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Penetrating Ulcers of the Abdominal Aorta and Iliac Arteries: Harbingers of Aortic Catastrophe or Benign?

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Objectives: Penetrating aortic ulcers can be a concerning finding on imaging. They are believed to be the predecessors for intramural hematomas, dissections, and aneurysm degeneration. It is hypothesized that penetrating ulcers of the abdominal aorta (PUAA) and iliac arteries (PUIA), like their thoracic counterparts, signal impending vascular catastrophe.

Methods: With the institution of electronic medical records at our health system in 2010, a search for the words "penetrating ulcer" in radiology reports became possible. Fifty-three patients were identified as having a penetrating ulcer of the abdominal aorta (PUAA) on computed tomography angiography during a 10-month period from October 2010 through August 2011, and 34 were identified as having a PUIA. The patients' clinical course was monitored through August 2014. No specific intervention for the ulcers was performed; however, if the patient had additional aortic pathology necessitating intervention, it was performed. Retrospective and prospective review of imaging was performed when possible. Student's *t*-test and χ^2 tests were performed for statistical analysis.

Table. Comparison of patients with penetrating ulcers of the abdominal aorta (*PUAA*) and iliac arteries (*PUIA*)

Variable	*PUAA (n = 53)*	*PUIA (n = 34)*	P
Age, years	76.7 ± 10.2	74.5 ± 10.0	.315
Males, No. (%)	35 (66)	28 (82)	.097
Length of follow-up, months	35.7 ± 29.9	34.7 ± 20.6	.613
Patients with serial imaging, No. (%)	30 (57)	19 (60)	.940
Length of time for serial imaging, months	20.6 ± 30.5	29.6 ± 19.7	.626
Concurrent aortic dissection or aneurysm, No. (%)	23 (46)	19 (56)	.255
Change in ulcer appearance or aortic diameter, No. (%)	13/30 (43)	1/19 (5)	*.004*
If change, worsening, No. (%)	8/30 (27)	1/19 (5)	.059
Died during follow-up, No. (%)	19 (36)	7 (21)	.129
Cause of death related to aortic pathology, No. (%)	5/19 (26)	1/7 (14)	.518

Results: The Table compares the two populations studied, PUAA and PUIA. Eight patients had both PUAA and PUIA. Of the five PUAA deaths related to aortic pathology, one died of complications related to type B dissection, three died of complications related to lower extremity thromboembolism, and one died of multisystem organ failure after attempted surgical repair of his iliac artery aneurysm. The one PUIA death related to aortic pathology died of complications related to lower extremity thromboembolism.

Conclusions: The patients identified with PUAA and PUIA were generally elderly with multiple comorbidities. A large percentage of patients had concurrent, separate, aortic pathology, most frequently aortic aneurysms, which were treated if size indicated. Small changes in the appearance of the PUAA were frequent, but did not equate with abdominal aortic catastrophe. Thromboembolic events occurred not infrequently in these patients. The mortality for these populations was high, but the change noted in the ulcers' appearance during follow-up did not suggest ulcer treatment would improve survival.

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Impact of Physician Specialty on Outcomes Following Thoracic Endovascular Aneurysm Repair

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Objectives: Thoracic endovascular aneurysm repair (TEVAR) is commonly performed by interventional radiologists, cardiologists, general surgeons, cardiothoracic surgeons, and vascular surgeons, with each specialty having differences in residency structure, operative experience, and subspecialty training. The aim of this study was to evaluate the impact of surgeon specialty on outcomes after TEVAR.

Methods: Patients who underwent TEVAR were identified from the 2007-2009 Nationwide Inpatient Sample (NIS). Physician identifiers in the NIS were used to determine surgical specialty and operative experience. Multivariate analysis adjusted for surgeon experience and mortality risk was used to compare differences in demographics, complications, outcomes, and hospital covariates.

Results: A total of 2531 TEVAR cases were completed during the study period, of which 73.8% were completed by vascular surgeons, 15.8%

Table I. Patient characteristics for those who underwent thoracic endovascular aneurysm repair (TEVAR) by specialty

Variable	*Interventional radiologist*	*Interventional cardiologist*[a]	*General surgeon*[a]	*Cardiothoracic surgeon*	*Vascular surgeon*
Demographics					
Total cases, No. (%)	203 (8.0)	40 (1.6)	20 (0.8)	400 (15.8)	1868 (73.8)
Age, years	62.4 ± 20.2	49.8 ± 23.4	38.8 ± 11.7[b]	66.3 ± 14.1	66.4 ± 15.7[b]
Female gender, %	39.6	49.6	25.7	37.5	42.5
Elective, %	77.8[b]	26.5	0.0[b]	47.2[c]	53.8
DRG mortality risk	3.5 ± 0.9	1.5 ± 0.5	+	3.4 ± 1.1	3.6 ± 1.0[d]
DRG severity of illness	2.4 ± 0.9	3.1 ± 1.1	+	2.6 ± 0.9	2.6 ± 1.0
Complications, %					
leeding	5.4	+	+	9.1	7.8
Stroke	7.6[b]	+	+	0.0[d]	1.1[d]
Cardiac	7.2[d]	+	+	6.1	3.6[c]
Respiratory	4.8[c]	+	+	1.2	1.9
Vascular	7.5[b]	+	+	2.4	2.6
SSI	2.8[c]	+	+	0.0	0.8
Other	0.0	+	+	0.0	0.2
Outcomes					
Length of stay, days	10.7 ± 14.1	15.1 ± 14.4	27.7 ± 16.0[b]	9.3 ± 10.3	10.1 ± 13.2
Costs	$52,156	$72,447	$52,742	$45,120	$46,450
Mortality, %	2.6	+	+	8.6[c]	5.5
Hospital covariates, %					
Urban location	100	100	100	100	96.3[c]
Teaching hospital	59.7[b]	100	100	87.5	84.3

DRG, Diagnosis-related group; *SSI*, surgical site infection.
[a]Insufficient sample size; data do not accurately represent population-level estimates.
[b]$P < .001$.
[c]$P < .01$.
[d]$P < .05$.

by cardiothoracic surgeons, 8.0% by interventional radiologists, and the remainder by interventional cardiologists and general surgeons (Table I). Interventional cardiologists and general surgeons had too low of a sample size for valid statistical analysis. Interventional radiologists had significantly more elective cases (77.8%; $P < .001$) than cardiothoracic surgeons (47.2%) or vascular surgeons (53.8%), but had a significantly higher rate of stroke (7.6% vs 1.1%; $P < .001$), cardiac events (7.2% vs 3.6%; $P < .001$), respiratory complications (4.8% vs 1.9%; $P < .001$), vascular complications (7.5% vs 2.6%; $P < .01$), and surgical site infection (2.8% vs 0.8%; $P < .01$). Despite these complications, length of stay (10.7 days) and median costs ($52,156) were similar across the three specialties. Cardiothoracic surgeons completing TEVAR have the highest mortality rate (8.6% vs 2.6%; $P < .01$). Vascular surgeons have a low stroke rate (1.1%; $P < .05$ vs interventional radiologists) and lower rate of cardiac events (3.6% vs 6.1%; $P < .01$) despite caring for patients with higher Diagnosis-Related Group mortality scores (3.6 vs 3.4; $P < .05$).

Conclusions: Physician specialty affects patient outcome after TEVAR. Vascular surgeons have the lowest overall morbidity after TEVAR compared with the other specialties and lower mortality compared with cardiothoracic surgeons. These findings may affect patient referral patterns and hospital privileges for providers.

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Predictive Ability of the Society for Vascular Surgery Lower Extremity Guidelines Committee Wound, Ischemia, and foot Infection (WIfI) Scale

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Objectives: The Society for Vascular Surgery (SVS) Lower Extremity Guidelines Committee has composed a new threatened lower extremity classification system that reflects the three major factors that affect amputation risk and clinical management: Wound, Ischemia, and foot Infection (WIfI). Our goal was to evaluate the predictive ability of this scale after any infrapopliteal endovascular intervention for critical limb ischemia (CLI).

Methods: From 2004 to 2014, 673 patients underwent an infrapopliteal endovascular intervention for tissue loss (77%), rest pain (13%), stenosis of a previously treated vessel (5%), acute limb ischemia (3%), or claudication (2%). Patients without an initial grade in all WIfI categories were excluded. Patients were stratified both into clinical stages 1 to 4 based on the SVS WIfI classification for 1-year amputation and revascularization risk as well as a novel composite score from 0 to 9. Outcomes included the SVS objective performance goals (major amputation, amputation-free survival, and wound healing) as well as mortality and RAS events (revascularization, major amputation, or stenosis [>3.5× step-up by duplex]). Analyses were performed using multivariable logistic regression, Cox regression models, and Kaplan-Meier survival estimates.

Results: Of the 596 CLI patients, 551 were classified in all three WIfI domains on a scale of 0 (least severe) to 3 (most severe). Of these 551 patients, 84% were treated for tissue loss and 16% for rest pain. A Cox regression model illustrated that an increase of 1 clinical stage increases the rate of major amputation (hazard ratio [HR], 1.4; 95% confidence interval [CI], 1.0-2.0). A separate regression model showed that a 1-unit increase in the composite WIfI scale is associated with an increase in the rate of RAS events (HR, 1.2; 95% CI, 1.1-1.3) and a decrease in wound healing (HR, 1.2; 95% CI, 1.0-1.3).

Conclusions: This study suggests that the SVS WIfI classification system can predict 1-year amputation, RAS events, and wound healing after any endovascular infrapopliteal intervention for CLI (Fig).

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Revascularization Risk Following an infrapopliteal Endovascular Intervention
Revascularization (n=117)

	Ischemia-0				Ischemia-1				Ischemia-2				Ischemia-3			
W-0	-	-	-	-	-	-	-	-	1%	-	-	-	11%	2%	-	-
W-1	-	-	-	-	1%	0%	1%	-	1%	4%	2%	0%	11%	7%	3%	0%
W-2	-	-	-	-	4%	3%	3%	-	6%	7%	5%	-	10%	4%	3%	1%
W-3	-	-	-	-	1%	1%	0%	-	1%	2%	2%	0%	1%	0%	2%	-
	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3
Clinical Stage 1*																
Clinical Stage 2*																
Clinical Stage 3*																
Clinical Stage 4*																

1-Year Amputation Risk Following an infrapopliteal Endovascular Intervention
1-Year Amputation (n=77)

	Ischemia-0				Ischemia-1				Ischemia-2				Ischemia-3			
W-0	-	-	-	-	-	-	-	-	1%	-	-	-	4%	2%	-	-
W-1	-	-	-	-	1%	0%	0%	-	2%	2%	0%	0%	7%	7%	3%	0%
W-2	-	-	-	-	2%	4%	1%	-	8%	10%	4%	-	0%	2%	17%	8%
W-3	-	-	-	-	0%	0%	3%	-	2%	0%	2%	2%	2%	3%	2%	-
	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3
Clinical Stage 1*																
Clinical Stage 2*																
Clinical Stage 3*																
Clinical Stage 4*																

W-Wound FI- Foot Infection
*Based on SVS WFI Classification System

Fig. Relative rate of 1-year amputation and revascularization risk based on clinical stage as per the SVS Wound, Ischemia, and foot Infection (WIfI) classification system.