

Endoleak and Thrombus Characterization with Dynamic Elastography after Endoleak Embolization following Aneurysm Endovascular Repair.

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Introduction. SuperSonic Imagine (SSI) measure the tissue elasticity in real-time. The goal of this study was to characterize in a canine model of aneurysm endovascular repair (EVAR) residual endoleak and thrombus organization with SSI after endoleak embolization and correlate results with CT-Scan, Doppler Ultrasound (DUS) and pathologic findings.

Methods. EVAR was done with creation of type I endoleak in eighteen aneurysms created in nine dogs (common iliacs arteries). Two embolization gels (Chitosan (Chi) or Chitosan-Sodium-Tetradecyl-Sulfate (Chi-STS)) were injected in the sac to seal the endoleak and promote healing. SSI and DUS were performed at baseline (implantation, 1-week, 1-month, 3-months) whereas angiography and CT-scan were performed at sacrifice. Macroscopic and histopathological analyses were processed to identify and segment five different regions of interest (ROIs) (endoleak, fresh or organized thrombus, Chi or Chi-STS). Elasticity modulus values were compared.

Results. At sacrifice, 10 aneurysms had endoleaks, 9 had fresh thrombus, 15 had organized thrombus and 3 were completely sealed. At 3 months, elasticity modulus (in kPa) of 0.1 ± 0.2 , 9.4 ± 3.3 , 47.6 ± 28.1 , 51.7 ± 24.1 and 49.1 ± 33.5 were respectively found in endoleak, fresh and organized thrombus, Chi and Chi-STS regions. Elasticity values of endoleak and fresh thrombus areas were significantly lower than organized thrombus, Chi and Chi-STS areas ($p < 0.001$). Elasticity values of fresh thrombus ranged between 3 and 19 kPa (8.7 ± 3.6 kPa) at 1-week and 30.2 ± 13.8 kPa at 3-months indicating that SSI can evaluate thrombus maturation. It can also characterize embolization agents degradation (39.3 ± 21.1 and 30.5 ± 13.8 kPa at 6-months for Chi and Chi-STS regions). SSI was able to detect endoleak where DUS failed and distinguish fresh thrombus (possibly endotension) which cannot be detected on CT-scan.

Discussion. This project confirms that SSI was able to characterize thrombus organization and embolization agents after endoleak embolization following EVAR. It can monitor thrombus organization over time. A lower elastic modulus value corresponds to fresh thrombus whereas a higher value corresponds to organized thrombus. In addition, this real-time ultrasound modality can complement conventional DUS which is already used in a clinical setting for EVAR follow up and endoleak detection. The SSI could reduce the cost, the exposition to ionizing radiation and nephrotoxic contrast agents of surveillance CT-scan follow-up. The next objective is to evaluate the feasibility and efficacy of this approach in a clinical study compared to CT-scan, which began in November 2014.

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