previously reported and that conventional risk factors for skin injury are poorly understood.

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Custom Fenestration Templates for Endovascular Repair of Juxtarenal Aortic Aneurysms

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Objective: Physician-modified endovascular grafts, with fenestrations added to accommodate major branch vessels, provide a means for endovascular treatment of abdominal aortic aneurysms (AAAs) that are adjacent to the renal arteries. Manual measurements of vessel origin locations from computed tomography (CT) images, however, take time and can lead to errors in the positions of the fenestrations. This is especially true for angulated aortic neck anatomy. To make the fenestration process faster and more accurate, we have developed a procedure to create custom templates that serve as patient-specific guides for graft fenestration.

Methods: We use custom proprietary software to outline the aorta in a patient's CT image data set and create a three-dimensional (3D) computer model of the lumen and the branch vessel origins (Fig, *A*). A clear rigid sleeve is then produced with a 3D printer that includes holes at the locations of the branch vessels (Fig, *B*). The sleeve is sterilized and slipped over the graft at the time of the operative procedure, and it can be rotated to avoid positioning the holes over stent struts (Fig, *C*). The locations of the openings are marked with a sterile pen, and the fenestrations are created after the sleeve is removed. Our template-based fenestration procedure was validated using an aorta phantom in which we deployed a fenestrated graft. The phantom was created by embedding a commercially available flexible AAA model in an agar block. The aorta phantom was scanned by CT, and a template was designed and printed to match the four branch vessels included in the phantom. Fenestrations were created in a standard graft using the custom template, and the alignment of the fenestrations with the branch vessels was evaluated by fluoroscopy.

Results: Continuous fluoroscopy of the aorta phantom showed proper alignment of the graft fenestrations with the 4 branch vessel origins after deployment of the modified graft. The 3D printing method has also been demonstrated by creating templates from clinical CT images of three patients with juxtarenal AAAs.

Conclusions: Custom fenestration templates provide for fast and accurate placement of all fenestrations, without the need for manual measurements. Graft fenestration using custom templates will likely save procedural costs and make minimally invasive aneurysm repair available to more patients with challenging anatomy.

Fig. Three-dimensional-printed template for graft fenestration.

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Risk Factors and Outcomes of Postoperative Ischemic Colitis in Contemporary Open and Endovascular Abdominal Aortic Aneurysm Repair

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Objectives: Postoperative ischemic colitis (IC) can be a serious complication after infrarenal abdominal aortic aneurysm (AAA) repair. We sought to identify risk factors and outcomes in patients developing IC after open and endovascular AAA repair (EVAR).

Methods: The NSQIP database was used to examine clinical data of patients undergoing AAA repair from 2011 to 2012 who developed postoperative IC. Multivariate regression analysis was performed to identify risk factors and outcomes.

Results: We evaluated a cohort of 3486 patients who underwent AAA repair (11.6% open repair and 88.4% EVAR). The incidence of postoperative IC was 2.2% (5.2% for open repair and 1.8% for EVAR). Surgical treatment was needed in 49.3% of patients. The mortality of patients with IC was higher than patients without IC (adjusted odds ratio (AOR), 4.78; $P < .01$). Also, the need for surgical treatment (AOR, 6.20) and age (AOR, 1.07) were mortality predictors of IC patients. Predictive factors of IC included ($P < .05$) female gender (AOR, 2.27), chronic renal failure (AOR, 5.75), need for intraoperative/postoperative transfusion (AOR, 5.50), and rupture of the aneurysm before surgery (AOR, 5.38). Open AAA repair was not an independent risk factor of IC (AOR, 1.40, $P = .39$), and the higher IC rate in open AAA repair compared with EVAR was related to the higher need for transfusion in open AAA repair (AOR, 10.67). Also, in open AAA repair, suprarenal clamping of the aorta (AOR, 2.76) was a predictor of IC. Subanalysis of the data in both groups is reported in Tables I and II.

Conclusions: Although the frequency of IC in open AAA repair was nearly three times greater than in EVAR, open surgery is not an independent predictor of IC. Rupture of the aneurysm before surgery, suprarenal clamping of the aorta, need for transfusion, and chronic renal failure are postoperative IC predictors. AAA patients who develop IC have a nearly fivefold higher mortality compared with those without IC. Surgical treatment is needed in nearly 50% of IC patients and is a mortality predictor.

Table I. Preoperative/intraoperative variables associated with ischemic colitis in open abdominal aortic aneurysm repair

Risk factors	*AOR*	*95% CI*	P
Female gender vs male gender	3.07	1.15-8.18	.025
Suprarenal clamping vs infrarenal clamping	2.67	1.02-7.02	.046
Ruptured aneurysm vs nonruptured aneurysm	3.96	1.43-10.97	.08
Operation time	1.001	0.9-1.00	.64
Chronic renal failure vs no comorbidity	5.49	0.48-62.66	.17
Age	0.99	0.99-1.005	.79
Need for intra/postoperative transfusion	2.06	0.44-9.58	.35

AOR, Adjusted odds ratio; *CI,* confidence interval.

Table II. Preoperative/Intraoperative variables associated with ischemic colitis in endovascular aneurysm repair

Risk factors	*AOR*	*95% CI*	P
Ruptured aneurysm vs non-ruptured aneurysm	7.61	2.44-23.66	<.001
Need for intra/postoperative transfusion	6.91	1.76-27.09	.006
Female gender vs male gender	1.56	0.50-4.86	.43
Operation time	1.001	0.99-1.006	.85
Chronic renal failure vs no comorbidity	5.14	0.84-31.28	.07
Age	1.01	0.95-1.06	.73

AOR, Adjusted odds ratio; *CI,* confidence interval.

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The Use of Micro-Oxygen Sensors (MOXYs) to Determine Dynamic Relative Oxygen Indices in the Foot of Patients with Critical Limb Ischemia (CLI) During an Endovascular Therapy: The First-in-Man 'Si Se Puede' Study

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Objective: Critical limb ischemia (CLI) patients exhibit uneven patterns of perfusion in the foot, which makes it challenging to determine adequate topographic needs by angiography alone. This study assessed the feasibility of reporting dynamic relative oxygen indices from multiple locations on the foot during endovascular therapy, using a novel micro-oxygen sensor (MOXYs) approach.

Methods: A prospective, 28-day, single-arm, observational study was performed on 10 patients who underwent endovascular therapy for CLI. At least 24 hours before therapy, four MOXYs were injected in each patient, one in the arm and three in the treated foot. The optical signal from the MOXYs corresponds to relative oxygen concentration. A custom detector on the surface of the skin was used to continuously and noninvasively