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High resolution ultrasound reveals six stages of stasis-induced vein valve damage

Background: Using novel high-resolution ultrasound systems (HRU), valvular structures and low-flow microaggregates may be depicted today in a more detailed way. We recently reported the existence of motion-resistant particle aggregations within valve sinus which are neither sludge nor thrombus, called motion-resistant aggregates (MRA). This consecutive prospective study compares valve structures, cusp motility and extent of aggregates, resulting in a new approach to vein damage classification.

Methods: In 500 consecutive patients (322 f, 178 m; 24 - 68 yr/o, GSV, SSV; C0-C6) presenting with unilateral epifascial venous insufficiency \geq C2, more than 6.800 saphenous vein valve locations were examined with high resolution ultrasound (14 – 23 MHz, peak up to 32 MHz, Vevo MD). Video recordings (manual 3-D scans) were collected for review and analysis by five experienced ultrasound investigators.

Results: Comparing repetitive patterns of valve formation, six different stages of valve changes were determined: 1) Alteration of sinus hemodynamics, marked by reduction of flushed sinus volume, was the most frequent finding (59.4%). 2) Restriction of cusp function due to aggregates but maintained valve closure was seen in 34.5% of the cases. Rare findings, correlating with short periods of occurrence, were 3) total fixation of cusps without reflux (3.1%), followed by stage 4 with initial onset of reflux (4.2%, Fig. 1). Cases with increased reflux showed reduction of aggregates and progressive valve degeneration (5) and finally loss of valve structures.

Conclusions: Motion-resistant blood cell aggregates at the valve sinus indicate successive stages of venous insufficiency, correlating with specific conditions of cusp motility, shape and flow. Knowledge of these consecutive stages provides a new basis to evaluate the effectivity of preventive measures, potentially effective in stages 1 - 4, and vein preserving strategies.

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Fig. 1: Example of stage 4 - onset of reflux

