow pattern
($p = 0.0069$)



Predictors of sac expansion



Multiple T2ELs
($p < 0.0001$)



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Question #4

Is DU useful for diagnosing a failing (stenotic) EVAR limb?

Double jeopardy: if so, what DU criteria?



Results:

Limb Patency

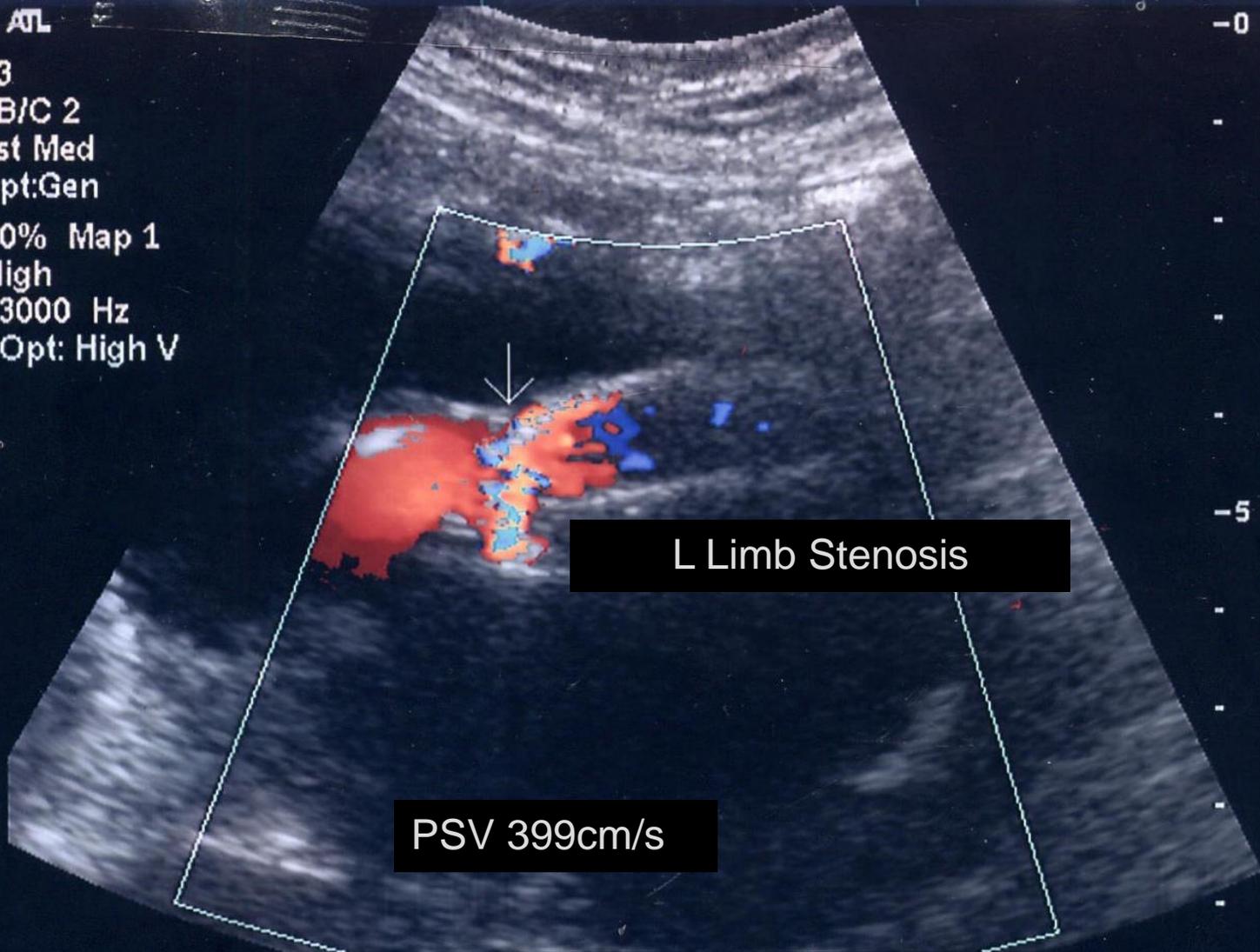
- 2.5% (5/199) EVARs: failing (stenotic) limb
- 5 stenoses or kinks
(PSV = 308, 399, 515, 521, 530 cm/sec)
(all with PSV ratio > 3.5)
- All detected by DU
(2 stented, 2 fem-fem, 1 ax-fem)

(Blom A, Troutman, D, Beeman B, Dougherty MJ, Calligaro KD.

J Vasc Surg 2012;55:1577-80)



lap 3
70dB/C 2
Persist Med
D Opt:Gen
Col 60% Map 1
/F High
RF 3000 Hz
low Opt: High V



L Limb Stenosis

PSV 399cm/s

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Question #5

Are early (< 1 yr) or late (> 1 yr) onset
Type II endoleaks more worrisome
- require Rx more frequently?



Early vs Late Type II endoleaks (462 EVARs)

New onset

	<u>< 1 yr</u>	<u>> 1 yr</u>	<u>p value</u>
Resolved	75% (49/65)	29% (9/31)	< 0.0001
Intervention	8% (5/65)	55% (17/31)	< 0.0001

*(Pineda, Tyagi, Troutman, Dougherty, Calligaro.
JVS 2018;67:449-52)*



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Question #6

What % of EVARs need intervention during follow-up:

< 5 years?

> 5 years?



Does EVAR surveillance matter > 5 years?

156 EVARs followed > 5 years

	<u>< 5 yrs</u>	<u>> 5 yrs</u>
Intervention	22% (34)	6% (10)

(*Pineda, Phillips, Calligaro, Krol, Dougherty, Dietzek.*
JVS 2017;66:392-5)



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Question #7

- What % of patients are compliant with EVAR surveillance after 3 years?
- *Double-jeopardy*: Why is compliance so poor?
- *Double-double-jeopardy*: Does compliance correlate with survival?



EVAR Surveillance

Surveillance compliance post-EVAR

- Analyzed 144 EVAR patients
- 25 patient variables
- Vascular registry, patient charts, telephone questionnaire

*(Tyagi, Calligaro, Pineda, Zheng, Troutman, Dougherty.
JVS submitted)*



EVAR Surveillance - Compliance

Estimated compliance at 3 years post-EVAR

= **70% ± 6%**

(other studies = 30-40% compliance)

Estimated 5-year survival rate:

Compliant group = **83%**

vs.

Non-compliant group = **34%**

($p < 0.001$)



EVAR Surveillance - Compliance

- Compliance

Predicted by patient satisfaction with vascular surgeon and hospital care

- Non-compliance

Predicted by stroke & CHF during follow-up

No other variables

*(postop complications, distance from hospital)
predicted compliance*



EVAR Surveillance - Compliance

Although patient satisfaction with surgeon and hospital leads to increased compliance (*be nice!*), non-compliance is associated with sick or dying patients.

We can try –
but it may not make a difference



Conclusion

Surveillance of EVAR patients –
performed accurately, safely, cost
effectively
using DU as sole imaging study



Cliff Sales Jeopardy!

Prizes

- Anyone who answered any question correctly...
- Anyone who stayed awake during this presentation...
- Talk to Dr. Sales and tell him your Caribbean Island





Pennsylvania *Hospital*



FINAL CLIFF SALES JEOPARDY!

- DU vs CT-A: sac diameter?
DU = CT-A
- DU vs CT-A: misses Type II endoleak?
DU misses less
- DU criteria: Type II endoleak enlargement?
Multiple endoleaks, to-and-fro
- DU criteria - failing EVAR limb?
PSV > 300 cms/sec, PSV ratio > 3.5



FINAL CLIFF SALES JEOPARDY!

- % Type II new onset < 1 yr need Rx?
8%
- % Type II new onset > 1 yr need Rx?
55%
- % EVARs need Rx < 5 yrs?
22%
- % EVARs need Rx > 5 yrs?
6%



FINAL CLIFF SALES JEOPARDY!

- % compliant f.u. after 3 yrs?
30-70%
- 5-yr survival if compliant?
83%
- 5-yr survival if non-compliant?
34%
- Why worse survival if non-compliant?
Sicker!

