Presentation Number: KC1

Publishing Title: Endovascular Aneurysm Repair and Follow-up: Foregoing the One-month CTA

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Abstract Body:
OBJECTIVES: Standard post-EVAR surveillance includes CTA at 1, 6, and 12 months. Early CTA exposes the patient to additional radiation and contrast shortly after the EVAR procedure. We hypothesize that routine use of CTA at 1 month does not affect patient outcome and is not justified.

METHODS: All consecutive patients undergoing EVAR over 6 years (2005-2010) at a tertiary academic center were analyzed for baseline patient and intervention characteristics and surveillance CTA results.

RESULTS: 657 patients underwent EVAR, of which 467 had a 1-month CTA. The median follow-up for these patients was 18.8 months. 354 (76%) of the CTA's had no EVAR-related abnormality. Endoleaks (93; type I-3, type II-89, type III-1) accounted for the majority of abnormal findings on the remaining CTA's. All of the type I and III, and 1 of the type II endoleaks were intervened upon based on their identification in asymptomatic patients at 1 month. Importantly, during the index procedure, these patients with type I/III leaks all had adjunctive procedures to assist in obtaining a seal, abnormal completion angiograms, or procedures outside of IFU. The patient with a type II leak had an extremely large AAA. Of patients with type II endoleaks at 1 month without intervention: the median sac growth in the ensuing 5 months was 0 mm; 25% resolved by 6 months, 11% were intervened upon between 6-12 months based on sac enlargement compared to the preprocedural CTA, and the remainder were followed. None resulted in aneurysm rupture or other adverse events during the follow-up period.

CONCLUSIONS: Abnormal findings during the 1 month CTA are uncommon and if present rarely require intervention. Those that require intervention can be predicted during the index procedure. Abnormalities not requiring intervention typically resolved within 6 months or usually remain benign. Based upon these findings we conclude that the 1 month CTA is unnecessary except under particular circumstances which are clear at the index procedure.

Presentation Number: KC2

Publishing Title: Endovascular aneurysm repair in nonagenarians improves survival

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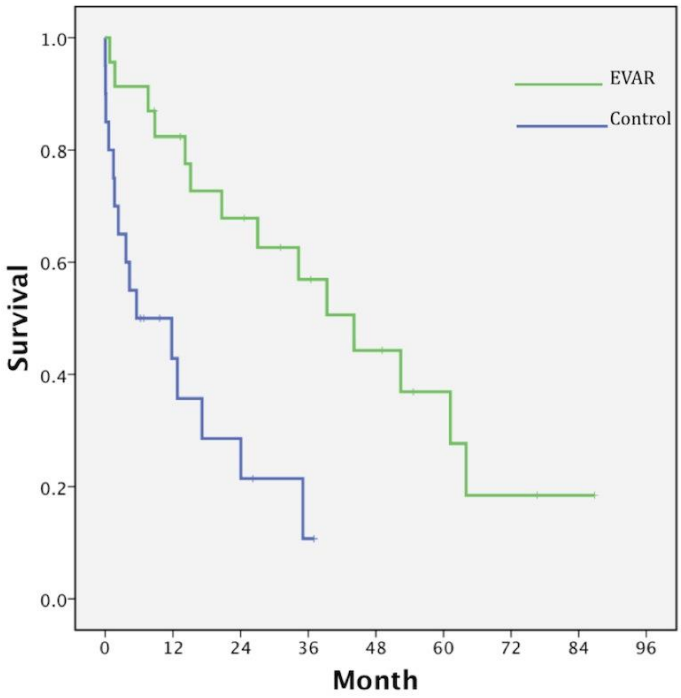
Abstract Body:

OBJECTIVES: Due to increasing life expectancy, the number of nonagenarians meeting size criteria for elective repair of infrarenal abdominal aortic aneurysm (AAA) continues to increase. This study reports the outcomes of endovascular aortic aneurysm repair (EVAR) in nonagenarians.

METHODS: A retrospective review was undertaken of all nonagenarians who underwent EVAR from January 2001 to June 2012. Patient demographics, hospital course and follow up visits were analyzed. This group was compared with nonagenarians with > 5 cm AAA who did not undergo EVAR (control group). Survival rates and outcomes were determined using the Kaplan-Meier method with Logrank test.

RESULTS: Of 1085 consecutive patients who underwent EVAR during this period, 23 were nonagenarians. Seventy-four percent were male. Mean age of individuals undergoing EVAR was 91.95 ± 2.4 years. The control group consisted of 20 nonagenarians managed using non-surgical means. Median follow-up was 31 months (range, 1- 87). The 30- day mortality rate was 9% after EVAR. Median hospital length of stay after EVAR was 3 days (range, 1-14 days). Median survival in the EVAR group was 44 months (interquartile range [IQR], 15-64 months) versus 9 months in the control group (IQR range, 1-24 months) (p <0.001) (Figure 1). Multivariate analysis found EVAR to be the only independent variable associated with increase in survival (hazard ratio: 0.2, confidence interval 0.1 - 0.7; p=0.003). In subgroup analysis, male patients who did not have chronic renal failure had the longest overall survival following EVAR.

CONCLUSIONS: EVAR in nonagenarians has acceptable perioperative mortality and improves overall survival compared with non-surgical therapy.



Presentation Number: KC3

Publishing Title: Patients With Dependent Functional Status Have Significantly Improved Outcome After Endovascular Aortic Aneurysm Repair Compared To Open Surgery

Author Block: **Muhammad Asad Khan, MD**, Rao Atul, MD, Shiferson Alexander, DO, Michael Shih, MD, QING HUA PU, MD, Suttatip Vechvitvarakul, MD, Robert Rhee, MD
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Abstract Body:

OBJECTIVE: The incidence of abdominal aortic aneurysm (AAA) has continued to rise over last 4 decades. With a growing aging patient population and increasing high comorbidities in this group of patients, risk assessment is increasingly important in achieving optimal clinical outcome. Dependent functional status has been demonstrated to lead to higher postoperative mortality in multiple studies of other surgical disease treatments; however the outcome in the AAA population is not well established. Our goal is to further delineate the impact of preoperative functional status on the 30 day outcome in patients undergoing AAA repair.

METHODS: Using the ACS-NSQIP (define) database, Patients who underwent elective infrarenal AAA repair from year 2005-2011 were identified utilizing CPT codes. Patients were grouped based on preoperative functional status: independent (IND) or dependent (DEP). Clinical risk factors and short term outcomes between groups were compared. Multiple logistic regression analysis was used to identify independent factors related to increase 30-day mortality.

RESULTS: A total of 19,441 patients underwent AAA repair (18754 [96.5%] IND and 687 [3.5%]) DEP). DEP patients were older (76.2 ± 8.8 vs 73.2 ± 8.6 years; p <0.001) and had higher comorbidities. DEP patients had significantly higher incidence of death (6.0% vs 1.5%) and major postoperative complications (32% vs 16.1%). More patients in DEP required second operation (9.5% vs 4.8%) and had longer total hospital stay (10 ± 13 vs 4.5 ± 6.8 days) [p<0.01 for all]. DEP was an independent predictor of increased mortality (OR 2.23; 95% CI: 1.54 - 3.22;p< 0.001). Both DEP and IND patients who underwent endovascular AAA repair (EVAR) had significantly lower postoperative complications compared to open AAA repair (OAAA). In addition, their total OR time, hospital length of stay and the 30-day mortality were reduced with EVAR compared to OAAA.

CONCLUSION: Preoperative dependent functional status is related to adverse 30-day outcome after AAA repair. Comparing to OAAA, EVAR is associated with lower incidence of postoperative complications, and shorter hospitalization in DEP patients. DEP patients with AAA disease should be preferentially considered for EVAR over OAAA.

Table: Perioperative outcome after EVAR and Open AAA repair in Dependent functional status patients

	EVAR N= 509	Open N = 178	P- value
SSI	10 (2.0%)	4 (2.2%)	0.764
Pneumonia	26 (5.1%)	25 (14%)	<0.001
Unplanned intubation	24 (4.7%)	18 (10.1%)	0.017
Failure to wean	28 (5.5%)	32 (18.0)	<0.001
Progressive renal failure	5 (1.0%)	4 (2.2%)	0.248
Acute renal failure	13 (2.6%)	9 (5.1%)	0.135
UTI	18 (3.5%)	18 (10.1%)	0.001
CVA/Stroke	8 (1.6%)	1 (0.6%)	0.459
Cardiac arrest	6 (1.2%)	5 (2.8%)	0.164
MI	11 (2.2%)	4 (2.2%)	1
Bleeding requiring transfusion	64 (12.6%)	30 (16.9%)	0.089
DVT	8 (1.6%)	3 (1.7%)	0.986
Septic shock	13 (2.6%)	19 (10.7%)	<0.001
Return to OR	41 (8.1%)	24 (13.5%)	0.038
Duration of anesthesia (min)	228 ± 146	315 ±315	<0.001
Total operation time (min)	185 ± 96	230 ± 91	<0.001
Length of total hospital stay (days)	81.6 ± 12.4	15.6 ± 14.7	<0.001
Major Morbidity	133 (26.1%)	87 (48.9%)	<0.001
Mortality	25 (4.9%)	16 (9.0%)	0.064

Presentation Number: KC4

Publishing Title: Loss of Proximal Fixation After EVAR: Durability Assessment of a Selected Algorithm for Endograft Salvage

Author Block: **Megan I. Carroll, MD**, Martin R. Back, MD, Ann C. Lopez, ARNP, Murray L. Shames, MD, Bruce R. Zweibel, MD, Brad L. Johnson, MD, Paul A. Armstrong, DO, Neil Moudgill, MD.
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Abstract Body:
OBJECTIVES: We sought to validate the use of a selected treatment algorithm for proximal fixation loss after EVAR with long term CT-based follow-up of endograft stability and AAA exclusion.
METHODS: A retrospective review was performed of 107 patients who underwent 117 secondary procedures for proximal fixation loss from 2001-2013. Fixation loss was defined as development of type 1A endoleak (n=28), reduction in proximal endograft fixation length to < 10mm (n=50), or both (n=39). A selected algorithm for endovascular management included proximal extension cuff for a primary device < 25mm below the renal arteries (RA) or aorto-uni-iliac (AUI) conversion for migration >25mm. Aortobi-iliac re-lining was performed for proximal fixation loss with inadequate distal fixation (<20mm) and suspected structural device failure. Proximal extensions with renal revascularization was performed when there was adequate pararenal aorta but required RA coverage. Open aortic neck plications were done for recalcitrant 1A leaks. CT-based follow-up was performed at 1, 6 and annual intervals.
RESULTS: Fixation loss occurred at an average of 55 $\pm$ 32mo following initial EVAR with a AAA size of 6.9 $\pm$ 1.7cm. Most cases were associated with disadvantaged infra-renal neck anatomy. Previous embolization of Type 2 leaks had occurred in 20 (35.9%) cases. Concurrent type 2 leaks were present in 44 (37.6%) cases with 22 (18.8%) of those having had a prior embolization, and 9 (7.7%) requiring additional embolization for sac growth post-secondary intervention. Secondary procedures included 65 proximal cuffs (42 single, 13 multiple cuffs), 22 AUI, 8 re-linings, 10 plications, and a single coil embolization. Eleven partial explants were necessary (9 after failed endovascular salvage at referring institutions). Intra-operative adjuncts included 31 distal iliac extensions and 14 renal stents (7 chimney endografts, 7 bare metal). Thirty-day mortality was 1.9% (n=2). Follow-up averaged 24 $\pm$ 23mo (range to 94 mo.) AAA sac regression (>5mm diameter) occurred after intervention in 41 cases, 44 with unchanged diameters, 21 experiencing growth (11 unknown). Ten (8.5%) tertiary procedures were done for recurrent fixation loss. Two late ruptures occurred due to other source endoleaks. Two device explants were performed for continued aortic sac expansion. No late AAA-related deaths occurred.
CONCLUSION: Successful salvage of proximal neck endograft fixation can be achieved using a selected treatment algorithm with mandatory CT-based ongoing surveillance.

Presentation Number: KC5

Publishing Title: Mid-term Cost Analysis of Endovascular versus Open Repair in the Treatment of Thoracic Aortic Aneurysms

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Abstract Body:

OBJECTIVE: For descending thoracic aortic aneurysms (TAAs), endovascular stents (TEVARs) reduce operative morbidity and mortality compared to open surgical repair. However, long-term differences in patient survival have not been demonstrated, and an increased need for aortic reintervention has been observed. This study investigated mid-term outcomes and hospital costs of TEVAR compared with open TAA repair.

METHODS: This was a retrospective, single institution review of elective thoracic aortic aneurysm repairs between 2005 and 2012. Patient demographics, operative outcomes, reintervention rates, and hospital costs were assessed. The literature was also reviewed to determine commonly observed complication and reintervention rates for TEVAR and open repair. Monte Carlo simulation was utilized to model and forecast hospital costs for TEVAR and open TAA repair at 30 days and 3 years.

RESULTS: Our cohort consisted of 131 TEVARs and 27 open repairs that were well matched demographically. Operative mortality for TEVAR and open repair was 5.3% and 3.7%, respectively (p=1.0). There was a trend towards more complications in the TEVAR group, although not statistically significant (all p>0.05, Table 1). Hospital costs were significantly greater in the TEVAR group ($52,008 vs $37,172, p=0.001). However, cost modeling utilizing reported complication and reintervention rates from the literature [Table 1] overlaid with our cost data produced a higher cost for the open group at 30 days ($55,119 vs $48,163) and at 3 years ($58,655 vs $52,638). Interestingly, TEVAR hospital costs, not reintervention rates, were the most significant driver of cost in the TEVAR group.

CONCLUSIONS: Our institution's data showed higher costs with TEVAR compared to open TAA repair due to the small number of complications within the open group. This relationship was reversed in our cost model, with higher costs in the open group at both 30 days and 3 years. These findings reinforce that single institution data can be deceptive compared to multi-institutional trends. Cost modeling is one method that may provide more accurate and generalizable information for comparisons between various intervention options.

Table 1. Postoperative Complications and Outcomes in TAA Repair

Outcome	Our TEVAR (n=131) % (n)	TEVAR from the literature mean % [range]	Our Open (n=27) % (n)	Open from the literature mean [range]
Stroke	5.3 (7)	3 [0-9.5]	0 (0)	5 [2.1-10.3]
Paralysis	2.3 (3)	2 [0-5]	0 (0)	4 [1.5-14]
Major bleed	2.3 (3)	0.01 [0-0.01]	0 (0)	3 [1.4-6.5]
Myocardial Infarction	3.0 (4)	2.1 [2-2.3]	3.7 (1)	5 [5.4-6.3]
Respiratory complication	14.5 (19)	10 [4.3-16]	11.1 (3)	23 [10.4-44]
30-day mortality	5.3 (7)	3 [0-8.1]	3.7 (1)	7 [2.3-20]
Reinterventions at 1 year	13.7 (18)	8 [4-20]	3.7 (1)	3 [0-7]
Reintervention at 3 years	17.6 (23)	11 [6.6-26]	11.1 (3)	5 [0-10]

Presentation Number: KC6

Publishing Title: **Adherence to Postoperative Surveillance Guidelines After Endovascular Aortic Aneurysm Repair Among Medicare Beneficiaries**

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Abstract Body:
OBJECTIVE: After endovascular aortic aneurysm repair (EVAR), the Society for Vascular Surgery recommends computed tomography (CT) scan within 30 days, followed by annual imaging. We sought to describe long-term adherence to surveillance guidelines among US Medicare beneficiaries, and determine patient and hospital factors associated with incomplete surveillance.
METHODS: We analyzed fee-for-service Medicare claims for patients receiving EVAR from 2002 to 2005, and then collected all relevant postoperative imaging through 2009. Additional data included patient comorbidities and demographics, yearly hospital AAA repair volume, and Medicaid eligibility. Allowing a grace period of three months, complete surveillance was defined as at least one CT or ultrasound every 15 months after EVAR. Incomplete surveillance was categorized as gaps for intervals >15 months between consecutive images, or lost to follow-up if >15 months elapsed after last imaging.
RESULTS: Our cohort comprised 9,503 patients. Median follow-up duration was 4.5 years. CT scan within 30 days of EVAR was performed in 3,090 (32.5%) patients. Median time to post-operative CT was 37 days (IQ range 25 - 94 days). Complete surveillance was observed in 51.0% of patients. For this group mean follow-up time was shorter than for those with incomplete surveillance (3.3 ± 2.1 vs. 5.1 ± 1.5 years, p<0.001). Among those with incomplete surveillance, follow-up became incomplete at 2.8 ± 1.3 years, with 53.0% lost to follow-up, 60.9% with gaps in follow-up (mean gap length 760 ± 325 days), and 13.9% with both. Patients with incomplete surveillance had fewer images in each postoperative year (Table 1), and fewer total images during follow-up (5.4 ± 3.6 vs. 6.8 ± 4.8, p<0.001). In a multivariable logistic regression, complete surveillance was less likely for patients with Medicaid eligibility (OR 0.79, 95% CI 0.68 - 0.92, p=0.002) and those treated in high volume hospitals (OR 0.89, 95% CI 0.80 - 0.99, p=0.039). **CONCLUSIONS:** Postoperative imaging after EVAR is highly variable and only a small proportion of patients meet current surveillance guidelines. Additional studies are necessary to determine if variability in postoperative surveillance impacts long-term outcomes.

Mean number of images per follow-up year by surveillance type

Years after EVAR	Complete Surveillance	Incomplete Surveillance	P value
0 - 1	2.54	2.07	<0.001
1 - 2	1.66	0.94	<0.001
2 - 3	1.62	0.81	<0.001
3 - 4	1.67	0.69	<0.001
4 - 5	1.28	0.59	<0.001
5 - 6	1.28	0.58	<0.001
6 - 7	1.15	0.47	<0.001
7 - 8	0.84	0.31	<0.001

Presentation Number: KC7

Publishing Title: **Aneurysm Sac Volume Measurements in Patients with and without Type 2 Endoleak Following Endovascular Abdominal Aortic Aneurysm Repair**

Author Block: **Young Erben, MD**, Manju Kalra, MBBS, Thomas C. Bower, MD, Gustavo Oderich, MD, Audra Duncan, MD, Mark Fleming, MD, Randall De Martino, MD, Peter Gloviczki, MD.
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Abstract Body:
OBJECTIVES: To assess the value of using aneurysm sac volume measurements during follow-up after endovascular aortic aneurysm repair (EVAR)

METHODS: Clinical data from 198 consecutive patients who underwent EVAR from January 2005 to December 2009 and had at least six month imaging follow-up were retrospectively reviewed. Pre- and post-operative maximal anteroposterior diameter (APD) as measured on axial computed tomography angiography (CTA) and aneurysm sac volume (ASV) as measured on centerline of flow CTA analysis were compared. APD and ASV measurements were correlated with absence or presence of endoleak and need for re-intervention

RESULTS: There were 176 male and 22 female patients (mean age: 76±7 years). Endografts employed included Gore Excluder (112), Cook Zenith (61), Medtronic AneuRx (20) and Endologix (5). Mean follow-up was 27±14months (range: 6-66 months). In the entire cohort both mean APD and ASV measured at last follow-up following EVAR had decreased significantly; APD from 58±9mm to 54±1mm ($p<0.001$) and ASV from 173±80cm^3 to 149±77cm^3 ($p<0.001$). Mean APD and ASV change were not significantly different among the 4 types of endografts; Excluder (4mm, 24 cm^3), Zenith (6mm, 30 cm^3), AneuRx (5mm, 11 cm^3) and Endologix (0.4mm, 10 cm^3). Among 121 patients without type 2 endoleak (T2E) there was good correlation in mean APD change (58 to 51 mm), ($p<0.001$) and ASV change (182 to 141cm^3), ($p<0.001$). In 77 patients with T2E overall APD (57 to 57mm) ($p=0.98$) and ASV (160 to 161cm^3) ($p=0.80$) remained stable. However, in this group, the APD and ASV increased in 42 patients by 6±5mm and 32±37 cm^3 respectively; and the APD and ASV decreased in 35 patients by 7±6mm and 31±42 cm^3 respectively. In 31 patients undergoing intervention for persistent T2E, the mean APD and ASV change were +3±9mm and +23±65cm^3

CONCLUSIONS: There is good correlation between APD and ASV measurements in follow up examination of patients undergoing EVAR. ASV measurements may be more sensitive to smaller magnitude changes in sac size and thus may be more useful in predicting the need for intervention in patients with T2E