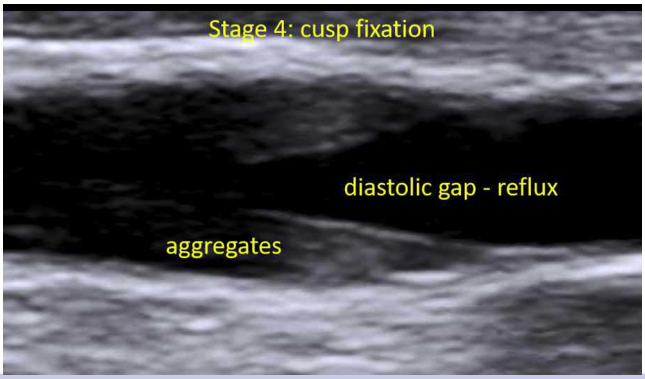

Fig. Aggregates identified with fixation of valve cusps.

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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Table. Lower limb volume assessment by truncated cone formula (Kuhnke formula), before and after exercise (walking) or postural condition (standing and sitting), with and without graduated compression stockings (*GCS*)

	Limb volume before sampling (mean ± SD), mL	Limb volume after sampling (mean ± SD), mL	Mean variation, %	*P*	
Walking, no GCS	2513 ± 406	2525 ± 413	0.4	NS	–
Walking, GCS	2469 ± 432	2361 ± 416	−4.4	.0001	↓
Standing, no GCS	2493 ± 399	2561 ± 392	2.7	.0001	↑
Standing, GCS	2497 ± 386	2381 ± 367	−4.6	.0001	
Sitting, no GCS	2534 ± 402	2547 ± 380	0.5	NS	–
Sitting, GCS	2483 ± 400	2362 ± 406	−4.8	.0001	↓

NS, Not significant; *SD*, standard deviation.

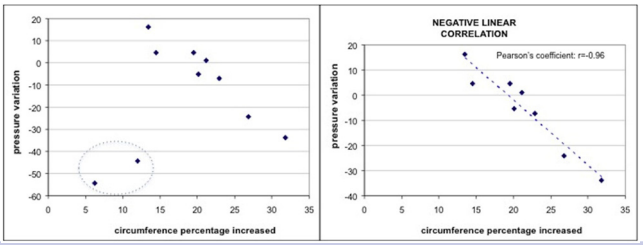

Fig. Negative linear trend between lower limb circumference and interface pressure variation. Excluding the two outliers leads to a strong negative correlation (Pearson coefficient, $r = -0.96$).

Background: The literature supports use of graduated compression stockings (GCS) for leg edema. Nevertheless, there is a paucity of data on the GCS effect related to sitting, standing, and walking on limb edema. Data on different limb shapes and their impact on GCS-exerted pressure are lacking. This investigation provides evidence-based information on GCS effect on edema reduction and the limb shape impact on GCS pressure.

Methods: Thirty healthy individuals (15 male, 15 female; mean age, 32 ± 5 years) were included. All the participants underwent lower limb volume (Kuhnke formula) and bioimpedance (Biody Xpert II; eBiody SAS, La Ciotat, France) measurement, before and after sitting for 30 minutes, wearing below-ankle noncompressive socks. The same assessment was repeated 7 days later, in the same individuals, but wearing a below-knee 16 to 20 mm Hg GCS.

At a 7-day interval, 1 week with below-ankle noncompressive socks and 1 week with below-knee 16 to 20 mm Hg GCS, all the participants repeated the same protocol including standing and walking. Ten individuals underwent bioimpedance assessment before and after sitting, standing, and walking. In the same group, B and B1 interface pressure values were measured.

Results: All 60 limbs completed the data collection. Sitting or walking, without GCS, led to no significant volume changes, whereas volume was decreased by the use of GCS (−4.8% [$P < .00001$] and −4.4% [$P < .00001$], respectively). Standing up, without GCS, led to an increase in volume (2.7%; $P < .0001$), whereas limb volume was decreased (4.6%; $P < .0001$) by use of GCS (Table).

Bioimpedance showed an extracellular water reduction only while walking with GCS (from 40.55% ± 1.66% to 40.45% ± 1.71%; $P < .017$). Mean interface pressure was 19 ± 5 mm Hg (B) and 16 ± 5 mm Hg (B1). The interface pressure variation from B to B1 was not homogeneous among participants (mean percentage variation of −13% ± 25%, ranging from −54% to 16%).

The Fig shows a negative linear trend between pressure variation and circumference percentage increase. The subanalysis excluding the two outliers shows a strong negative linear correlation (Pearson coefficient, $r = -0.96$).

Conclusions: GCS led to a significant limb volume reduction irrespective of limb position and muscle pump function. However, extracellular fluid is mobilized only during muscle walking with GCS. Interestingly, leg shape variation influences the interface pressure gradient, indicating the importance of proper fitting of both B and B1 during prescription. These data provide a foundation for future investigations dealing with GCS effect on fluid mobilization and with limb geometry impact on compression performance.

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Total Laparoscopic Removal of Inferior Vena Cava Filters

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Background: Indwelling inferior vena cava (IVC) filters can cause significant complications. With more frequent use of optional IVC filters, there has been increasing need for filter retrieval procedures. Perforations of the IVC wall by the struts of the filter are frequent. These complicated filters have increased because of low retrieval rates. Some filters cannot be removed through endovascular techniques. In this study, we report our experience of total laparoscopic removal of IVC filters in eight patients when the struts were nonretrievable through an endovascular approach.

Methods: Retrospective analysis was performed of eight patients who underwent filter laparoscopic retrieval procedures between December 2016 and July 2018 . Seven patients had the Celect filter (Cook Medical, Bloomington, Ind) placed. One patient had the Denali (Bard, Covington, Ga) filter implanted. In all patients, an attempt to remove the filter by means of the standard percutaneous procedure failed. Eight cases of IVC filter removal due to caval perforation were identified by computed tomography venography. Patients' demographics, clinical presentation, laparoscopic indication and technique, and outcomes were recorded.

Results: Six patients were male, and the median age was 45 years (24-58 years). All IVC filters were the retrievable type and had an average indwelling time of 4.2 months (2-10 months). In each patient, removal had been attempted at least two times through endovascular retrieval. One filter was implanted above the left renal vein. Seven patients underwent total laparoscopic surgical removal of complicated IVC filters, which included six Cook Celect filters and one Bard Denali filter. Open surgical removal of the filter that could not be removed by laparoscopy was performed in one patient. The total removal rate was 100%, and the laparoscopic retrieval rate was 87.5%. All patients recovered well after the operation. No death related to laparoscopic and open removal occurred.

Conclusions: Total laparoscopic removal with minimally invasive IVC manipulation is feasible for extraction of complicated IVC filters that cannot be removed with an endovascular procedure. Laparoscopic removal is associated with excellent outcomes and minimal morbidity.

Author Disclosures: P. Jiang: Nothing to disclose; **J. Liu:** Nothing to disclose.

Is Compression Required After Radiofrequency Ablation? A Randomized Controlled Trial

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Background: With endovenous procedures becoming increasingly preferred to open surgical operations, radiofrequency ablation (RFA) is now established as an efficacious endothermal modality for superficial truncal incompetence. Postprocedure limb compression, hitherto