routine after open varicose vein surgery, has been extended to endovenous procedures. There is, however, no robust evidence to support this practice. This study comparatively evaluated the outcome with and without postoperative compression after RFA.

Methods: This single-center prospective randomized controlled trial recruited adult patients undergoing RFA into two groups (A, compression stocking for 2 weeks; B, no compression). Duplex ultrasound scan was performed at 2 weeks, but the primary outcome was successful obliteration of target vein as determined by duplex ultrasound scan at 12 to 14 weeks. Secondary outcome measures included quality of life scores (Aberdeen Varicose Vein Symptom Severity [AVVSS] score and Venous Clinical Severity Score [VCSS]), patient satisfaction, and complications. To detect 2.5% difference in success rate between the groups, assuming 90% power and a type I error of 5%, a minimum of 39 patients were required in each arm. Stata 15 (StataCorp, College Station, Tex) was used to perform statistical analysis. Ethical approval was granted by Regional NHS National Research Ethics Service. The study was registered with ISRCTN (Registration No.: 18119345).

Results: In total, 100 patients were recruited (group A, 51; group B, 49), with no significance difference in age, sex, clinical class, mean AVVSS score (17.7 vs 15.7), and VCSS (10.2 vs 10.4) between groups. At 2 weeks, the occlusion rate of the target vein was similar in both groups at 96.1% and 95.9%, respectively, with no significant change at 12 weeks. There was no significant difference in the incidence of deep venous thrombosis. One patient in each group did not achieve vein occlusion, and three patients in each group did not attend for the final ultrasound scan. There was no statistical difference in mean AVVSS score (5.7 vs 5.0) and mean VCSS (3.2 vs 3.7) score at 12 weeks. Of the 93 patients who returned their satisfaction survey, 97% would recommend the RFA procedure, and this did not differ between groups.

Conclusions: The outcome of RFA without post-treatment compression is no worse than with compression. Use of compression after RFA did not improve success rate, quality of life scores or patient satisfaction, or postoperative complications. It may be concluded that the widely practiced use of compression after RFA adds no clinical benefit for the patients.

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Serum ^{1}H Nuclear Magnetic Resonance Metabolomic Profiling in Acute Deep Venous Thrombosis

Marina Kafeza,[1] Richmond Bergner,[2] Joseph Shalhoub,[2] Sarah Onida,[2] Elaine Holmes,[2] **Alun H. Davies**[2]. [1]Academic Section of Vascular Surgery, Department of Surgery, and Cancer Faculty of Medicine, Imperial College London; [2]Imperial College London

Background: Deep venous thrombosis (DVT) biomarker research is an area of great interest, given the significant morbidity and mortality associated with the disease. High-throughput metabolomic profiling of circulating metabolites has emerged as a promising method in biomarker research. An untargeted metabolic profiling approach using ^{1}H nuclear magnetic resonance spectroscopy may reveal possible diagnostic biomarkers of acute DVT.

Methods: Comprehensive untargeted metabolic profiling of serum of patients with acute DVT (DVT+) compared with serum of patients with similar symptoms and excluded DVT (DVT−) and nonsymptomatic volunteers (controls) was undertaken using ^{1}H nuclear magnetic resonance spectroscopy. Multivariate analysis including principal component analysis and orthogonal partial least squares discriminant analysis was performed to assess whether there was a differential metabolic profile in comparing serum of DVT patients and controls, followed by univariate analysis to identify possible compounds responsible for any difference between the groups.

Results: In total, 121 patients were included in the study: 41 DVT+ patients, 40 controls, and 40 DVT− patients. Multivariate analysis of the blood samples showed a differential metabolic profiling in comparing the serum of DVT+ patients with that of controls (R^2 = 0.806; Q^2 = 0.352) or DVT− patients (R^2 = 0.848; Q^2 = 0.199). Univariate analysis showed that the compounds responsible for the metabolic difference between DVT+ and controls were *N*-acetylglucosamines, histidine, tyrosine, alanine, choline and lipids. *N*-Acetylglucosamine was also driving the metabolic difference between DVT+ and DVT− groups.

Conclusions: The study proves the presence of a specific metabolic signature of acute DVT and utility of a metabolomic approach to identify possible diagnostic DVT biomarkers in serum.

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Risk of Acute Kidney Injury with Intervention for Acute Deep Venous Thrombosis

Sarah Sternbach,[1] Yaron Sternbach,[2] John Taggert,[2] **Kathleen Ozsvath**[3]. [1]Albany Medical Center; [2]Vascular Surgery, Albany Medical Center; [3]Vascular Surgery, Albany Medical Center

Objective: The treatment of acute deep venous thrombosis (DVT) continues to evolve. Whereas catheter-directed thrombolysis with mechanical thrombectomy has been used to treat patients successfully, such treatment regimens carry an inherent risk of nephropathy that has yet to be quantified. The goal of this study was to determine the risk of acute kidney injury in patients treated for acute DVT with mechanical thrombectomy and lysis.

Methods: A retrospective review of prospectively collected data was conducted for 152 patients presenting to the two hospitals in Albany, New York, where lysis is performed by the Vascular Group, a large single-specialty vascular surgery group composed of board-certified vascular surgeons. Data collection included demographics, preprocedural and postprocedural creatinine concentration and glomerular filtration rate (GFR), number of interventions within the acute episode, total contrast material dose, adjuvant procedures, and anatomic location of the DVT. All interventions were performed by vascular surgeons adept at evaluation and endogenous treatment. Decisions about initiation of therapy and method of intervention were made at the discretion of the treating surgeons.

Results: During 5 years (2012-2017), 152 patients underwent intervention for treatment of acute DVT. Group 1 included 144 patients who had no significant periprocedural renal changes. Group 2 had eight patients with changes in renal function periprocedurally. Mean age, number of procedures, anatomic location of the DVT, and contrast material dose were similar in the two groups. Patients in group 2 did have both a higher baseline creatinine concentration (0.87 vs 1.35 mg/dL; P = .03) and lower GFR (58.6 vs 48.3 mL/min/1.73 m^2; P = .046). Patients with abnormal GFR were more likely to have periprocedural renal impairment (P = .0023). The addition of mechanical thrombectomy to any procedure conferred an increased risk of acute renal impairment (P = .039). No patient required permanent hemodialysis, although two patients with normal initial renal function required temporary hemodialysis after intervention.

Conclusions: This study represents initial evidence that for patients undergoing intervention for acute DVT, there is a small (5.2%) but real risk of temporary periprocedural renal impairment. Predisposing factors in the study are limited to impaired renal function at admission, although normal renal function is not completely protective. Renal tubular necrosis may complicate mechanical thrombectomy and augment the risk of nephropathy posed by the use of iodinated contrast agents. Whereas intervention for acute DVT can be safely undertaken, additional investigation is necessary to clarify what specific elements of mechanical thrombectomy pose the greatest risk to patients and how that risk may best be mitigated in the future.

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A Pathologic Perforator May Predict the Presence of an Ipsilateral Central Venous Stenosis

Mikel Sadek, Lowell Kabnick, Thomas Maldonado, Caron Rockman, Neal Cayne, Todd Berland, Glenn Jacobowitz. New York University Langone Health

Objective: The treatment of a refluxing perforator is indicated in the setting of severe venous insufficiency (ie, pathologic perforator), but there

are minimal data characterizing the presence of a concomitant ipsilateral central venous stenosis. Consequently, central venous stenosis may be underdiagnosed and undertreated in this cohort of patients with active or healed venous stasis ulcerations. This study sought to evaluate whether the presence of a pathologic perforator is predictive of the presence of an ipsilateral central venous stenosis.

Methods: This was a retrospective review of a prospectively maintained institutional Vascular Quality Initiative database from May 2016 to April 2018. Consecutive patients were identified who underwent laser ablation of a pathologic perforator per American Venous Forum guidelines, and most had not undergone dedicated central venous imaging. Patients were identified who underwent incidental abdominal imaging that allowed evaluation of the central veins (eg, magnetic resonance, computed tomography, venography or intravascular ultrasound [IVUS]). The patients were divided into those who had imaging (group A) and those who did not (group B). Of those patients who underwent imaging, the primary outcome was the presence of an ipsilateral central venous stenosis as measured by orthogonal diameter reduction of >50% on axial imaging or by cross-sectional surface area reduction of >50% on IVUS.

Results: There were 63 patient limbs that underwent ablation of a pathologic perforator (group A, n = 18; group B, n = 45). Of the total cohort, 47.6% were men; average Venous Clinical Severity Score was 8.8 ± 5.4, right-sided treatments occurred in 44.4%, and average perforator diameter was 5.7 ± 3.3 mm. Demographic variables did not differ significantly between groups. Right-sided procedures trended more in group A compared with group B (group A, 61.1%; group B, 37.8%; $P = .09$). Imaging was as follows: computed tomography, n = 10; magnetic resonance, n = 6; and venography or IVUS, n = 2. Limbs with pathologic perforators demonstrated ipsilateral central venous stenoses in 83.3% vs the contralateral limbs, which demonstrated central venous stenoses in 44.4% ($P = .04$). In perforator-treated limbs, the average iliac vein diameter decreased from 15.5 ± 4.1 mm to 4.5 ± 1.6 mm ($P < .01$). This represented an average stenosis of 70.2% ± 11.0% in the perforator-treated limb vs 45.4% ± 31.1% in the unaffected limb ($P = .009$). Concomitant central venous stenting was performed rarely (group A, 2; group B, 0; $P = .07$), presumably because of the lack of imaging and diagnosis.

Conclusions: This study suggests that the majority of patients who undergo treatment for a pathologic perforator have ipsilateral central venous stenosis. The identification of central venous stenosis in limbs with a treated pathologic perforator supports the concept that multilevel disease may underlie severe venous insufficiency and that this is often underdiagnosed and undertreated. Ongoing evaluation will demonstrate whether identification and treatment of central venous stenosis in patients with a pathologic perforator will result in improved outcomes.

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Spine Stabilization Is a Risk Factor for the Development of Pelvic Iliac Vein Lesions

Golta Rasouli, Maxwell Tran, Vinay Satwah, Sanjiv Lakhanpal, **Peter Pappas**. Center for Vein Restoration

Objective: Open lumbar spine stabilization surgery often requires mobilization of the left and right common iliac veins (CIVs) and the placement of plates and screws that can impinge on iliac veins. We reviewed our venography experience during the past 3 years to determine whether there is an association between spine stabilization surgery and the development of iliac vein lesions and symptomatic iliac vein outflow obstruction.

Methods: A retrospective chart review was performed to identify patients who underwent venography with or without venous stenting and who had a history of previous lumbar spine stabilization.

Results: From January 2014 to April 2018, venography were performed in 1713 limbs in 1245 patients at the Center for Vascular Medicine. Of the 1245 patients, 17 patients had a history of lumbar spine stabilization procedures (4 anterior-posterior and 13 posterior). Nine had single-level and eight had two- or three-level fusions. All 17 patients demonstrated pelvic lesions, which included the following: one left CIV aneurysm, five left CIV stenoses, three bilateral CIV stenoses, two left CIV and inferior vena cava occlusions, and two external iliac vein stenoses. The aneurysm patient was treated with anticoagulation. Eight patients underwent stenting, and one patient refused stenting because of relocation to another country. One inferior vena cava-CIV occlusion could not be crossed. Fear of dislodging a thrombus and the proximity to a protruding posteriorly placed screw prevented stenting in two patients. Four patients had a venoplasty alone because of undersizing of a stenosis or missed lesions with intravascular ultrasound after review by a blinded reviewer. Lesions in anterior-posterior patients were extremely stenotic, required predilation, and resulted in a residual stenosis requiring venoplasty at a second setting in one patient.

Conclusions: Lumbar spine stabilization surgery may be a risk factor for development of symptomatic venous outflow obstruction lesions. During venography and stenting in patients with anterior-posterior approaches, significant scarring may be encountered, resulting in a residual stenosis after stent placement. Predilation venoplasty, before stent deployment, is recommended to prevent stent migration. Furthermore, a history of spine stabilization surgery in patients presenting with pelvic or lower extremity pain or swelling should prompt consideration of a pelvic venous duplex ultrasound examination to assess for the presence of an iliac venous outflow lesion.

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Outcomes of Left Renal Vein Stenting in Patients with Nutcracker Syndrome

Efthymios D. Avgerinos, Zein Saadeddin, Rishab Humar, Karim Salem, Michael Singh, Eric S. Hager, Michel Makaroun, Rabih A. Chaer. Division of Vascular Surgery, Department of Surgery, University of Pittsburgh Medical Center

Objective: Nutcracker syndrome (NCS) is a rare condition that can present with hematuria, flank pain, pelvic varicosities, or chronic pelvic congestion related to left renal vein (LRV) compression. Open surgery, specifically LRV transposition, has been the mainstay of treatment, but during the past few years, LRV stenting has emerged as a valid alternative without sufficient evidence to support it. This study aimed to assess outcomes of renal vein stenting in the treatment of NCS.

Methods: A retrospective chart review of patients with NCS who underwent LRV stenting between 2010 and 2018 was performed. End points were perioperative adverse outcomes, symptom relief, and stent patency. Symptom resolution was classified as complete, partial, and none on the basis of the interpretation of medical records on clinical follow-up. Standard descriptive statistics and survival analysis were used.

Results: Seventeen patients (16 female; mean age, 35.8 ± 14.6 years; mean body mass index, 21.3 ± 4.1 kg/m^2) diagnosed with NCS and treated with LRV stenting were identified. Five of these had a prior LRV transposition that had failed within a mean of 7.0 ± 4.9 months. Ten patients had coexisting pelvic congestion syndrome treated with gonadal vein embolization. The most frequent sign and symptom were hematuria (9/17 patients) and flank pain (14/17 patients), respectively. All patients received self-expanding stents (mean diameter, 12.7 ± 1.6 mm), the smaller ones typically placed in the previously transposed LRVs. No perioperative complications occurred. Eight patients were discharged on the same day; the remaining stayed longer for pain control (mean hospital stay, 1.0 ± 1.3 days). At an average follow-up of 33 ± 25 months, 13 (76.5%) patients had symptom relief (9 complete, 4 partial). Three of the four patients whose symptoms persisted had previous LRV transposition surgery. Five of nine patients who presented with hematuria had it resolved.

Three patients underwent a reintervention. Two of these had successful balloon venoplasty for restenosis. The third patient had persistent debilitating pain despite a patent stent and eventually underwent renal auto transplantation with no symptom relief. Two-year primary and primary assisted patencies were 81.8% and 90%, respectively. No stent migration occurred.

Conclusions: Endovascular treatment with renal vein stenting is safe and effective, providing good midterm patency rates and symptom relief. Minimally invasive approaches may have a potential role in the treatment of NCS. Larger series and longer follow-up are needed to better assess its comparative performance against LRV transposition.

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