

Diagnostik af endoleaks

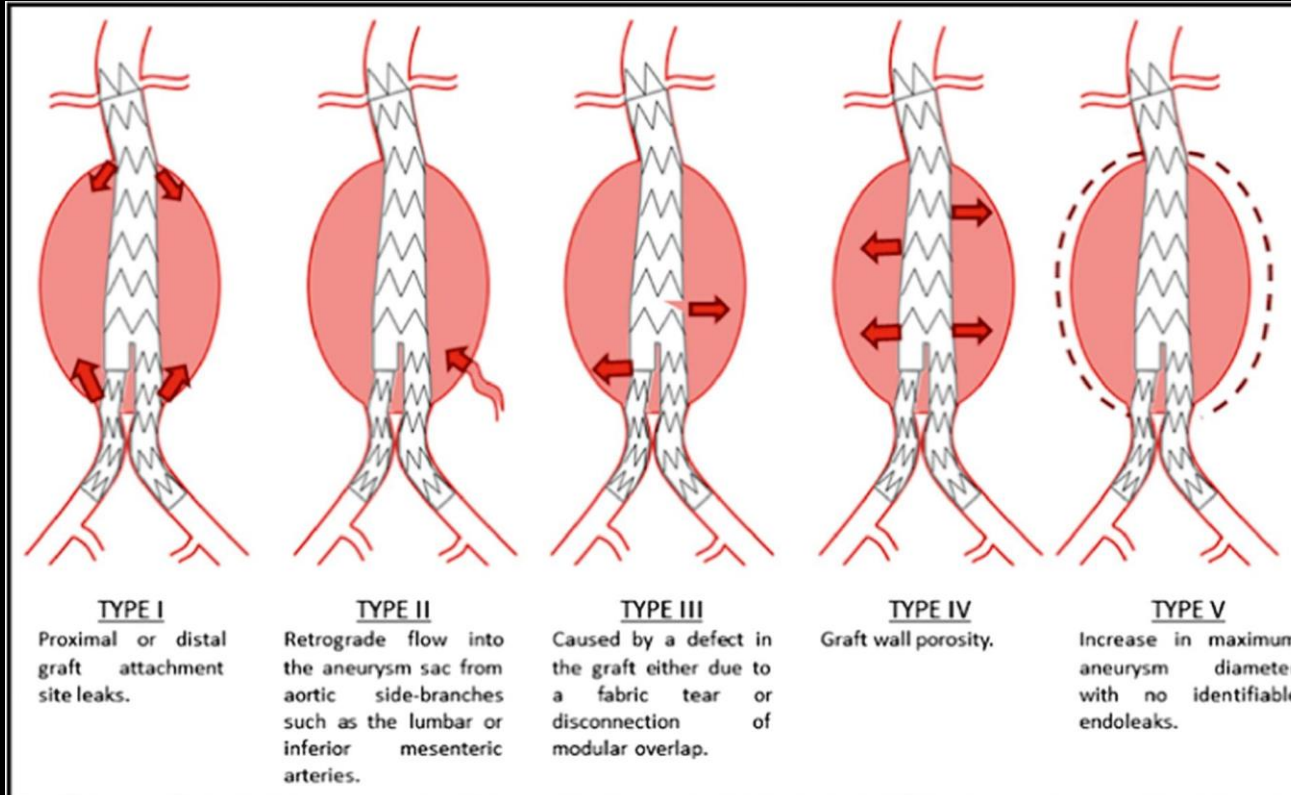
ovl. **Radu L. Vijdea**

Røntgen og Scanning

Kolding Sygehus



Endoleaks - typer



ENDOLEAK

11 %

TYPE I

Inadequate seal
at graft ends

1A (Proximal)
1B (Distal)
1C (Iliac)

Contrast extravasation in continuity with
the site of the graft attachment

Interv.

80 %

TYPE II

Retroleak. Aneurysm sac filling
via branch vessel. 80 %

2A (1vessel)
2B (2 or more vessels)

Retrograde flow through branch
vessels (lumbar arteries or
inferior mesenteric artery)

Observ.

3 %

TYPE III

Leak through
defect in graft

3A (Junctional separation of the modular components)
3B (Fractures or holes involving the endograft)

Contrast extravasation:
central or distal to the
graft attachment

Interv.

2 %

TYPE IV

Graft porosity

Contrast extravasation anywhere of the aneurysmal sac
without evidence of clear leak origin

Observ./
Interve.

4%

TYPE V

Endotension

Continued expansion of aneurysm sac without demonstrable
leak on imaging

Observ./
Interve.

CT aorta - flere faser

- ↪ CT non-kontrast + CT i arteriel fase (evt. + venøs fase), evt Dual energy m. virtual non-kontrast
- ↪ Jodholdige kontrast – Visipaque 320 / Omnipaque 350
- ↪ Bolus – 75 ml Omnipaque 350, 4 ml/s + 50 ml saltvand, 4 ml/s
- ↪ Planlægning – auto bolus tracing i aorta
- ↪ Skanningsfelt, hastighed, forstørrelse
- ↪ Rekonstruktioner – aks./cor./sag. 2,5/3 mm
- ↪ Evt. diagnostik på CT dedikeret software (AW server, Syngovia, Intelispace)

UL kontrast - CEUS

- ↪ B mode + doppler us
- ↪ Aneurisme størrelse (inkl væg)
- ↪ EVAR anatomi – krop, ben, evt. viscerale gren
- ↪ Kontrast – 2 ml. SonoVue
- ↪ Kontinuerlig skanning i arteriel og venøs fase op til 2 min
- ↪ Gennemgang af hele endoprotesen i venøs fase

Systematic review and meta-analysis of duplex ultrasonography, contrast-enhanced ultrasonography or computed tomography for surveillance after endovascular aneurysm repair

A. Karthikesalingam¹, W. Al-Jundi², D. Jackson³, J. R. Boyle⁴, J. D. Bear and M. M. Thompson¹

A comparison between contrast-enhanced ultrasound imaging and multislice computed tomography in detecting and classifying endoleaks in the follow-up after endovascular aneurysm repair

2013

Verena M. Gürtler, MD,^a Wieland H. Sommer, MD,^a Georgios Meimarakis, MD,^b Reinhard Kopp, MD,^b Rolf Weidenhagen, MD,^b Maximilian F. Reiser, MD, FACR, FRCR,^a and Dirk-André Clevert, MD,^a
Munich, Germany

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<https://doi.org/10.1007/s11547-018-0926-z>

2018

ABDOMINAL RADIOLOGY



CEUS versus CT Angiography in the follow-up of abdominal aortic endoprostheses: diagnostic accuracy and activity-based cost analysis

Niccolo' Faccioli¹ · Giovanni Foti¹ · Giulia Casagrande¹ · Elena Santi¹ · Mirko D'Onofrio¹







diagnostics

2022



Article

EVAR Follow-Up with Ultrasound Superb Microvascular Imaging (SMI) Compared to CEUS and CT Angiography for Detection of Type II Endoleak

Marco Curti^{1,*} , Filippo Piacentino², Federico Fontana^{1,2}, Christian Ossola¹, Andrea Coppola² , Paolo Marra³ , Antonio Basile⁴, Anna Maria Ierardi⁵, Gianpaolo Carrafiello^{5,6}, Giulio Carcano^{1,7} , Matteo Tozzi^{1,8}, Gabriele Piffaretti^{1,8} and Massimo Venturini^{1,2}

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- 25 studier
- 1997- 2012
- CT og Doppler UL (DUS)
- CT og Kontrast UL (CEUS)
- CT - standard
- alle endoleaks
- type 1 og 3 endoleaks

Alle endoleaks		
	DUS vs .CT	CEUS vs. CT
Se	74%	96%
Sp	94%	85%

Type 1 og 3 endoleaks		
	DUS vs .CT	CEUS vs. CT
Se	83%	99%
Sp	100%	100%

Conclusion: Both CEUS and DUS were specific for detection of types 1 and 3 endoleak. Estimates of their sensitivity were uncertain but there was no evidence of a clinically important difference. DUS detects types 1 and 3 endoleak with sufficient accuracy for surveillance after EVAR.

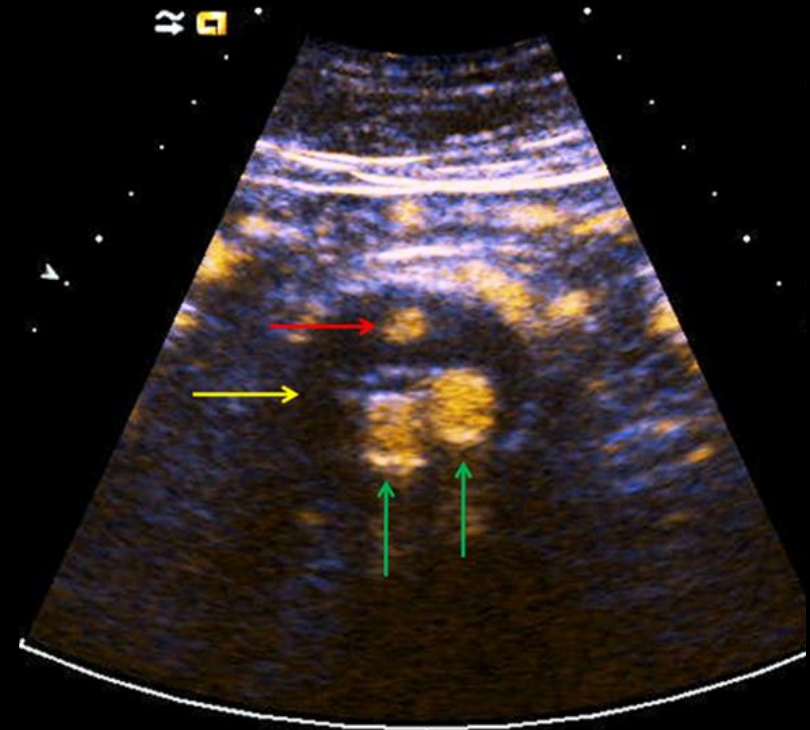
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- feb 2006 - feb 2011
- Retrospektiv studie
- 200 matched pairs
- CEUS og CT indenfor 30 dage

	CEUS vs. CT
Se	97 %
Sp	93 %
Falsk pos.	4 %
Falsk neg.	2 %



Conclusions: CEUS imaging appears to be as good as MS-CT angiography in the detection of endoleaks in the follow-up after EVAR, with the added advantages of no radiation dose and no nephrotoxicity of the contrast agents. A switch of the preferred examination from MS-CT to CEUS imaging should be considered. (J Vasc Surg 2013;58:340-5.)

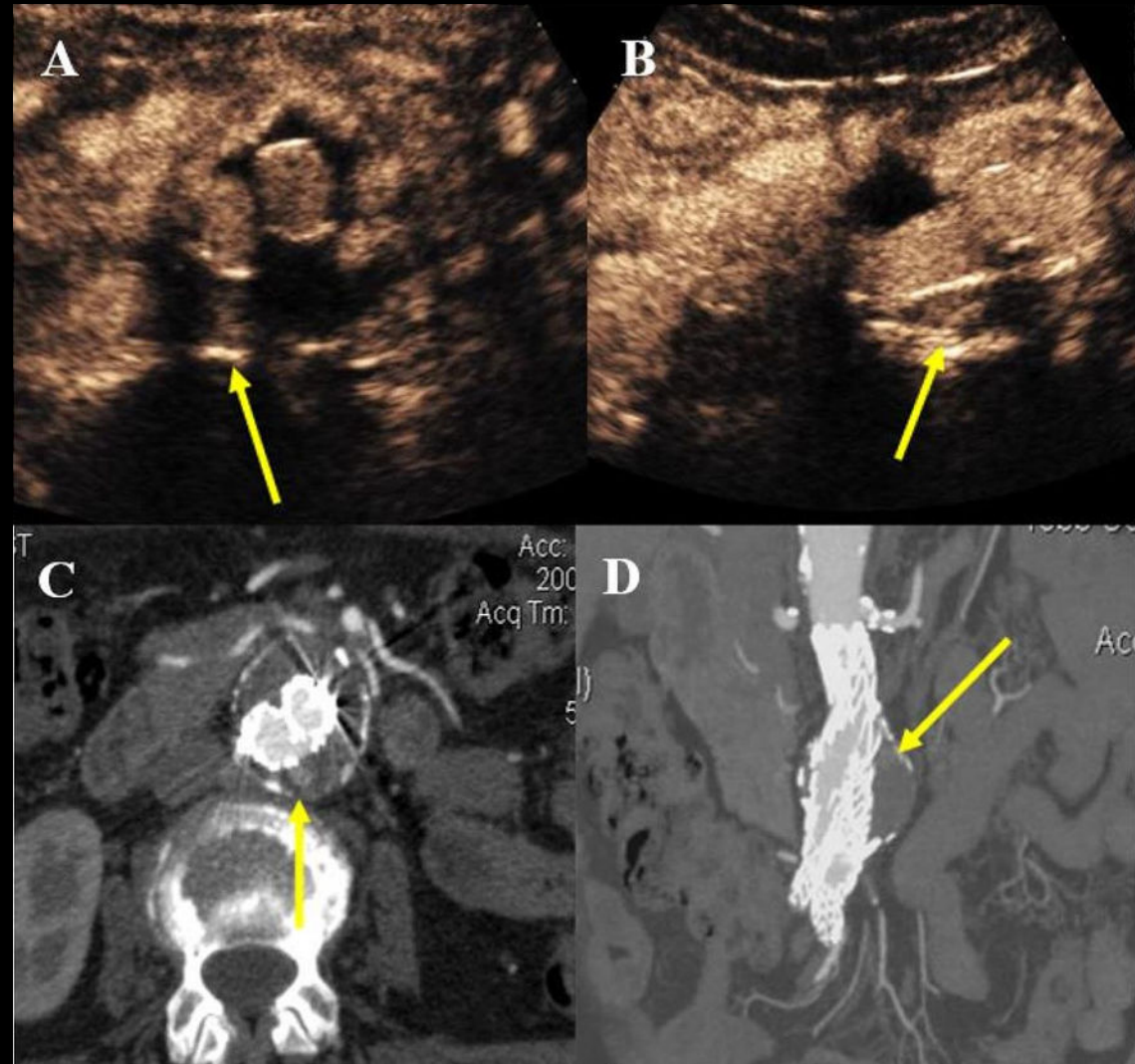


CEUS versus CT Angiography in the follow-up of abdominal aortic endoprostheses: diagnostic accuracy and activity-based cost analysis

Niccolo' Faccioli¹ · Giovanni Foti¹ · Giulia Casagrande¹ · Elena Santi¹ · Mirko D'Onofrio¹





- 137 pt.
- 6 år follow-up efter EVAR
- CEUS vs. CT angio
- CT - standard
- activity-based cost analysis

	CEUS vs. CT
Ac	97,4 %
Se	96 %
Sp	100 %
PPV	100 %
PNV	93,1 %
cost	84 vs 157 €



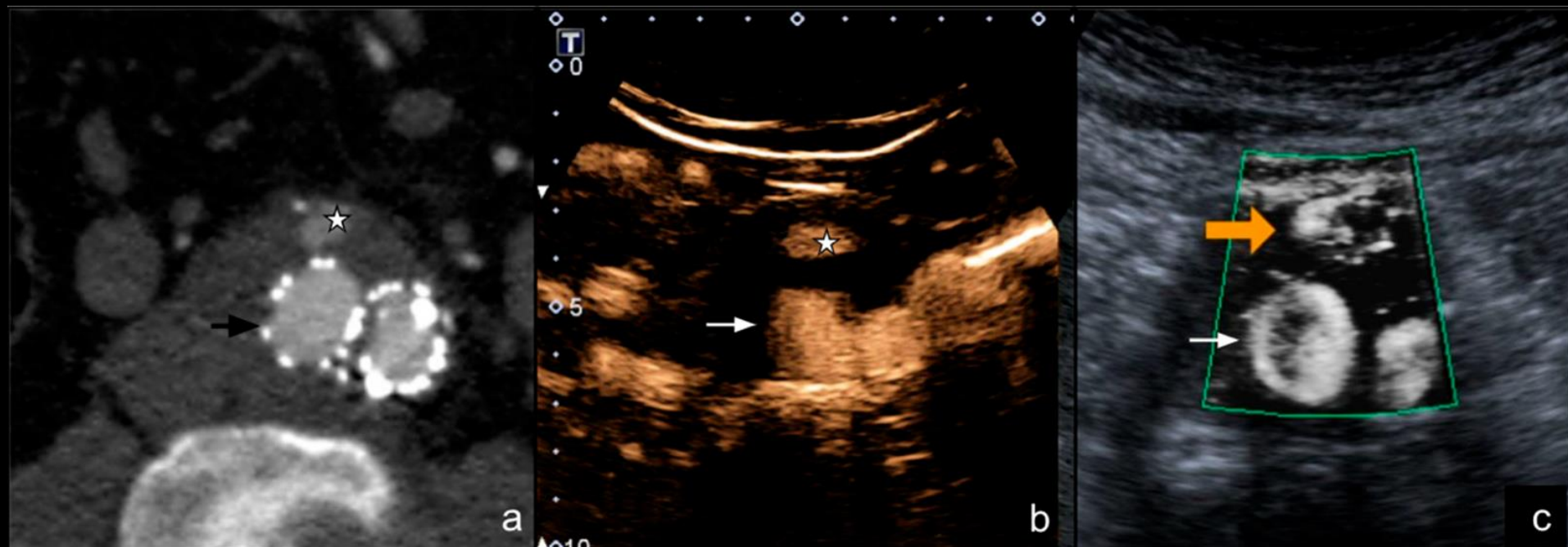
Article

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Marco Curti ^{1,*}, Filippo Piacentino ², Federico Fontana ^{1,2}, Christian Ossola ¹, Andrea Coppola ², Paolo Marra ³, Antonio Basile ⁴, Anna Maria Ierardi ⁵, Gianpaolo Carrafiello ^{5,6}, Giulio Carcano ^{1,7}, Matteo Tozzi ^{1,8}, Gabriele Piffaretti ^{1,8} and Massimo Venturini ^{1,2}

- apr. 2017 - sep. 2020
- 122 pt.
- mikrovaskulær imaging (SMI) og CEUS vs. CT
- 4 pt. gendinkaldt

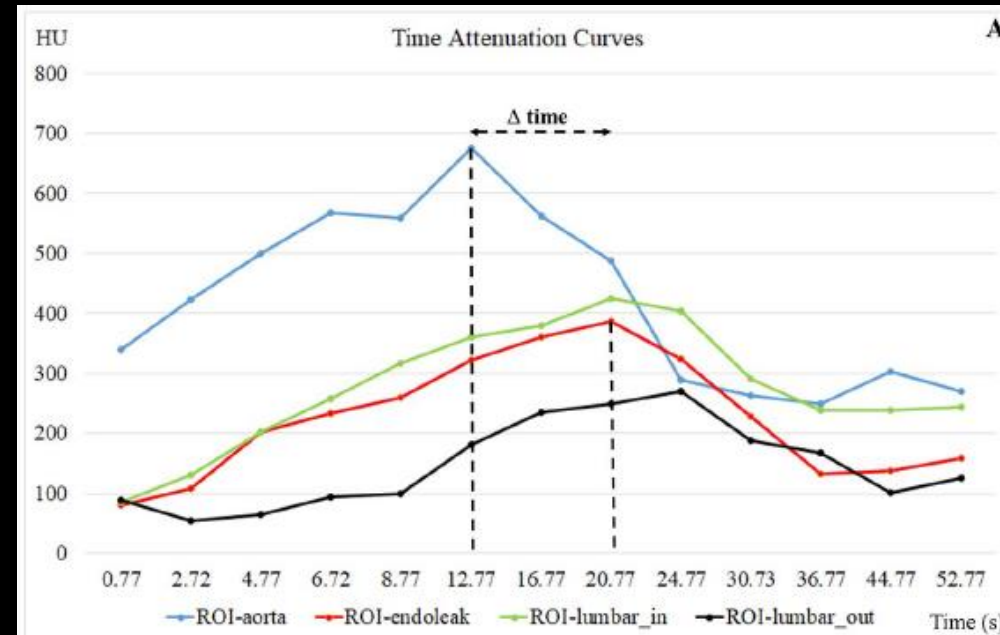
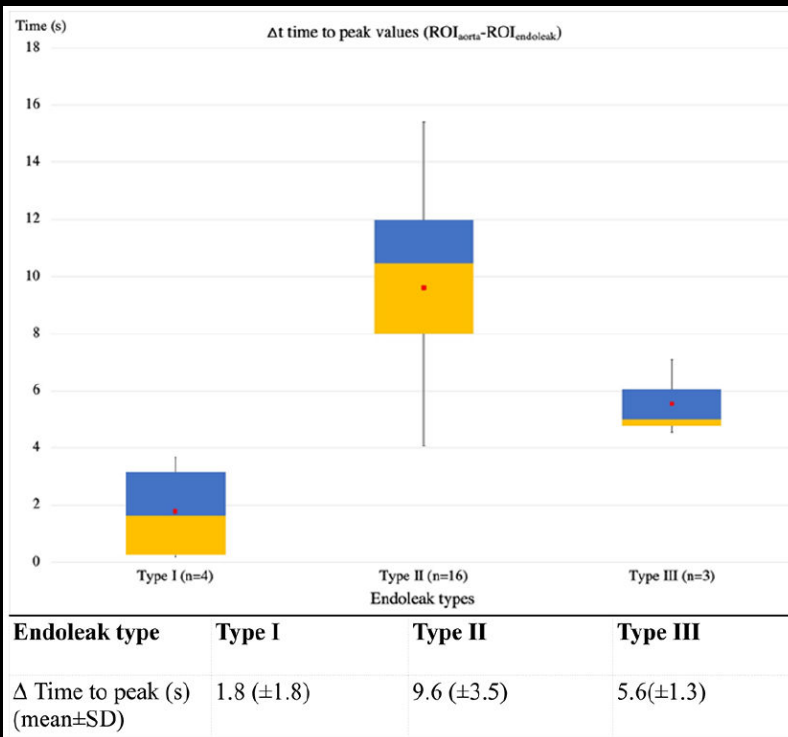
	SMI vs. CT	CEUS vs. CT
Ac	95,97 %	95,97 %
Se	91,53 %	91,53 %
Sp	100 %	100 %
PPV	100 %	100 %
PNV	92,86 %	92,86 %
Tid	3 – 5 min	6 – 7 min



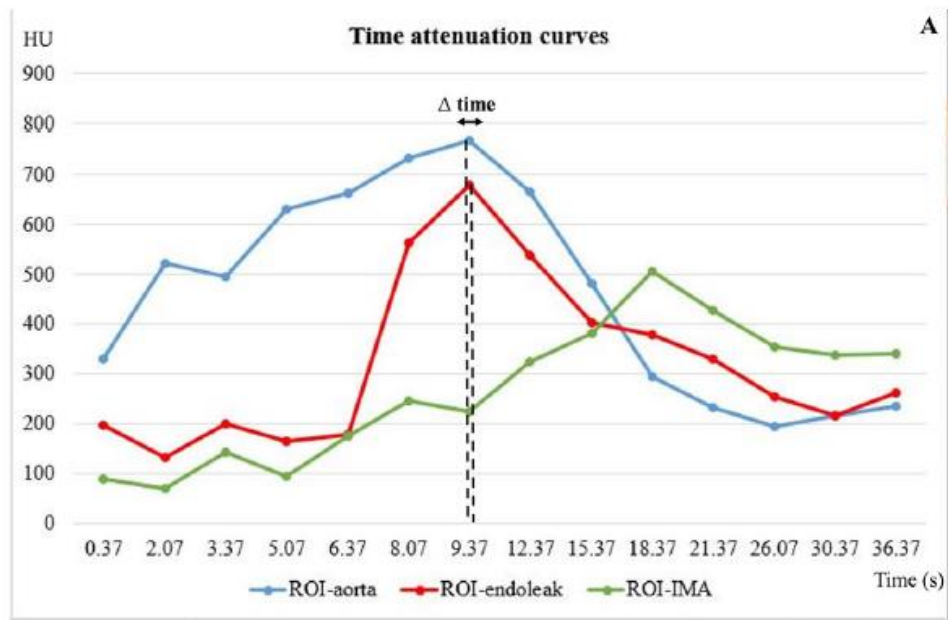
Dynamic, Time-Resolved CT Angiography After EVAR: A Quantitative Approach to Accurately Characterize Aortic Endoleak Type and Identify Inflow Vessels

Marton Berczeli, MD^{1,2}, Ponraj Chinnadurai, MBBS, MMST^{1,3}, Peter Legeza, MD^{1,2}, Eric K. Peden, MD¹, Charudatta S. Bavare, MD, MPH¹, Su Min Chang, MD⁴, and Alan B. Lumsden, MD¹

- tom + dynamisk kontrast CT vs. DSA
- endoleak type og inflow kar
- 14-20 ml Visipaque 320 (3,5-4 ml/s)
- ROI proksimal for graft
- 70-90 ml Visipaque 320 (3,5-4 ml/s)
- 0/ 4,5/ 6/ 12/ 18/ 28,5 sec
- Time attenuation curves
- Time to peak



Conclusion: Dynamic CTA can accurately characterize aortic endoleak type, inflow vessels as compared with DSA imaging. Quantitative parameters such as Δ TTP enhancement can help better differentiate endoleak types and provide an objective approach to endoleak diagnosis.



CT vs. CEUS

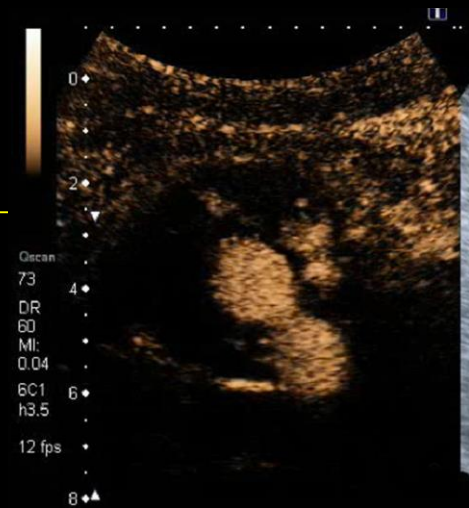
CTA

- 3D us. med mulighed for rekon. (MIP)
- Planlægning af intervention
- Jodholdige kontrast
- Us tid +/-
- Dynamisk CTA og perfusion CT (4D CT)
- Pris ↑



CEUS

- 2D us.
- Pt. afhængig (luft, obesitet, kalk, metal artefakter)
- Undersøger afhængig (erfaring med CEUS)
- Ikke snit diagnostik
- Flow kvantificering
- Us tid +/-
- Low flow endoleaks
- Ingen nefrotoxicitet
- Pris ↓



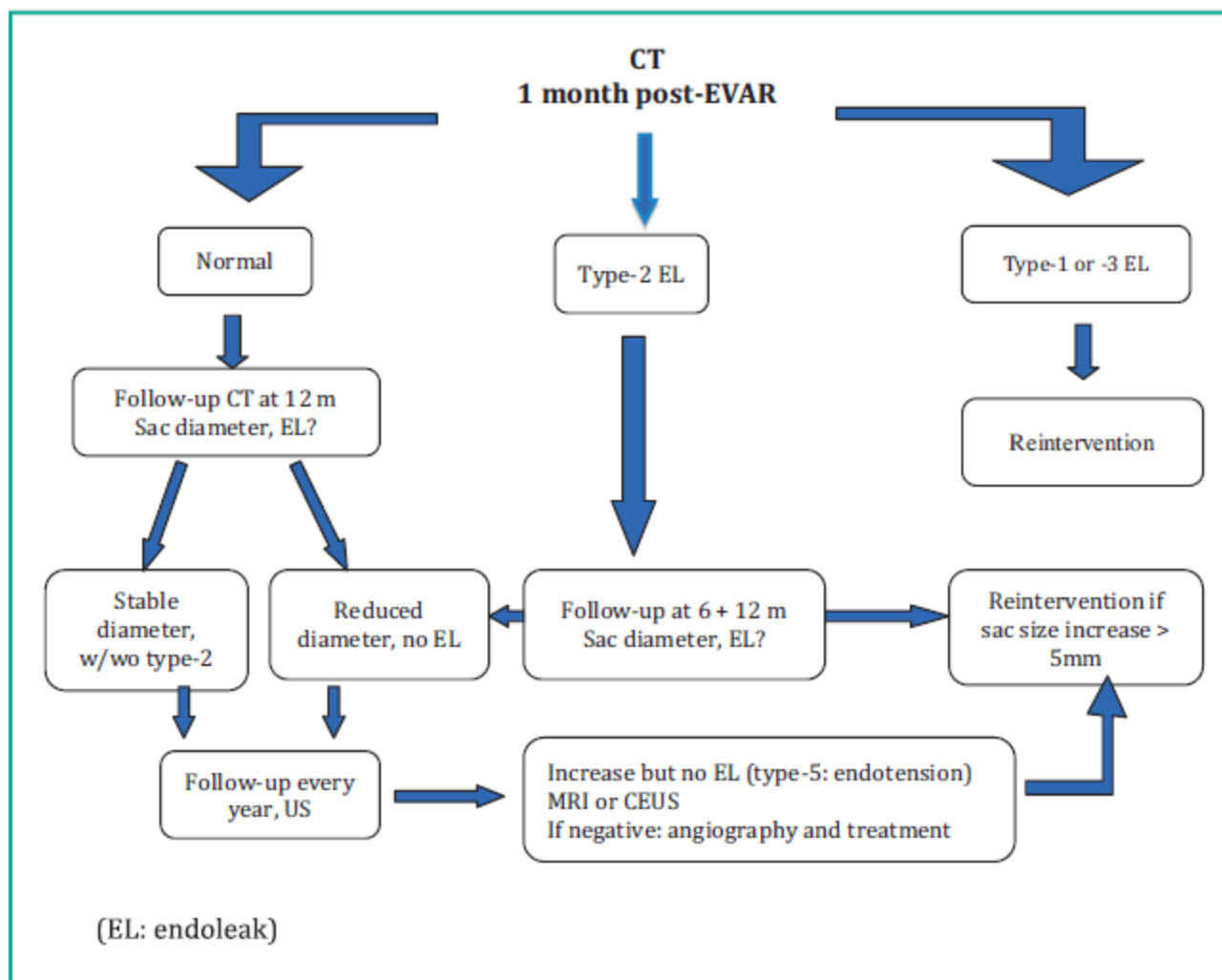


Figure 7. Follow-up protocol proposed by H. Rousseau in 2013 for the SFICV, modified from the North-American consensus [29].

Type 2 endoleak – follow up

2010

Evaluation of Potential Outcome Predictors in Type II Endoleak: A Retrospective Study With CT Angiography Feature Analysis

Alexander W. Keedy¹
Benjamin M. Yeh¹
Jennifer R. Kohr¹
Jade S. Hiramoto²
Darren B. Schneider²
Richard S. Breiman¹

- 59 pt. med type 2 endoleaks
- 23 reintervention vs. 35 ingen reintervention



TABLE 4: Comparison of the Test Characteristics for CT Features in Predicting Future Need for Reintervention

Feature	AUC (95% CI)	Sensitivity	Specificity	PPV	NPV	Threshold
Endoleak transverse diameter ^a	0.74 (0.60–0.80)	0.74	0.80	0.71	0.82	1.42 cm
Endoleak transverse diameter ratio ^a	0.73 (0.60–0.84)	0.70	0.77	0.65	0.77	0.22
Endoleak volume ^a	0.69 (0.59–0.81)	0.95	0.46	0.53	0.94	1.35 cm ³
Endoleak maximum diameter	0.63 (0.49–0.79)	0.83	0.49	0.51	0.81	1.42 cm
Communicating vessel maximum diameter ^a	0.65 (0.52–0.77)	0.74	0.54	0.52	0.76	0.32 cm
Complex shape of endoleak	Not calculated	0.70	0.57	0.52	0.74	Not calculated
Endoleak length ^a	0.65 (0.51–0.77)	0.87	0.40	0.49	0.82	2.00 cm
Inferior mesenteric artery diameter	0.63 (0.50–0.76)	0.74	0.51	0.50	0.75	0.35 cm
Aneurysmal sac transverse diameter	0.61 (0.48–0.74)	0.39	0.83	0.60	0.67	6.29 cm
Anterior location of endoleak	Not calculated	0.91	0.29	0.46	0.83	Not calculated

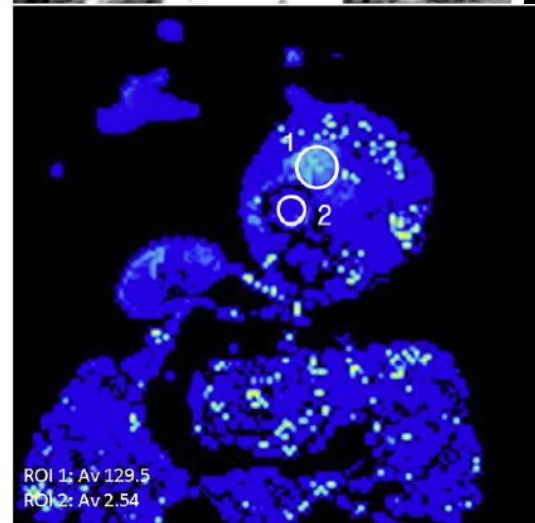
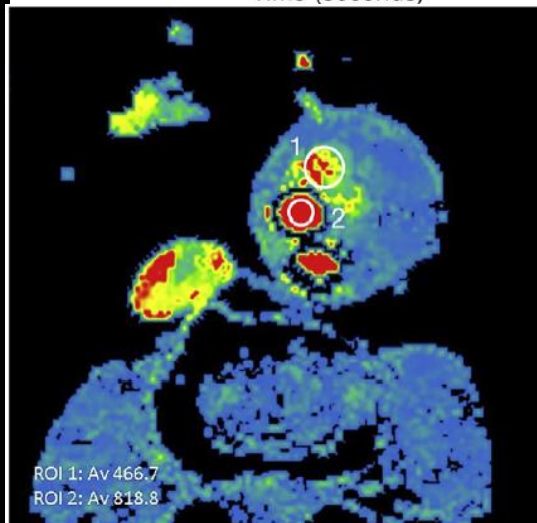
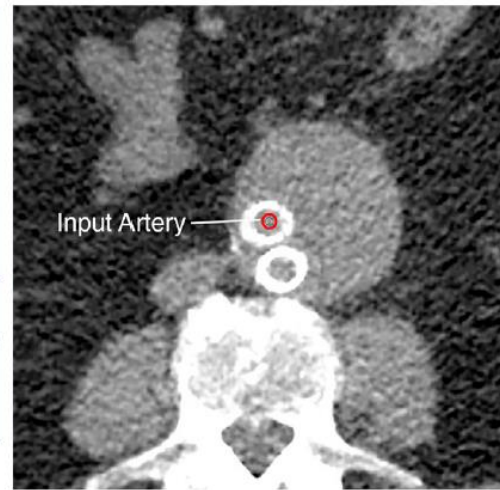
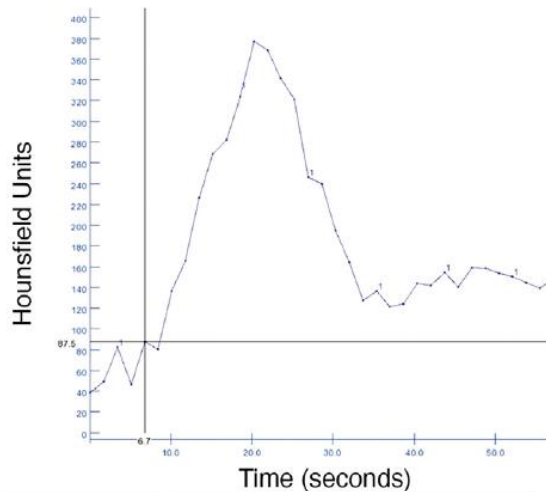
CONCLUSION. There are identifiable CT features associated with the clinical outcome of patients with type II endoleak that have moderate predictive capabilities.



Discrimination of High-Risk Type-2 Endoleak after Endovascular Aneurysm Repair through CT Perfusion: A Feasibility Study

2021

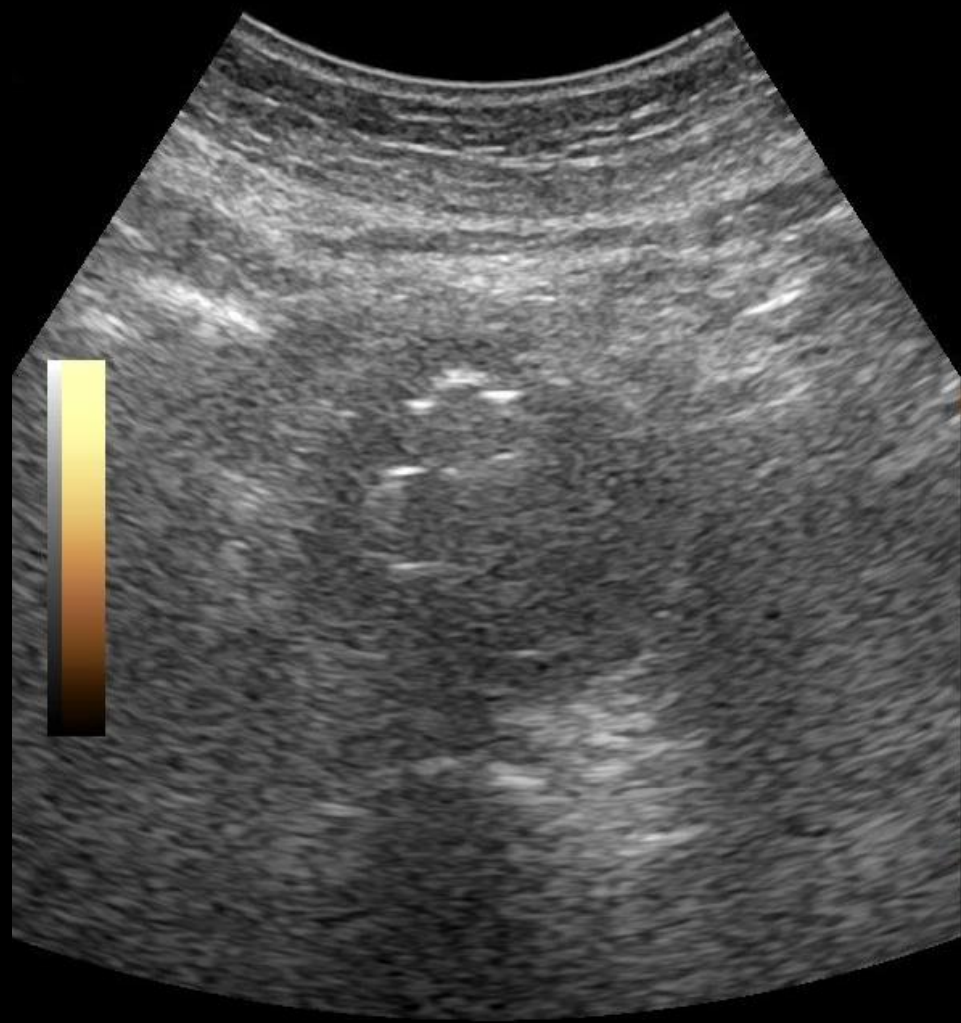
Stavros Charalambous, MD, Kostas Perisinakis, PhD, Nikolaos Kontopodis, MD, PhD, Antonios E. Papadakis, PhD, Nikolaos Galanakis, MD, PhD, Elias Kehagias, MD, PhD, EBIR, Nikolas Matthaiou, MD, Thomas G. Maris, PhD, Christos V. Ioannou, MD, PhD, and Dimitrios Tsetis, MD, PhD, EBIR



- 24 pt. med type 2 endoleak på CT
- perfusion CT 3 dage efter almindelig CT + ny CT efter 6 mdr
- 60 ml Ultravist 370 4 ml/sec
- 35 skanninger på 14 cm lang segment
- effektiv dose 25 mSv
- aneurisme volumen: vækst (A) vs ikke vækst (B)
- retrospektiv studie
- **perfusion parametre:** BF, BV, MTT, TTP, time to max, maximum slope of increase, positive enhancement integral, permeability surface (PS)

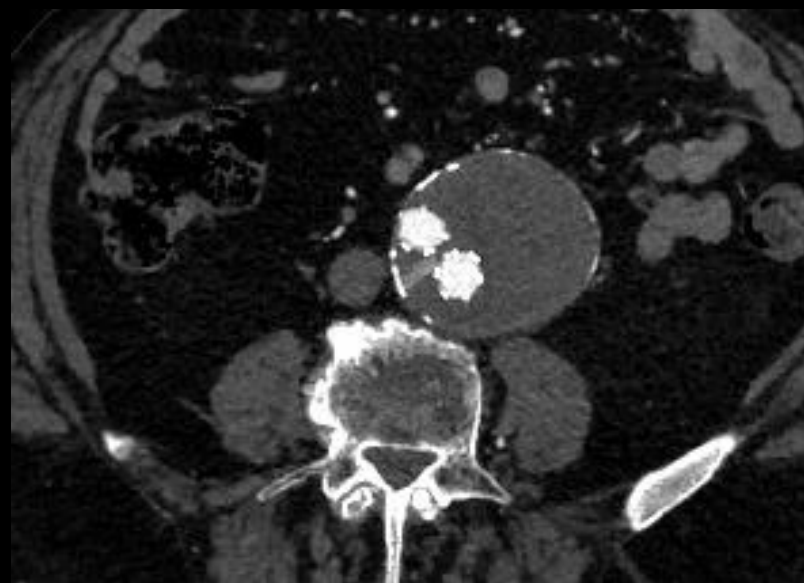
BF og PS – højeste diskriminations factor mellem høj og lav risiko type 2 endoleaks.

CEUS



T1: 0:31

CT



CT

