same number of procedures per patient as other physicians (2.37 ± 1.39 vs 2.73 ± 2.03; $P = .964$) but did this for fewer cases (1.41 ± 0.62 vs 1.86 ± 0.97; $P = .002$; Fig 2).

Conclusions: Vein surgery practice patterns differ between vascular surgeons and other physicians. This study found that vascular surgeons perform surgery for more severe venous disease than other physicians. It also found that vascular surgeons do so in a more cost- and time-efficient fashion by performing a similar number of procedures in a smaller number of cases per patient. Further study is necessary to determine the impact of this difference in practice patterns on patient outcomes.

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AMERICAN VENOUS FORUM INTERNATIONAL SESSION

Initial Results of a Clinical Feasibility Study for Endovenous Deep Venous Valve Formation to Treat Chronic Venous Insufficiency

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Background: Chronic venous insufficiency (CVI), due to superficial and deep venous reflux (DVR) and venous obstruction, is widespread and associated with significant morbidity. DVR correlates with increased symptoms. Historically, therapeutic approaches to DVR involved difficult and morbid surgical procedures or unsuccessful attempts to implant valves. The study objective was to assess the safety and effectiveness of endovenous formation of autogenous deep vein valves in patients with DVR and significant associated symptoms. The study is ongoing, and results are presented for the first 10 treated patients.

Methods: Patients with DVR and correlating symptoms of CVI (Clinical, Etiology, Anatomy, and Pathophysiology [CEAP] class C4-C6) were treated with an endovenous autogenous valve formation system in four centers in New Zealand and Australia. Patients with outflow obstruction were excluded. Retrograde percutaneous access was obtained through the common femoral vein, and contrast venography and intravascular ultrasound were used to assess reflux and to identify potential treatment sites. If the patient was deemed eligible, the 16F study device was introduced and used to form monocuspid valves in femoropopliteal vein segments spanning 7 to 11 mm in diameter. Intravascular ultrasound and venography were used to assess valve functionality. Postprocedurally, patients were prescribed 7 days of low-molecular-weight heparin injections, followed by 6 months of anticoagulation. Follow-up included duplex ultrasound scan, physical examination, and questionnaires. Deep venous thrombosis (DVT) was defined as a treated vein found to be noncompressible with visible echogenic thrombus or dilated with decreased flow by ultrasound. Mural thrombus was a deposition that did not fit the DVT criteria.

Results: The patients were clinical class C4 (n = 3), C5 (n = 2), and C6 (n = 5) and of both primary (n = 8) and secondary (n = 2) etiology. One or more monocuspid valves were successfully formed in 9 of 10 patients. One valve formation was completed in four patients, two formations in four patients, and three formations in one patient; the anatomy did not accommodate successful valve formation in one patient. Follow-up ranged from 30 to 210 days with a median of 30 days. During this time, no occlusive DVTs were reported, and adverse events related to the device or procedure included access site-related events (n = 7) and mural thrombus (n = 3). All mural thrombi resolved by 90 days. At 30 days, there was a median change in reflux time (seconds) in the proximal femoral vein of 0.3 (−1.9 to 4.3), in the distal femoral vein of 0.4 (−1.4 to 5.6), and in the mid popliteal vein of 0.2 (−3.3 to 6.7). Seven of 10 patients had a ≥4-point improvement in the Venous Clinical Severity Score.

Conclusions: Endovenous valve formation in the deep venous system is feasible. Initial experience suggests that it may be safe and effective for treatment of CVI.

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A Randomized Trial of Moderate (Class 2), High (Class 3), and Very High (Class 4) Elastic Compression in the Prevention of Recurrence of Venous Ulceration

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Background: Venous leg ulcers (VLUs) are an important health problem because of their high prevalence and associated high cost of care. Despite many available contemporary treatment modalities (surgery, endovenous thermal ablation, foam sclerotherapy, compression), recurrence rates remain high and range between 25% and 70% according to different studies. Numerous studies have suggested that regular use of compression stockings reduces VLU recurrences. However, there are limited data concerning two important questions: How long should compression hosiery be worn after ulcer healing, and which class of compression hosiery achieves better results in the prevention of VLU recurrences? The aim of this study was to establish the efficacy of three different strengths of compression (class 2, class 3 and class 4) in the prevention of VLU recurrences.

Methods: An open, prospective, randomized, single-center study with a 10-year follow-up was performed. There were 477 patients (240 men, 237 women; mean age, 59 years) with recently healed venous ulcers and no significant arterial disease, rheumatoid disease, or diabetes mellitus who were randomized into three groups: group A, 149 patients who were wearing a class 2 elastic stocking (Rudo, Nis, Serbia); group B, 167 patients who were wearing a heelless open-toed elastic class 3 compression device knitted in tubular form (Tubulcus; Laboratoires Innothera, Arcueil, France); and group C, 161 patients who were wearing a multilayer compression system composed of Tubulcus compression device and one elastic bandage 15 cm wide and 5 m long (Niva, Novi Sad, Serbia). The main outcome measures were recurrence of leg ulceration and compliance with treatment.

Results: There were 117 patients (24.52%) who did not comply with the randomized compression class: 24 (16.1%) in class 2, 34 (20.36%) in class 3, and 59 (36.65%) in class 4 ($P < .05$). Overall, 65% (234/360) of patients had recurrent leg ulceration by 10 years. Recurrence occurred in 120 (96%) of 125 class 2 compression cases, in 89 (66.9%) of 133 class 3 compression cases, and in 25 (24.5%) of 102 class 4 compression cases ($P < .05$; graph; Kaplan-Meier survival analysis showing ulcer recurrence at 10 years).

Conclusions: The results obtained in this study suggest that compression systems with the higher compression class provide a statistically significant lower recurrence rate compared with elastic compression of lower class.

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Stationary Blood Particle Aggregates and Vein Valve Shape: A New Classification of Vein Damage

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Background: By use of novel high-resolution ultrasound systems, valvular structures and low-flow microaggregates may be depicted today in a more detailed way. The existence of particle aggregations within a valve sinus that are neither sludge nor thrombus, detected by high-resolution ultrasound (American Venous Forum Servier Travel Award 2017), was recently reported. This consecutive study of 180 single-vein valves showing motion-resistant aggregates compares valve structures, cusp motility, and extent of aggregates, resulting in a new approach to vein damage classification.

Methods: In 100 consecutive patients (68 female, 32 male; 42-64 years old) presenting with unilateral epifascial venous insufficiency, a total of 180 saphenous vein valves with motion-resistant aggregates were selected for closer high-resolution ultrasound analysis (14-16 MHz, peak

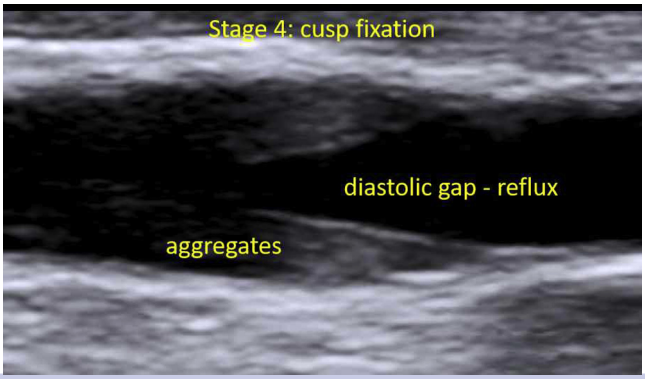

Fig. Aggregates identified with fixation of valve cusps.

up to 40 MHz; Vevo MD [SonoSite, Bothell, Wash]). Video recordings (manual three-dimensional scans) were provided for review and analysis by five experienced ultrasound investigators.

Results: Six different stages of valve changes could be determined. In stage 1, alteration of sinus hemodynamics (reduction of flushed sinus volume) was present in 102 of 180 cases (56.7%). In stage 2, restriction of cusp function due to aggregates while maintaining valve closure was seen in 64 cases (35.6%). Of 180 cases, 6 (3.3%) showed fixation of cusps (without visible motility) but yet without reflux (stage 3), whereas in 8 cases (4.5%), there was fixation of cusps causing diastolic gap and reflux (stage 4; Fig). Stages 5 and 6 were related to segments with significant reflux (>1000 ms, >10 cm/s), showing valve regression and finally loss of valve structures and aggregates.

Conclusions: Permanent blood cell aggregates at the valve sinus seem to indicate successive stages of venous insufficiency, correlating with specific relations of sinus shape and flow. Analysis of valves and aggregates allows a new staging of vein damage and thus a more detailed determination of the individual history of disease with potential impact for early-stage treatment or prevention.

Author Disclosure: J. C. Ragg: Nothing to disclose.

Comparative Efficacy and Safety of Direct Oral Anticoagulants and Warfarin for the Treatment of Deep Venous Thrombosis and the Prevention of Post-Thrombotic Syndrome

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Background: In recent years, clinical trials have shown that direct oral anticoagulants (DOACs) are at least as effective and safe as oral warfarin for the treatment of venous thromboembolism (VTE). However, there are few studies comparing efficacy and safety of different DOACs for VTE. The purpose of this study was to compare antithrombotic and hemorrhagic effects of different DOACs and warfarin in patients with acute deep venous thrombosis (DVT). In addition, we studied preventive effects of these anticoagulants on the post-thrombotic syndrome (PTS).

Methods: Consecutive patients with acute DVT who were treated with anticoagulants were enrolled. The cumulative incidence of VTE recurrence and bleeding events was assessed. Furthermore, we assessed cumulative complete thrombus resolution and development of PTS.

Results: During the 3-year period, 264 patients were treated with anticoagulation alone. Of these, 69 patients (26%) received apixaban, 64 (24%) received edoxaban, 67 (25%) received rivaroxaban, and 64 (25%) received warfarin. There were no significant differences in mean age ($P = .131$), sex distribution ($P = .858$), body mass index ($P = .392$), distribution of DVT (proximal vs distal, $P = .072$), proportion of concomitant pulmonary embolism ($P = .317$), and duration of anticoagulation ($P = .117$) between the groups. The higher incidence of the recurrent VTE was found in the warfarin group; however, this was not statistically significant (log-rank, $P = .478$). Similarly, bleeding events were more common in the warfarin and rivaroxaban groups, and fewer bleeding complications were noted in the apixaban group; this did not result in any significant difference (log-rank, $P = .303$). In contrast, apixaban showed earlier thrombus resolution, and the cumulative thrombus resolution was highest in the apixaban group, followed by the rivaroxaban group (log-rank, $P = .022$,). Development of PTS was higher in the rivaroxaban and warfarin groups, but no significant difference was found in cumulative development of PTS (log-rank, $P = .943$).

Conclusions: Although DOACs did not appear to differ in the recurrent VTE events, the bleeding complications, and the development of PTS, apixaban showed the earliest thrombus resolution among the anticoagulants studied. These results suggest that apixaban seems to be safer and more effective than some of its competitors in the management of acute DVT.

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Global Management of Venous Leg Ulceration: Pre-EVRA Publication

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Background: Various guidelines exist worldwide for the diagnosis and management of venous leg ulcers. However, these guidelines are difficult to implement and may not be followed, resulting in disparate treatment of patients globally.

Methods: An online 26-question survey was created to evaluate the current global management of venous leg ulceration. The survey was classed as a service evaluation according to the Health Research Authority decision tool and therefore did not require Health Research Authority or ethical approval. The link to the survey was e-mailed globally by several vascular and venous societies to approximately 15,000 participants using local, national, and international mailing lists (November 2017-February 2018).

Results: There were 799 complete responses received from 86 countries. The respondent physicians saw a median of 10 patients per month. The median time of referral from primary to secondary care was 6 weeks. Of the respondents, 60% arranged an ankle-brachial pressure index on the first visit and 84% performed a venous duplex ultrasound examination, with 95% prescribing compression for those in whom it was not contraindicated; 78% thought that treatment of superficial truncal venous reflux by endovenous intervention or surgery benefits ulcer healing, whereas 80% thought it benefits recurrence; 59% performed endovenous intervention or surgery before ulcer healing, with 73% performing a duplex ultrasound examination after intervention to assess technical success.

If the Early Venous Reflux Ablation (EVRA) study results were positive, 46% agreed that they would change practice, with 43% stating they would not, but 86% of those already treated before ulcer healing.

Conclusions: The survey showed a diversity of treatment pathways. The need to develop a robust clear pathway for patients with leg ulceration is clearly required, which should be informed by the results of the EVRA trial.

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Graduated Compression Lower Limb Volume Control in Different Muscle Pump Activation Conditions and Related Limb Shape Impact

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