

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

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BACKGROUND

Using novel high-resolution ultrasound systems (HRU), valvular structures and low-flow micro-aggregates 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.

AIM

To understand changes in vein valve morphology during stasis-induced degeneration.

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), including the contralateral leg to potentially detect early stages of venous disease.

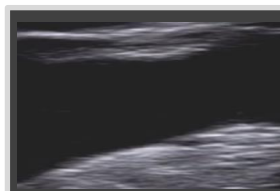
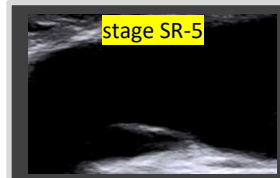
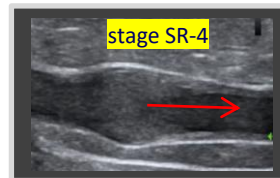
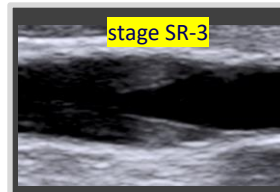
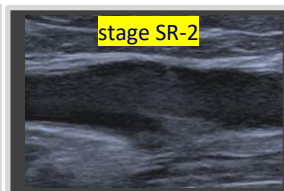
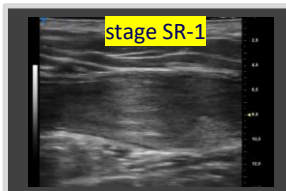
Multiplane video recordings were collected for analysis by independent investigators.

RESULTS

By identifying and comparing repetitive patterns of valve morphology, six different types of valve function and morphology could be detected, indicating six consecutive stages of stasis-related (SR) damage:

- 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, no reflux (3.1%),
 - 4) with initial onset of reflux (4.2%, "crisis")
 - 5) After onset reflux or coincident with it, valve degeneration becomes manifest. Aggregates vanish within months due to increased flushing. Main features are sclerosis and shrinkage.

- 6) The final stage is marked by loss of valve structures. Usually, stages 5 - 6 will be found in surgically removed veins.



CONCLUSIONS

Motion-resistant blood cell aggregates at the valve sinus, valve integrity and cusp motility indicate successive stages of venous insufficiency. Permanent aggregates correlate with stasis.

Knowledge of these consecutive stages provides a new basis to evaluate the effectivity of preventive measures (like muscle pump training, compression stockings, medication) in stages SR 1 - 4.

The longer the history of the disease, the more interaction with pressure-related (PR) mechanisms may be expected, marked by consumption of the valve's functional reserve.

Therefore, studies on the very early stages of venous insufficiency are the key to recognize and to distinguish different pathomechanisms (SR, PR, congenital, and to optimize prevention.

REFERENCES

Ragg JC et al. Ultrasound Proof of Pre-Reflux Stages of Venous Insufficiency. J Vasc Surg - VL 2017 (5;1), 152

DISCLOSURES

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