Table. Operative variables by aneurysm and treatment type

Aneurysm type	*Treatment*	*No.*	*OR time (min)*	*Fluoro time (min)*	*Contrast (mL)*	*EBL (mL)*	*No. of components*
Bi-iliac involvement (n = 10)	Bilateral hypogastric branches	2	243	68	191	600	8.0
	Unilateral hypogastric branch (+ control embolization)	8	265	76	137	346	5.9
Uni-iliac involvement (n = 6)	Unilateral hypogastric branch	6	248	56	138	275	5.2
Total (mean)		16	262	70	148	380	6.1

Early Experience with the Snorkel Technique for Juxtarenal Aneurysms: The Preferred Off-the-Shelf Solution for Challenging EVAR Anatomy?

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Objective: The lack of readily available branched and fenestrated endovascular aneurysm repair (EVAR) options for most centers has created an opportunity for creative deployment of endograft components to treat juxtarenal aneurysms. We sought to examine our early experience with "snorkel" or "chimney" techniques in the endovascular management of complex aortic aneurysms.

Methods: Retrospective review of a single-center series of planned snorkel utilization for juxtarenal aneurysms was used for this study. Standardized technique included axillary or brachial cut down for delivery of covered snorkel stents and percutaneous femoral access for the main body endograft.

Results: Forty-two snorkel grafts were placed in 23 consecutive patients (mean age 75 years old) with prohibitive operative risk treated over the past 2 years. Aneurysm morphology and perioperative outcomes are listed in the Table. The snorkel configuration extended the proximal seal zone from an unsuitable infrarenal neck (mean diameter 33 mm, mean length 0.9 mm) to a favorable neck (25-mm diameter, 18-mm length). To achieve this result, 13 patients had bilateral renal snorkels, 6 patients had unilateral renal snorkels, 3 patients had celiac/superior mesenteric artery (SMA)/renal combinations, and 1 patient had a single SMA snorkel with 95% technical success. Thirty-day mortality was 4.3%, occurring in 1 patient readmitted with pneumonia and ultimately died of sepsis. Other major complications included two perinephric hematomas from wire manipulation (8.7%) and one axillary nerve injury (4.3%). Mean follow-up was 13 months (range, 1-24 months). Follow-up imaging revealed one renal snorkel graft occlusion (97.6% primary patency) at 6 months in an asymptomatic patient without change in renal function. Four (17.4%) early endoleaks were noted (two type I, one type II, one type III) leading to two secondary interventions (8.7%), including proximal balloon molding (type I) and extender cuff placement (type III). One patient with a small type I endoleak at 1-month computed tomography (CT) resolved at the 6-month scan. Mean sac diameter for the group decreased from 65.0 mm to 63.0 mm, and no aneurysm enlarged in follow-up.

Conclusions: Early success with the snorkel technique for juxtarenal aneurysms has rapidly made it our procedure of choice for complex EVAR. Although long-term follow-up is needed, the flexibility of the snorkel technique and lack of requirement for custom-built devices may make this approach more attractive than branched or fenestrated stent grafts.

Table. Aneurysm morphology and results of snorkel technique

	Mean	*SD*
Preoperative AAA diameter (mm)	67.0	10.5
Infrarenal neck diameter (mm)	32.8	8.1
Infrarenal neck length (mm)	0.95	1.7
Planned landing zone neck diameter (mm)	24.8	4.4
Additional seal length gained by snorkel (mm)	18.1	5.8
Operative time (minutes)	242.6	103.9
Contrast dose (mL)	188.6	84.0
Fluoroscopy time (minutes)	73.7	40.2
Estimated blood loss (mL)	386.8	207.4
Pre and postoperative creatinine (mg/dL)	1.2/1.3	0.3/0.8
ICU stay/total length of stay (days)	1.5/4.6	1.6/2.2

AAA, Abdominal aortic aneurysm; ICU, intensive care unit.

Patient Outcomes and Thoracic Aortic Volume and Morphologic Changes following TEVAR in Patients with Complicated Type B Aortic Dissection

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Objective: True and false lumen changes and patient outcomes after thoracic endovascular aortic repair (TEVAR for patients with stable type B dissection have been described by the Investigation of Stent Grafts in Aortic Dissection (INSTEAD) trial. However, these changes have not been described in patients who received TEVAR treated for complications of chronic dissection.

Methods: A total of 73 patients with complicated type B dissection were treated from 2002 to 2010. Indications included aneurysmal enlargement (n = 62), failure of medical management (n = 7), and perforation with hematoma (n = 4). Spiral computed tomography (CT) reconstructions using M2S were analyzed for sequential changes in aortic volume and diameter during patient follow-up.

Results: TEVAR was successfully performed in 72 of the 73 patients (99%). The 30-day procedure-related mortality rate was 14%; causes included retrograde dissection with tamponade (n = 4), cardiac-related (n = 4), and rupture (n = 2). In the mean patient follow-up of 18 months, 11 of the 72 patients (15%) required a secondary procedure for endoleak (n = 7) and persistent distal perfusion (n = 4). Expansion of the true lumen was noted during the follow-up period: 38%, 46%, 71%, and 114% at 1-month, 3-months, 6-months, and 12-months, respectively, with concomitant regression of the false lumen of -65%, -68%, -84%, and -84% at the same intervals, respectively. Patients with an initial extension of the thoracic dissection into the infrarenal aorta (n = 46) had an increase in aortic diameter and volume to 21% and 17% at 1-year, respectively. In contrast, in patients without infrarenal dissection (n = 13), the infrarenal aortic diameter and volume remained unchanged at 3% and -0.9%, respectively, at 1-year postsurgery.

Conclusions: TEVAR is an appropriate treatment strategy for patients with complicated chronic type B dissection. During follow-up, there is a predictable expansion of the true lumen and regression of the false lumen. These findings correlate with those of the INSTEAD trial, which demonstrated false lumen regression and true lumen expansion in a cohort of patients with stable type B dissection. Patients with extension of thoracic dissection into the infrarenal aorta demonstrate continued aortic dilation and occasionally a need for secondary intervention for persistent distal perfusion. Further device development and potential use of bare metal stents are options to treat infrarenal aortic expansion.

A Morphologic Study of Chronic Type B Aortic Dissections and Aneurysms after Thoracic Endovascular Stent Grafting

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Objective: The long-term results of treating chronic aortic dissections and dissecting aneurysms with thoracic endovascular aortic repair (TEVAR) are unknown, and the timing for intervention uncertain. We aim to evaluate the morphology of stent graft and aorta remodeling, and the volumetric changes in these patients after successful TEVAR.

Methods: Serial computed tomography (CT) scans of 32 patients who had TEVAR for uncomplicated chronic dissections (group A, n = 17) and dissecting aneurysms (group B, n = 15) were analyzed at 1, 6, 12, and 36 months. Stent graft diameter changes and positional migration were assessed 3-dimensionally using Mimics 14.0 (Materialize, Leuven, Belgium). Volumetric data for true lumen, false lumen, thrombus load, and aortic size were measured by Aquarius Nutrition 4.4 (TeraRecon, San Mateo, Calif). Results were compared between the two groups and with stent graft diameter, length, and oversizing.

Results: Aortic stent graft remodeled progressively with inlet area increased 4.4%, 10.1%, and 14.2% and outlet area increased 42.6%, 67.2%,

and 72.3% at 6, 12, and 36 months. True lumen volume increased progressively in both group A (114 mL to 174 mL), and group B (124 mL to 190 mL) from baseline to 36 months. False lumen volume decreased in group A (150 mL to 88 mL) and group B (351 mL to 250 mL), respectively; while total thrombus load in the false lumen increased from 73% to 80% for group A and 84% to 87% in group B in 3 years. Eight patients (4 in each group) showed an increase in total aortic volume of >10%. Twelve patients showed a static volume and 12 patients showed a shrinkage. Aortic volume change had no relationship to pathology, stent graft sizing, and thrombus load, but was positively associated with the placement of a longer graft. There was a small but progressive distal migration of stent grafts in all patients (3.1, 4.5, and 4.6 mm at 6, 12, and 36 months), more prominent in shorter stent grafts (<160 mm). No mortality, rupture, or secondary interventions occurred during follow-up.

Conclusions: Aortic remodeling after TEVAR in chronic dissection is a continuous process. There were no significant differences between chronic dissections and aneurysms in all volumetric parameters. Treating chronic dissections early before aneurysm formation did not seem to have a morphologic advantage.

Readmissions after Abdominal Aortic Aneurysm Repair: Differences between Open Repair and Endovascular Aneurysm Repair

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Objective: Reintervention rates are higher for endovascular aneurysm repair (EVAR) compared with open repair (OR) due to endoleak treatments, while surgical reoperations for bowel obstruction and abdominal hernias are higher after OR. However, readmission rates for nonoperative conditions after aneurysm repair are not well documented. We sought to determine reasons for statewide nonoperative readmissions within the first year after open abdominal aortic aneurysm (AAA) repair and EVAR.

Methods: Patients who underwent an elective AAA repair in California over a 4-year period were identified from the Office of Statewide Health Planning and Development (OSHPD) administrative database. All patients who had a readmission within 1 year were included for evaluation. Readmission rates as well as diagnoses associated with each readmission were analyzed and recorded.

Results: From 2005 to 2008, there were 22,972 operations for elective aneurysm repair, 13,454 EVAR (59%), and 9,518 OR (41%). Postoperatively, there was a 30% readmission rate following OR and a 28% readmission rate after EVAR ($P = .02$). The most common principle diagnoses associated with readmission after either type of AAA repair were infection (14.5%), cardiac problems (13.7%), and failure to thrive (12.7%). Patients who underwent OR were more likely to be readmitted with diagnoses associated with failure to thrive ($P < .0001$), gastrointestinal complications ($P < .0001$), wound infection ($P = .04$), and small bowel obstruction (SBO; $P < .0001$). Those who underwent EVAR were more likely to be readmitted with diagnoses of cardiac conditions ($P < .0001$), device-related complications ($P < .0001$), cardiovascular accident (CVA) ($P = .011$), and renal complications ($P < .0001$).

Conclusion: Nonoperative readmission rates within 1 year of elective AAA repair are greater after OR compared with EVAR. Reasons for readmission vary significantly between the two cohorts. Systems-based analysis of these causes of readmission can potentially improve patient expectations and care after elective aneurysm repair.

Characterization of Thoracic Aortic Arch Anatomy in the Asian Elderly Population

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Objective: Endovascular repair of the aortic arch is often unsatisfactory due to poor stent-vessel conformity and inadequate landing zones. This study aims to characterize the structural dimensions of aortic arch so as to facilitate the development of arch-specific endovascular devices.

Methods: Three-dimensional (3D) models were reconstructed in Mimics (an image segmentation software) from computed tomography (CT) aortograms of 120 Asian elderly patients using manual segmentation. Centerlines of each 3D aortic model were calculated using a repulsive forcefield method. After which, measurements of the aorta and supra-aortic branches were obtained and analyzed in Patran (a Finite Element software). A statistical aortic arch-shape model was built using Principal Component Analysis (PCA).

Results: Average diameters of the ascending, descending aorta, origin of the innominate, left common carotid artery, and left subclavian artery were 39.4 ± 6.7 mm, 34.5 ± 7.9 mm, 18.0 ± 3.8 mm, 12.6 ± 2.7 mm, and 14.1 ± 2.5 mm, respectively. Length of the ascending aorta, innominate to left common carotid artery, and left common carotid to the left subclavian artery were 62.6 ± 11.4 mm, 12.0 ± 5.6 mm, and 18.7 ± 5.6 mm along the centerline. Type II and type III arches were more prevalent than type I. Mean angle of curvature was 103.8 ± 25 degrees. PCA of the 3D centerlines derived three main modes of variation which could account for 61% of the overall shape range.

Conclusions: Aortic arch anatomic information from the Asian elderly population can be used as reference for the development of future endovascular devices.

Inferior Vena Cava Resection and Reconstruction for Retroperitoneal Tumor Excision

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Objective: The purpose of this study was to review the results of resection and reconstruction of the inferior vena cava (IVC) for en bloc malignant tumor excision.

Methods: We conducted a retrospective review of all patients having IVC resection for en bloc malignant tumor excision. IVC resection was categorized as suprarenal, perirenal, infrarenal, or extensive (>1 segment resected). Repairs were divided into primary, patch, or circumferential. Tumor type, perioperative morbidity, mortality, clinical graft patency, and survival (social security death index) were recorded.

Results: Between 1992 and 2010, 48 patients (24 female) had IVC resection for tumor en bloc excision. Sarcomas were most common (33; 69%: 5 [10%] primary IVC). Thirteen patients had primary IVC repair, nine patch repairs (one autogenous), and 26 had circumferential replacement with polytetrafluoroethylene (PTFE) ringed graft (12-16 mm). Extensive IVC reconstructions were performed in 17 cases of which seven involved the entire IVC with renal vein (RV) and hepatic vein reimplantation, six were suprarenal and perirenal (seven RV reimplanted), and four were infrarenal and perirenal (four RV reimplanted). All single segment (9) repairs were infrarenal. Overall morbidity was 6% (one bowel obstruction requiring surgery, one chyle leak resolved with medical therapy, and one renal failure with complete recovery [L RV reimplant, R nephrectomy]). There was no difference in morbidity between primary, patch, circumferential, and extensive reconstruction. There was no mortality. One IVC graft thrombosis was documented on follow-up (after chemotherapy/sepsis). There were two graft stenosis associated with tumor recurrence. Lower extremity edema was universally avoided. Mean long-term survival was 3.34 years (4 months to 11 years) with a significant difference between primary or patch (mean 66.7 months) and circumferential or extensive repair (mean 39.7 months; $P < .005$). There was no survival difference between single segment and extensive IVC repair (36.7 vs 42.8 months; $P > .12$).

Conclusions: IVC resection and reconstruction for en bloc tumor excision is safe even when extensive repairs are necessary. Replacement of the IVC with a prosthetic graft avoids extremity venous complications and likely contributes to quality of survival. Survival is dependent on tumor behavior and degree of IVC involvement where primary and patch repair has a better prognosis than circumferential resection.

Under-Utilization of Transfer for Ruptured Abdominal Aortic Aneurysm (rAAA) in the Western United States

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Objective: The utility of transferring patients with ruptured abdominal aortic aneurysms (rAAAs) remains controversial. Previous studies have examined rAAAs only after transfer has occurred. The goals of this study were to determine the incidence of transfer and identify factors associated with transfer compared with local care for patients presenting to emergency departments (EDs) with an rAAA.

Methods: Data for patients presenting with International Classification of Disease, 9th Revision, Clinical Modification (ICD-9-CM) codes for rAAA from 2006 to 2008 were extracted from the National Emergency Department Sample (NEDS), developed as part of the Healthcare Cost and Utilization Project (HCUP). The NEDS is the largest stratified weighted sample of US hospital-based ED visits with links to inpatient files. We compared those transferred to those admitted and treated. Sample weights were applied to produce nationally representative estimates. Patient and hospital factors associated with transfer were identified using multivariate logistic regression. These factors were then analyzed for a relationship with ED death.

Results: A total of 18,363 patients were evaluated for rAAA. Of these, 7% (1201) died in the ED, 8% (1511) were admitted and died without a procedure, 40% (7379) were admitted and died after repair, and 41% (7479) were admitted, treated, and survived. Transfers accounted for only 4% (793) of all ED visits for rAAA. Transfer was more likely for patients seen in nonmetropolitan hospitals (25.6%) vs metropolitan nonteaching (5.4%) or metropolitan teaching hospitals (0.4%; $P < .0.0001$), low volume EDs (24.7% vs 3.8%; $P = .0001$), and non-trauma centers (7.5% vs 0.2%; $P <$