praceliac aorta, superior mesenteric artery, renal arteries, and iliac artery bifurcation. Median oral examination scores were 5% vs 87%, 26% vs 94%, 19% vs 86%, 30% vs 88%, and 29% vs. 87%, respectively (all $P < .001$) and median or scores were 1.1 vs 2.9, 1.3 vs 3.5, 1.2 vs 3.2, 1.2 vs 3, and 1.5 vs 3.9, respectively (all $P < .001$).

Conclusions: Fresh cadaver laboratory sessions can provide a learner-centered and safe environment for acquiring procedural understanding and operative confidence of complex vascular exposures and allow for transformational change that is essential to becoming a competent vascular surgeon.

Osteoprotegerin Serum Levels in Abdominal Aortic Aneurysm

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Objectives: Serum levels of osteoprotegerin (OPG) are a significant marker for the prediction of cardiovascular disease severity and patient mortality. Its association with abdominal aortic aneurysm (AAA) is still a matter of discussion. The aim of our prospective nonrandomized study was to find if any correlation existed between serum levels of OPG and AAA.

Methods: In 43 patients operated on for AAA, venous (peripheral blood samples before operation) and arterial OPG serum levels (aneurysm blood samples during open surgery) were evaluated by multiplex immunoanalytic assay (xMAP) technology. Plasma OPG levels were correlated with age, gender, diameter, and symptoms of AAA, hypertension, smoking, diabetes mellitus, carotid artery stenoses, peripheral arterial stenoses, or occlusions and AAA wall thrombus in multifactorial analysis. Twenty patients operated on for hernia served as a control group.

Results: OPG plasma levels were 1000 times higher in the AAA group compared with controls. Venous OPG plasma levels were directly dependent on AAA diameter ($P < .01$) and symptoms ($P < .0005$). Other important factors for OPG plasma levels were smoking ($P < .01$) and age ($P < .05$). Arterial plasma levels of OPG were significantly higher compared with venous levels. Factors significant for arterial OPG plasma levels were age ($P < .01$), hypertension ($P < .05$), and smoking ($P < .03$).

Conclusions: OPG venous levels are related to diameter and symptoms of AAA. OPG should be used as a predictor of AAA growth in small AAAs and also as a predictor of imminent AAA rupture. OPG is also a marker of cardiovascular risk in smokers, diabetic patients, and those with carotid artery stenosis, which is important for the type of operating procedure decision making.

Interpreting the EVAR versus OPEN Repair Randomized Trials: A Critical Meta-Analysis

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Objectives: Although endovascular aneurysm repair (EVAR) has lower perioperative mortality than open aortic aneurysm repair (OPEN), its benefits may be compromised by an increase in secondary interventions and a possible increase in late mortality. The goal of this study was to explore these findings by performing an analysis of randomized controlled trials (RCTs) comparing the outcomes of EVAR and OPEN.

Methods: A meta-analysis of RCTs comparing EVAR with OPEN was performed, encompassing 2484 patients. Outcome measures included all-cause mortality (early, late, total), AAA-related mortality (early, late, total), graft-related complications, and secondary interventions.

Results: A total of 349 deaths (28.1%) occurred among 1243 EVAR patients, and 367 deaths (29.6%) among 1241 OPEN patients. EVAR was associated with a significant benefit in early all-cause mortality (1.3% vs 4.7%), with an odds ratio (OR) of 0.27 (95% confidence interval [CI], 0.15-0.49; $P < .001$). However, no significant differences were noted for late all-cause mortality (OR, 1.04; 95% CI, 0.86-1.27; $P = .67$), or total all-cause mortality (OR, 0.93; 95% CI, 0.77-1.12; $P = .43$). EVAR was associated with a significant reduction in early AAA-related mortality (1.4% vs 4.0%; OR, 0.36; 95% CI, 0.20-0.63; $P < .001$). However, EVAR was also associated with a significant increase in late AAA-related mortality (2.2% vs 0.9%; OR, 2.25; 95% CI, 1.11-4.56; $P = .03$). There was no significant difference noted for total AAA-related mortality (3.5% vs 4.9%; OR, 0.73; 95% CI, 0.49-1.09; $P = .13$). EVAR was associated with a significant increase in graft-related complications (40.1% vs 10.5%; OR, 6.01; 95% CI, 4.59-7.89, $P < .001$), and secondary interventions (19.2% vs 10.1%; OR, 2.12; 95% CI, 1.67-2.69; $P < .001$).

Conclusions: In pooled analysis of the RCTs comparing EVAR and OPEN, EVAR has clear advantages of decreased early AAA-related and all-cause mortality. Although the success of EVAR in reducing late AAA-related mortality may be suboptimal, the importance of decreased early mortality cannot be minimized, particularly from the patient's perspective. Future work must focus on improvements in design and techniques that will decrease device-related complications and the need for secondary interventions to further improve the long-term success of EVAR. Despite these issues, EVAR remains the procedure of choice in anatomically suitable AAA patients.

Totally Robotic Aortic Surgery versus Robotic-Assisted Aortic Surgery with Mini-Laparotomy

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Objectives: Safety and efficacy of totally laparoscopic aortic surgery and laparoscopic-assisted aortic surgery with minilaparotomy have been demonstrated in previous studies. Published reports of robotic-assisted aortic surgery involve a combination of laparoscopy for aortic dissection and robotic system for vascular reconstruction. The objective of this study is to determine the feasibility and advantage of a totally robotic aortic dissection and vascular reconstruction versus robotic-assisted aortic procedures for aortoiliac occlusive disease (AIOD) and abdominal aortic aneurysm (AAA).

Methods: From February 2006 to August 2010, 21 patients were selected for robotic aortic procedures: 12 had aortobifemoral bypass, 6 had AAA repairs, 1 had iliac aneurysm repair, and 2 had ligation of type II endoleak after endovascular aneurysm repair. Inclusion criteria included AAA >5 cm, iliac aneurysm >3 cm, and AIOD TransAtlantic InterSociety Consensus C or D. The daVinci S Surgical System was used for the aortic dissection in all cases and the aortic anastomosis in three. Institutional Review Board approval and informed consent were obtained.

Results: The 21 patients (6 women, 15 men) were an average age of 65.7 years (range, 44-86 years) and body mass index of 27.23 kg/m^2, and 90.4% were American Society of Anesthesiology 3 or 4. Twenty patients (95.2%) underwent successful robotic dissection of the abdominal aorta. One patient underwent full conversion to open AAA repair due to trocar injury. Of the remaining 20 patients, the average robotic dissection of the infrarenal aorta was 113.1 minutes and average aortic clamp time was 86 minutes. Procedures in 15 patients were performed with a minilaparotomy using an average abdominal incision of 13 cm to implant the Dacron or PTFE graft. Five patients underwent a totally robotic procedure with robotic aortic reconstruction or ligation of type II endoleak. Thirty-day survival rate was 100%. Median length of stay (LOS) was 7.5 days. All grafts were patent with a median follow-up of 26.5 months.

Conclusions: In this selected group of patients, totally robotic aortic surgery for aortic dissection and vascular reconstruction is feasible. For aortic procedures completed total robotically without an abdominal incision, the estimate blood loss was significantly less than robotic-assisted procedures with minilaparotomy.

Table. Totally robotic versus robotic-assisted aortic procedures

	Aortic clamp time (*min*)	*Estimated blood loss* (*mL*) (*mL*)	*LOS* (*days*) (*days*)	*Mini-incision* (*cm*)
Totally robotic ($n = 5$)	60	200	6.6	None
Robotic-assisted ($n = 15$)	89.5	1474.4	11.7	13

Outcomes of EVAR in Hemodynamically Stable and Unstable Patients with Ruptured AAA: A Prospective Analysis

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Objectives: To date there are no published reports comparing hemodynamically (Hd) stable and Hd unstable patients with ruptured abdominal aortic aneurysms (r-AAA) undergoing endovascular aneurysm repair (EVAR). This study evaluated outcomes of EVAR for r-AAA based on patient hemodynamic status

Methods: From 2002 to 2009, 106 patients with r-AAA were categorized into two groups based on systolic blood pressure (SBP) measurements before EVAR: Hd-stable (SBP ≥80 mm Hg; n = 72, 68%), and Hd-unstable (SBP <80 mm Hg; n = 34, 32%). All data were prospectively collected, and statistical analysis was performed using χ^2 square and life-table methods

Results: Of the 106 r-AAA patients with EVAR, the Hd-stable and Hd-unstable groups had similar comorbidities (coronary artery disease: 63% vs 59%, hypertension: 72% vs 75%, chronic obstructive pulmonary disease: 21% vs. 26%, and chronic renal insufficienc: 18% vs 18%), the need for

"on-table" conversion to open surgical repair (2.8% vs 5.9%), the incidence of nonfatal complications (37% vs 41%), and secondary interventions (26% vs 24%). Hd-unstable patients had a significantly higher incidence of developing abdominal compartment syndrome ([ACS] 29.4% vs 4.2%, $P < .05$), and death (Table). ACS had a significant impact on mortality (death with ACS: 62%; death without ACS: 11%, $P < .05$).

Conclusions: EVAR for r-AAA is feasible in both Hd-stable and Hd-unstable patients. Hd-stable patients have a short-term and long-term survival advantage, a lower incidence of ACS, and there is no difference in the incidence for conversion to open surgical repair, nonfatal complications, or the need for secondary interventions. Lowering the incidence of ACS might have an impact on improving survival in Hd-unstable patients.

Table.

Variable	*Hd-stable*	*Hd-unstable*	P
Mean AAA size, cm	6.4	6.6	NS
Preoperative CTA	70 (97.2%)	21 (61.8%)	<.05
ACS	3 (4.2%)	10 (29.4%)	<.05
30-day mortality	8 (9.7%)	11 (32.2%)	<.05
Survival at			<.05
1 year	88%	65%	
2 years	79%	54%	
3 years	71%	41%	

Clinical Relevance of Serial CT Scans in Post-Endovascular Aneurysm Repair Patients

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Objective: This study examined the incidence of new clinically significant incidental (CSI) and endovascular aortic aneurysm repair (EVAR)-related findings seen on CT scans during long-term follow-up to identify demographic and clinical predictors of these findings.

Methods: We retrospectively reviewed 915 patients who underwent EVAR at our institution between December 1, 1999, and November 30, 2009. A total of 608 patients who had an initial repair and had available preoperative and postoperative CT scan reports defined the study population. CSI and EVAR-related findings, demographic, and clinical variables were recorded. Time course analysis of detection of new findings, and univariate and multivariate analyses of predictors were performed.

Results: We reviewed 2965 CT scans. There was a median of four (range, 2-16) CT scans and 32 months (range, 1-121 months) of follow-up per patient. Overall detection of new CSI findings was 21%. Annual rate of detection ranged from 14% to 32% over 9.5 years. Annual rate of detection of EVAR-related findings ranged from 2% to 5% over the first 6 years and was zero thereafter. Age >65 years ($P = .024$), glomerular filtration rate (GFR) <60 ($P = .002$), and body mass index <22 ($P = .019$) were predictors of detecting new findings on univariate analysis. On multivariate analysis age and GFR remained significant; tobacco use ($P = .015$) was also a predictor. No predictors were identified for EVAR -related findings.

Conclusions: New CSI findings were detected at a constant rate on CT scans obtained for post-EVAR follow-up over 10 years. EVAR-related findings were detected at a constant rate up to 6 years after the procedure and then were no longer detected. Patients with older age, renal impairment, and tobacco use had more CSI findings. Our data suggest that (1) CT scan may not be necessary for follow-up of EVAR patients after 6 years, and (2) CT is more likely to detect a CSI finding that warrants further work-up than a problem with the endograft. These findings are especially relevant as the risks from repeated CT scans are being highlighted.

Single-Center Experience of Anticoagulation Therapy in Deep Venous Thromboembolism Patients: Different Treatment Patterns?

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Objective: The optimal duration of anticoagulation therapy for deep venous thromboembolism (DVT) is still under debate. The objective of our study was to compare the outcome of anticoagulation treatment in DVT patients by vascular surgeons (VS) and primary care physicians (PCP) and analyze the underlying reasons that cause the differences.

Methods: Medical records of 485 DVT patients treated at our center from 2000 to 2007 were retrospectively reviewed. Demographic data and information about risk factors, site of DVT, length of anticoagulation therapy, clot resolution rate monitored by ultrasound (US) imaging follow-ups, and complications related to treatments were collected. Statistic analysis was conducted with SPSS 17.0 software. The χ^2 test or Fisher exact test was used for categoric data, and the Student t test was used for continuous data. $P < .05$ was considered statistically significant.

Results: Of the 485 patients, 122 were treated by VS and 363 were treated by PCP. There were no significant differences in age, gender, preexisting risk factors, and incidences of complications between two groups. However, the VS group had a significantly higher US imaging follow-up rate (73% vs 47.1%, $P = .0001$), longer anticoagulation therapy duration ($P = .03$), and better clot resolution rate ($P = .009$) than the PCP group (Table). Further analysis demonstrates a significant difference in the length of anticoagulation therapy between patients with or without US venous tests. Forty-eight percent of patients without a US test received <3 months treatment vs 52% patients with US test received > 6 months of anticoagulant treatment ($P = .0001$).

Conclusions: Venous US tests can provide valuable information during the anticoagulation therapy in DVT patients. The optimal length of anticoagulation treatment should be adjusted based on the US findings to improve the outcome of DVT management and avoid dangerous complications. The results in our study clearly show that VS use US follow-up in DVT patients more than PCP and thus have better resolution rates of the clots and longer period of Coumadin treatment.

Table. Length of anticoagulation therapy and clot resolution rate in different groups

	Length of anticoagulation therapy (% of patients)[a]			*Clot resolution rate in US follow-ups (% of patients)*[b]		
Variable	*<3 mon*	*3-6 mon*	*>6 mon*	*No change*	*Partial resolution*	*Complete resolution*
Vascular surgeon	23.4	22.3	54.3	12.4	25.8	61.8
Primary care physician	39.1	18.8	42.1	28.7	24.6	46.8

[a] $P = .03$;
[b] $P = .009$.

Procedural Factors Influencing the Incidence of Endovenous Heat-Induced Thrombus (EHIT)

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Objectives: Endothermal ablation (ETA) has been shown to effectively treat superficial venous reflux. Endothermal heat-induced thrombosis (EHIT) from the great saphenous vein (GSV) up to or into the common femoral vein (CFV) has been reported as an early postprocedural complication of ETA. Our objective was to determine whether procedural factors influence the incidence of EHIT.

Methods: From 2007 to 2009, 878 endothermal ablation procedures, comprising 482 endovenous laser ablation (ELA), and 396 radiofrequency ablation (RFA), were performed in a single office practice to treat superficial venous reflux. A retrospective review was performed of ultrasound images and patient records. Ultrasound images showing the position of the catheter tip in relation to the saphenofemoral junction (SFJ) were available for 519 procedures and were reviewed by independent evaluator. There were 234 ELAs (45%) and 285 RFAs (55%). The distance between the tip of the catheter and the SFJ was measured. Duplex ultrasound imaging was performed a mean of 2 days (range, 1-8 days) postprocedure.

Results: Of the 519 procedures, duplex ultrasound identified 21 (4.0%) with extension of thrombus towards the femoral vein; of these 15 EHITs occurred after ELA (6.4%) and 6 after RFA (2.1%; $P = .02$). There was no difference in the mean (SD) distance of the catheter tip from the SFJ between the EHIT and non-EHIT groups (2.3 [0.5] cm, P = NS). The mean (SD) diameter of the treated vein was similar (EHIT, 7.9 [2.3] mm, non-EHIT, 7.8 [3.1] mm; P = NS). There was no difference in the EHIT and non-EHIT groups in concomitant thermal ablation of an additional veins (14% vs 17%, P = NS), ambulatory phlebectomy (86% vs 90%, P = NS), or use of sclerotherapy of incompetent perforators and/or tributaries (19% vs 9%, $P = .13$). The immediate postprocedure closure rate was 99.6%.

Conclusions: EHIT occurred more frequently after ELA than RFA. There was no difference in catheter tip position or mean diameter of the treated vein between the EHIT and non-EHIT groups. The concomitant treatment of additional veins with ETA and/or microphlebectomy was equal between the two groups. EHITs were found more commonly after ETA in combination with sclerotherapy, but this difference was not statistically significant.