Increasing Ablation Distance Peripheral to the Saphenofemoral Junction May Result in a Diminished Rate of EHITs

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Background: The treatment of venous insufficiency using endovenous laser ablation or radiofrequency ablation may result in endothermal heat induced thrombosis (EHIT), a form of deep venous thrombosis. This study sought to assess the effect of ablation distance peripheral to the deep venous system on the incidence of EHIT.

Methods: This study was a retrospective review of a prospectively maintained database from 4/2007 to 7/2011. Consecutive patients undergoing great saphenous vein (GSV) or small saphenous vein (SSV) ablation were evaluated. Previous to 2/2011, all venous ablations were performed 2cm peripheral to the saphenofemoral or saphenopopliteal junctions (Group I). Subsequent to 2/2011, ablations were performed 2.5cm peripheral to the respective deep system junctions (Group II). The primary outcome was the development of EHIT II or greater, i.e. thrombus protruding into the deep venous system. Secondary outcomes included procedure-site complications such as hematomas and saphenous nerve injury. Chi-square tests were performed for all discrete variables, and unpaired Students t-tests were performed for all continuous variables. $P<.05$ was considered statistically significant.

Results: A total of 3,526 procedures were performed, Group I (N=2672) and Group II (N=854). General demographics and CEAP classification did not differ significantly between the two groups. EHIT demonstrated a trend towards diminished frequency in Group II (Group I: 2.8% vs Group II: 1.6%, $P=.077$). There were no reported cases of EHIT III or IV in this patient cohort. Patients in Group I were treated using anticoagulation 56% of the time, and patients in Group II were treated using anticoagulation 100% of the time. The frequency of procedure site complications was low and did not differ significantly between the two groups.

Conclusions: This study suggests that changing the treatment distance from 2cm to 2.5cm peripheral to the deep venous junction may result in a diminished incidence of EHIT. Ongoing evaluation is required to validate these results and to reaffirm the durability of the technique.

Venous Endovascular Simulation Training - Initial Observations

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Objectives: Endovascular simulation training has been advocated as a method to improve the endovascular skills of interventional trainees but only procedures involving arteries have been reported. We describe our experience in venous endovascular simulation training for performance of diagnostic venography and inferior vena cava (IVC) filter placement.

Methods: Endovascular simulation performance data on 4 vascular surgery fellows and one radiology resident were evaluated over a 14-month period. Simulated diagnostic and therapeutic procedures were performed in the IVC and renal veins using a VIST endovascular simulator (Mentice Inc., Gotenburg, Sweden). All procedures were proctored by a faculty observer with immediate formative feedback. Internal (simulator based) and external (physician developed) metrics were measured and obtained. Paired Student's *t*-test was used to compare combined initial (procedure 1) vs. final (procedure 20) performances. A postperformance questionnaire was completed by all of the trainees.

Results: 100 simulated endovascular venous procedures were performed. Each trainee performed 20 nonselective cavagrams, 20 selective bilateral renal vein venograms, and 20 IVC filter placements. The Table below lists the values ÷ SD for procedures 1 and 20. Compared to their clinical experience a greater number of simulated diagnostic venous procedures and IVC filter placements were performed (100 vs 25, $P<.001$). Time to completion for simulated nonselective cavagram, selective bilateral renal vein venography and IVC filter placement decreased significantly from procedure 1 to 20 ($P<.05$). By procedure 20 total procedure and fluoroscopy times had been reduced by more than 50% ($P<.006$ and $P=.07$). Combined wire, catheter, and fluoroscopic errors were significantly reduced by the final procedure ($P<.04$). Procedural checklist (quantitative assessment) and global rating scale scores (qualitative assessment) were increased significantly by procedure 20 ($P<.005$) (instructional effectiveness). Questionnaire feedback indicated that venous endovascular simulator training coupled with immediate formative feedback improved endovascular skill sets and should be incorporated into fellow and resident training. The simulation program was reported as being useful for acquiring both basic and advanced endovascular skills in the venous system.

Conclusions: Initial observations indicate endovascular simulation training improved the skill sets of vascular surgery and radiology trainees performing specific simulated venous procedures (diagnostic venography and IVC filter placement). Endovascular simulation training in the venous system offers an effective method in which to enhance skills training in catheter-based techniques.

Table.

Variable	*Procedure 1*	*Procedure 20*
Total procedure time (sec)	2195 ± 455	1066 ± 270
Total fluoroscopy time (sec)	948 ± 435	477 ± 82
IVC cavagram (sec)	487 ± 166	187 ± 66
Bilateral renal vein venograpy (sec)	1265 ± 571	450 ± 162
IVC filter placement (sec)	2029 ± 487	989 ± 273
Combined errors (#)	8 ± 4	1 ± 2
IVC Filter movement (mm)	17 ± 15	7 ± 12
Procedural checklist score (max 42)	23 ± 5	41 ± 5
Global rating scale score (max 95)	41 ± 5	87 ± 14

Left Common Iliac Vein Compression Is Not Uncommon CT Finding

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Background: Left Common Iliac compression (LCIVC) is a known clinical entity that can be associated with venous thrombosis. The incidence of LCIVC is variable based on the methods of evaluation. In the current study we evaluated the incidence of LCIVC based on CT scans done in a university hospital and correlated the presence of compression with clinical findings.

Methods: All CT scan done were reviewed for the presence of LCIVC. The diameter of the left CIV at the point of crossing with the right common iliac artery was measured and compared to the diameter of the right CIV at the same level and to that of the left CIV distal to the point of compression. Stenosis of the left CIV at the point of crossing was calculated. The computer medical records of all patients were reviewed. Data was entered on an excel sheet. SPSS version 19 was used for analysis.

Results: A total of 495 CT scans were reviewed. Only 300 patients had full medical records and CT scans involving the abdomen and pelvis. The average age is 51.9 years, 174 (58%) were females. 32 (10.7%) had swelling in left leg. 119 (39.7%) patients were overweight with 29.3% had BMI more than 30. Leg swelling was increased in patients with BMI > 40 and history of DVT but not associated with the presence of LCIVC. Diameters of IVC, RCIV, and distal LCIV decreases with age in contrast to the diameter of the LCIV at crossing which increases with age. The diameter iliac veins and IVC are smaller in females than males, (Table I). The diameter of the left CIV at the compression site shows a stenosis of 43.1% and 38.2% when compared to the distal left CIV and right CIV, respectively. The incidence of different degrees of LCIV stenosis as compared the distal LCIV and RCIV in males and females summarized in Table II.

Conclusion: LCIVC is a common CT finding. Generally it is more frequent in females at different degrees of stenosis. LCIVC decreases with age. Swelling of the left leg is not related to the presence of LCIVC or to the degree of stenosis. Swelling is associated with morbid obesity and history of DVT.

Table I.

Diameter (mm)	*All patients*	*Males*	*Females*	P
LCIV crossing	7.5	8.6	6.6	0.001
LCIV distal	13.6	13.8	13.4	NS
R CIV	12.1	12.9	11.6	0.001
IVC	15.3	16.6	14.4	0.001

Table II.

Site stenosis	*Overall*	*Males (M)*	*Females (F)*	P *value (M vs F)*
vs distal L CIV	43.1%	36.6%	48.5%	.0001
>90%	12 (4%)	2 (1.6%)	10 (5.7%)	NS
>70%	59 (19.7%)	14 (11.1%)	45 (25.9%)	.002
>50%	134 (44.7%)	42 (33.3%)	92 (52.9%)	.001
vs R CIV	38.2%	32.1%	42.7%	.003
>90%	5 (1.7%)	1 (0.8%)	2 (2.3%)	NS
>70%	48 (16%)	14 (19.5%)	34 (19.5%)	.049
>50%	110 (36.7%)	37 (29.4%)	72 (42%)	.026

Responsiveness of Individual Questions From The Venous Clinical Severity Score And The Aberdeen Varicose Vein Questionnaire

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Background: The Venous Clinical Severity Score (VCSS) and the Aberdeen Varicose Vein Questionnaire (AVVQ) are both dynamic assessment tools which measure the effects of venous treatment in patients with Superficial Venous Insufficiency (SVI). The total scores universally improve after treatment but it is unclear which questions are the most responsive to change and which questions remain relatively static. The aim of this study was to evaluate the change in each question following treatment at 3 weeks and 3 months.

Methods: This is a retrospective study on a database of 100 patients (M:F=41:59) with SVI (C_2=34,C_3=14,C_{4a}=29,C_{4b}=9,C_5=7,C_6=7) who received treatment with endovenous laser ablation (n=50) or foam sclerotherapy (n=50). The change scores of each question of the VCSS (questions 1-10) and the AVVQ (questions 1-13) were calculated by subtracting the score at 3 weeks, and 3 months, from the pretreatment score. Significant changes ($P<.05$) were highlighted using the Wilcoxon test. A subgroup analysis was also performed (n=92) on treatment type. Patients were also stratified at 3 months using complete abolition of saphenous reflux with normalization of the Venous Filling Index (VFI<2.5ml/sec) on air plethysmography (n=38, Group A) versus any remaining haemodynamic impairment on duplex or VFI (n=54, Group B).

Results: Both the median (IQR) VCSS and the AVVQ scores significantly improved. From 6(4) and 21.4(15.1) at baseline to 3(4) and 18.6(12.1) at 3 weeks ($P<.0005$, $P=.031$) and to 2(3) and 8.8(13.6) respectively at 3 months, ($P<.0005$, $P<.0005$). The first 3 questions of the VCSS (pain, extent of varicosities, edema) responded most to the effects of treatment, in all categories, Table I. Questions 5,6,7,9 on inflammation and active ulceration all improved individually but responded least overall due to statistical dilution (7/100 patients). The majority of the AVVQ questions on quality of life significantly improved, Table II. However, VCSS Q.10 and AVVQ Q.5 were not useful (negative change) because stocking application was recommended early posttreatment identifying greater severity.

Table I. Individual VCSS questions and the significance of their change.
*deterioration

VCSS	P > .05	P < .05 & P > .0005	P < .0005
Total 3 weeks	5,6	7,8,9,10*	1,2,3,4
Total 3 months	6,7,9	4,5,8,10	1,2,3
Laser 3 weeks	5,6,7,8,9	4	1,2,3,10*
Foam 3 weeks	5,6,7,8,9,10	4	1,2,3
Laser 3 months	5,6,7,8,9,10	4	1,2,3
Foam 3 months	4,5,6,7,8,9	10	1,2,3
Group A	4,5,6,7,8,9,10	—	1,2,3
Group B	5,6,7,8,9	10,4	1,2,3

Table II. Individual AVVQ questions and the significance of their change.
*deterioration

AVVQ	P > .05	P < .05 & P > .0005	P < .0005
Total 3 weeks	9,12,13	2,3,6,11	1,4,5*,7,8,10
Total 3 months	5,9	3	1,2,4,6,7,8,10,11, 12,13
Laser 3 weeks	2,9,12,13	4,6,8,11	1,3,5*,7,10
Foam 3 weeks	3,6,9,11,13	2,7,8,10,12	1,4,5*
Laser 3 months	3,5	8,9,11,12	1,2,4,6,7,10,13
Foam 3 months	3,5,9	6,7,8	1,2,10,11,12,13
Group A	3,5,9	7,8	1,2,4,6,10,11,12,13
Group B	5,9	3,7,8,12	1,2,4,6,10,11,13

Conclusions: The individual questions of the VCSS and AVVQ are significantly responsive to change following treatment at 3 weeks and 3 months. However, questions 6,7,9 of the VCSS and 5,9 of the AVVQ (stocking use, ulceration) failed to respond overall after 3 months. These results may be of importance in deciding on future revisions of these dynamic assessment tools.

ECG-Gated Dynamic Magnetic Resonance Is The Preferred Imaging Modality For May-THurner Syndrome

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Background: May-Thurner syndrome occurs secondary to chronic extrinsic compression of the left common iliac vein by the overlying right common iliac artery. Patients with symptoms consistent with this disease merit further evaluation and treatment. Several options exist for noninvasive diagnostic imaging. Ultrasound allows for rapid visualization of the lower extremity vessels and is highly sensitive for detecting obstruction and reflux, however it is a poor choice for visualizing the iliac vessels. CTA can identify extrinsic sources of compression that is static but is limited in its ability to identify dynamic compression that occurs only during a portion of the cardiac cycle. Dynamic MR allows for noninvasive imaging of the pelvic vasculature and surrounding structures with the ability to identify changes that occur throughout the cardiac cycle. Here we present a series of 6 patients with suspected May-Thurners who underwent dynamic MR.

Methods: MR was performed using a 1.5-T or 3.0-T scanner (Magnetom Verio, Siemens Medical Solutions, Erlangen, Germany). Morphologic images were obtained using ECG-gated bright blood steady state free precession (6.0 mm slice) in axial, coronal and sagittal planes. ECG-gated SSFP cine images (5.0 mm slice) were obtained in the axial plane at the level of the aorto-iliac bifurcation (20-25 frames per cardiac cycle). High-resolution 3D MR angiography (1.3 mm slice) was obtained in the coronal plane during the administration of gadolinium-based contrast to obtain arterial and venous phase images. ECG-gated, phase contrast images were acquired to assess flow acceleration. After contrast administration, 2 additional steady state sequences are obtained; direct thrombus imaging sequence, and a postcontrast 3D gradient echo T1-weighted sequence in which images comparable to CT are used to identify extrinsic compression, poststenotic dilation, or superficial venous engorgement.

Results: Six patients presenting with symptoms of May-Thurners and LLE venous reflux and varicocities by duplex U/S were evaluated with MR. Criteria for diagnosis included: extrinsic compression or poststenotic dilation, and demonstration of flow acceleration during systole. 3/6 had evidence of May-Thurners by MR. Four patients (3 with +MR, one negative study but strong clinical suspicion), were evaluated with venography and IVUS, confirming the diagnosis in all 3 patients with +MR. One patient with a negative MR had venous stenosis with luminal disease confirmed by IVUS, without evidence of extrinsic compression by multiview venography.

Conclusion: Dynamic MR can diagnose May-Thurners by different available sequences, and because these sequences are ECG-gated, can demonstrate flow acceleration during systole, offering an important advantage over CT, which only provides anatomical images. Limitation of MR is demonstrated in the case where luminal disease was not identifiable.

Prospective Comparison of Iliac Vein Compression Using Computed Tomography

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Introduction: The anatomic course of the iliac veins as they travel through pelvis has been implicated in venous disease. The true role in contributing to venous disease is not exactly known but has gained more attention as advanced imaging and endovascular tools are more available to vascular physicians.

Methods: A prospective study of 30 consecutive asymptomatic patients and 30 advanced venous disease patients were evaluated for proximal vein compression. Contrast enhanced computerized tomography (CT) was used to survey the common iliac veins through the pelvis as they interact with the iliac arteries and the L5 vertebral body. Cross-sectional area of the maximally compressed and uncompressed iliac veins was calculated using the major and minor diameters of the vessel. Additional sites of external compression of the caudal iliac veins at multiple levels were observed.

Results: The mean area reduction of the iliac veins were 36.65% +/− 20.23% for advanced venous disease patients, and 31.75% +/− 23.65% for asymptomatic control patients. This difference was not statistically significant with a p-value of 0.325 (Mann-Whitney U Test). In the advanced venous disease patients, an area reduction of >25%, 50%, and 70% was seen in 11, 7, and 2 patients, respectively. Equivalent area reductions were seen in 8, 7, and 1 asymptomatic control patient, respectively. In both groups there were multiple sites of "alternative" compression or non-May-Thurner compression found. In 18 patients (30%) we found this type of alternative compression with the right common iliac vein being compressed by the right common iliac artery (n = 6) and the right common iliac vein being compressed by the right internal iliac artery (n = 6) as the most common.

Discussion: Despite the implicated role of extrinsic compression of the iliac veins in venous disease, we did not find statistically significant area reductions of the iliac veins in advanced venous disease patients as compared with asymptomatic controls. Computed tomography, as a method to systematically quantify iliac vein compression has limitations. Even using mulitplanar reconstructions, measurement of the area of the iliac veins can be difficult as the course of the vein is often not directly in the plane of the image. It was noted that 30% of patients displayed "alternative" or non-May-Thurner compression in their iliac vessels. The role of this alternative compression in advanced venous disease patients is currently unknown.

Effect of Body Mass Index On Lower Extremity Duplex Ultrasonography

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Background: Duplex ultrasonography has long been considered the gold standard diagnostic modality for evaluation of lower extremity acute deep venous thrombosis. (DVT) Multiple known advantages include its noninvasiveness, high sensitivity and specificity rates, and accuracy. However, certain clinical circumstances can negatively impact the findings of a