Abdominal Aortic Aneurysm follow-up after endovascular repair in a canine model with non-invasive vascular elastography

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Purpose

To assess the ability of non-invasive vascular elastography (NIVE) to characterize endoleaks and thrombus organization in a canine model of abdominal aortic aneurysm (AAA) after endovascular aneurysm repair (EVAR) with stent-graft (SGs).

Methods

Endoleak creation in a canine model

Table 1. Endoleak and thrombus organization

	N=	Organized Thrombus	Fresh Thrombus
Type I (n)	4	4	1
Type II (n)	14	14	5

- Creation of AAA with jugular venous patch.
- After 8 weeks of recovery and healing period, a SG (10 mm of diameter) was implanted.

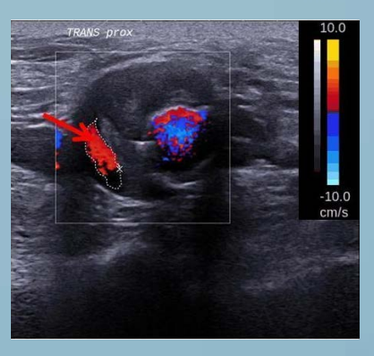
Follow up

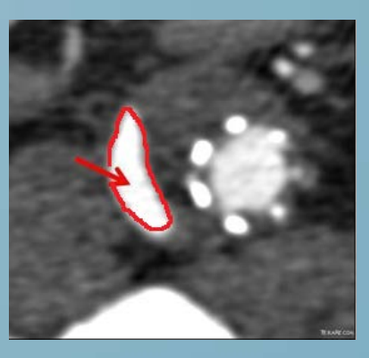
Table 2. Elastography and DUS were performed at each follow up. Angiography was performed before implantation and before sacrifice whereas CT scan was performed before sacrifice followed by pathology

	Elastography	DUS	CT	Pathology	Angiography
T_0	+	+	-	-	+
1 Week	+	+	-	-	-
1 Month	+	+	-	-	-
3 Months	+	+	-	-	-
6 Months	+	+	+	+	+

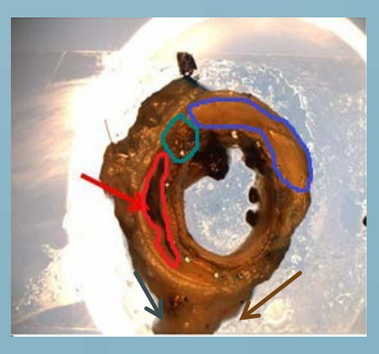
In quasi-static elastography, radiofrequency echo signals acquired before and after a small (about 1%) of applied deformation are correlated to estimate tissue displacements. Local tissue displacement vector estimates between small segments of the pre- and post-deformation signals are estimated and the corresponding strain distribution imaged.

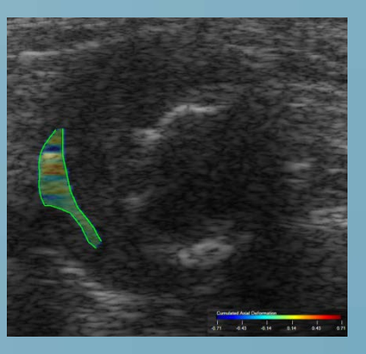
Segmentation





3 ROI:
- Endoleak
- Organized thrombus
- Fresh Thrombus





The segmentation was performed by the same technician and verified by the same radiologist

Results

Table 4. NIVE strain parameters in segmented regions

	Endoleak (Mean ± SD) (%)	Organized Thrombus (Mean ± SD) (%)	Fresh Thrombus (Mean ± SD) (%)	P Value *		
				E Vs. OT	E Vs. FT	OT Vs. FT
MaxAxStrain	0,78 ± 0.22	0,10 ± 0,04	0,23 ± 0,02	< 0.001	< 0.001	< 0.001
MinAxStrain	-0,44 ± 0,30	-0,17 ± 0,06	-0,17 ± 0,05	0.004	0.023	0.818
MaxCumAxStrain	0,85 ± 0,56	0,16 ± 0,10	0,20 ± 0,08	<0.001	0.002	0.316
MaxStrainRate	5,61 ± 3,75	1,16 ± 0,60	1,66 ± 0,69	<0.001	0.006	0.11
MinStrainRate	-6,00 ± 3,71	-1,10 ± 0,53	-1,76 ± 0,81	<0.001	0.006	0.033

- Strain measurements were significantly different between endoleak and thrombus for all strain parameters
- Strain measurements (Max Ax strain and Min A strain) were significantly different between fresh and organized thrombus
- No correlation found between sac pressure and strain values for the different ROIs
- The leak size and type of endoleak had no impact on strain measurements

Conclusion

Different values of NIVE parameters were displayed in endoleak and thrombus with different grade of thrombus organization inside the aneurysm sac. Even though, NIVE could not differentiate type I & II endoleaks, it could reduce the need for CT angiography.