

**CANADIAN SOCIETY FOR VASCULAR SURGERY
ABSTRACTS
Annual Meeting – September 13-14, 2019
Kelowna, BC, Canada**

Friday, September 13th, 2019

PAPER SESSION I: THE THORACIC AORTA

A Systematic Review and Meta-Analysis of Endovascular Juxtarenal Aortic Aneurysm Repair Demonstrates Lower Perioperative Mortality Compared to Open Repair

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Objective: The objective of this study was to compare outcomes of endovascular versus open repair for treatment of juxtarenal aortic aneurysms.

Methods: OVID Medline and Embase were searched for studies from January 2000-December 2018 that compared endovascular versus open repair of juxtarenal aortic aneurysms. Studies that included patients with pararenal and suprarenal aneurysms were also included. Endovascular interventions included were off instructions for use standard endovascular aneurysm repair (EVAR), parallel grafts, and fenestrated/branched EVAR. Primary outcomes were 30-day mortality, perio-operative reinterventions, acute renal failure, permanent dialysis, stroke, and spinal cord ischemia. Secondary outcomes were myocardial infarction, bowel and limb ischemia, length of stay, and long-term survival. Data were pooled and we performed a meta-analysis using random-effects models.

Results: There were 20 studies meeting inclusion criteria. Five studies contained duplicated data and therefore only 15 were included for analysis with 5121 patients (1506 endovascular, 3615 open). There were no randomized controlled trials. Endovascular repair patients were older (mean difference 3.42, 95% CI 2.54-4.3, $P<.00001$, $I^2=56\%$) more likely to be male (OR 1.33, 95% CI 1.02-1.73, $P=.04$, $I^2=33\%$), have diabetes (OR 1.24, 1.04-1.50, $P=.02$, $I^2=0\%$) coronary artery disease (OR 1.64, 95% CI 1.03-2.62, $P=.04$, $I^2=75\%$), and chronic kidney disease (OR 1.52, 95% CI 1.07-2.15, $P=.02$, $I^2=50\%$). Pooled analysis found endovascular repair to be associated with significantly decreased 30-day mortality (odds ratio [OR] 0.50, 95% confidence interval [CI] 0.34-0.74, $P=.0006$, $I^2=0\%$). This remained significant when including only fenestrated EVAR (OR 0.55, 95% CI 0.36-0.85, $P=.007$, $I^2=0\%$). Endovascular repair also had significantly decreased acute renal failure (OR 0.50, 95% CI 0.28-0.89, $P=.02$, $I^2=67\%$), increased spinal cord ischemia (OR 3.14, 95% CI 1.08-9.09, $P=.03$, $I^2=0\%$), decreased bowel ischemia (OR 0.50, 95% CI 0.24-1.05, $P=.07$, $I^2=7\%$) and length of stay mean difference (-5.99 days, 95% CI -7.42 - -4.57, $P<.00001$, $I^2=78\%$). There were no significant differences in other outcomes including permanent dialysis and stroke. Eight of nine studies that reported long-term survival (1-7 year follow-up) found no significant difference between groups (data not pooled). Only one study was noted to have improved long-term survival in the open repair group.

Conclusion: Pooling data from 15 studies, we found endovascular repair to be associated with lower 30-day mortality, acute renal failure, bowel ischemia, and length of stay, but increased spinal cord ischemia. These data are limited by risk of bias of the included studies. Further long-term studies are needed to determine if these differences persist during long-term follow-up.

Early and Late Population-based Thoracoabdominal Aortic Aneurysm Outcomes Following Endovascular and Open Repair

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Objective: To evaluate in-hospital and long-term outcome of endovascular and open thoracoabdominal aortic aneurysm (TAAA) repair in Ontario.

Methods: Population-based study in Ontario, from 2006 – 2017, using a validated algorithm to accurately identify patients receiving endovascular or open TAAA. Primary endpoint was mortality. Secondary endpoints were a composite of mortality, permanent spinal cord injury, permanent dialysis, and stroke (TALE); the individual endpoints of the composite; disposition at discharge; hospital length of stay; myocardial infarction; and secondary procedures in the thoracoabdominal aorta or its branches following discharge.

Results: 664 adults underwent surgical repair of a TAAA by Endovascular (n=303 (45.5%)) vs. Open (n=361 (54.5%)) approach. Propensity score matching resulted in 241 patient pairs with mean age of 70.1 ± 9.6 vs 69.4 ± 10.0 years for endovascular vs open repair, respectively (standardized mean difference: 0.07). Endovascular repair frequency increased during the study period and in the last 5 years comprised over 50% of repairs. In the matched sample, open repair was associated with a higher incidence of in-hospital death (17.4% vs 10.8%, p=0.04), TALE (26.1% vs 17.4%, p=0.02), discharge to re-habilitation facilities (18.7% vs 10.0%, p=0.02), and longer median length of stay (12 [7-21] vs 6 [3-13] days, p<0.01) (**Table 1**). Long-term mortality was not significantly different (HR 1.07 95% CI 0.77-1.48) (**Figure 1**), nor were the other secondary endpoints, with the exception of secondary procedures in the thoracoabdominal aorta or its branches, which was higher in the endovascular group (HR 2.64 95% CI 1.54-4.55). Among those undergoing endovascular vs open repair, 5-year survival was 54.4% vs. 63.2% and 10-year survival was 30.7% vs. 34.9%, respectively (p=0.62).

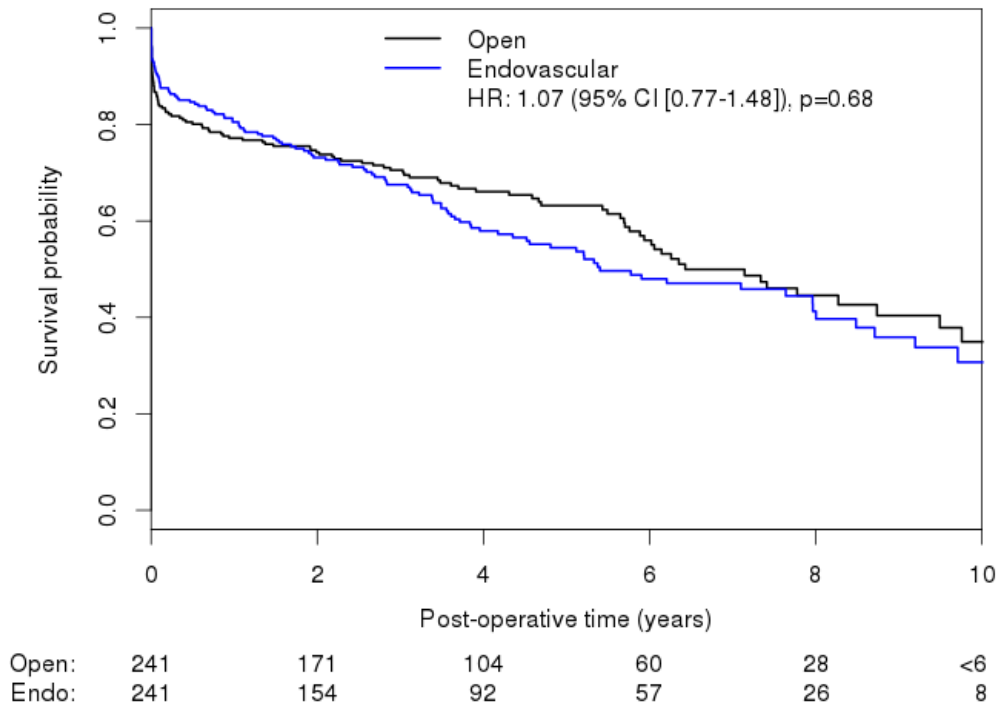
Conclusion: Endovascular repair was associated with improved early mortality that diminished after one year and had a higher rate of secondary procedures. Long-term survival following TAAA repair was poor and independent of repair technique.

Table 1: In-hospital outcomes of endovascular versus open TAAA repair before and after propensity score matching

Outcome	Pre-propensity score matching			Post-propensity score matching		
	Open N= 361	Endovascular N= 303	p-value	Open N= 241	Endovascular N= 241	p-value
Death, n (%)	64 (17.7)	31 (10.2)	< 0.01	42 (17.4)	26 (10.8)	0.04
Transient dialysis, n (%)	45 (12.5)	21 (6.9)	0.02	27 (11.2)	20 (8.3)	0.35
Permanent dialysis	17 (4.7)	8 (2.6)	0.22	14 (5.8)	≤5 (NA)	0.07
Permanent paraplegia	13 (3.6)	13 (4.3)	0.69	10 (4.1)	11 (4.6)	1.00
Stroke	18 (5.0)	18 (5.9)	0.61	10 (4.1)	12 (5.0)	0.83
TALE	93 (25.8)	54 (17.8)	0.02	63 (26.1)	42 (17.4)	0.02
Myocardial infarction	22 (6.1)	18 (5.9)	1.00	13 (5.4)	17 (7.1)	0.57
Disposition*			<0.01			0.02
Home	160 (44.3)	163 (53.8)		110 (45.6)	133 (55.2)	
Home with services	71 (19.7)	78 (25.7)		44 (18.3)	58 (24.1)	
Rehab institution	66 (18.3)	31 (10.2)		45 (18.7)	24 (10.0)	
Length of stay (median [IQR])	13 [7-22]	6 [3-13]	<0.01	12 [7-21]	6 [3-13]	<0.01

Legend: IQR: Interquartile range; PSM: Propensity Score Matching; SD: Standard deviation; TAAA: Thoracoabdominal aortic aneurysm; TALE: Thoracoabdominal aortic aneurysm life-altering events. * Excluding patients that died in-hospital.

Figure 1: Kaplan-Meier curves for survival following endovascular versus open thoracoabdominal aortic aneurysm repair following propensity score matching



Health Care Costs of Endovascular Compared to Open Thoracoabdominal Aortic Aneurysm Repair

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Objective: To compare 1-year health care costs of open and endovascular thoracoabdominal aortic aneurysm (TAAA).

Methods: Population-based administrative health databases were used to capture TAAA repairs performed in Ontario, Canada, between January 2006 - March 2017. All health care costs incurred by the Ministry of Health were included. Costs of the aortic endografts and devices for the index procedure were C\$44,000 per case versus C\$1,000 for open cases. Costs (2017 Canadian \$) were calculated in phases (1, 1-3, 3-6, 6 -12 months) with censoring for death. Propensity score matching based on 26 pre-operative characteristics was employed. The association between pre-operative characteristics and 1-month cost were characterized through multivariable analysis.

Results: Overall 664 TAAA repairs were identified (open: n=361 (54.5%) and endovascular: n=303 (45.6%)) and 241 open/endovascular propensity score matched pairs were formed. At 1 month, mean [median] total cost for the pre propensity score matched open TAAA group was C\$ 46,575 [36,647] (77% hospital cost, 14% physician billings, 3% graft cost, 6% other), whereas for the endovascular group, total cost was C\$ 72,581 [64,892] (67% graft cost, 27% hospital cost, 5% physician billings, 1% other), p<0.01. At 1-3 months, 3-6 months, and 6-months-1-year post-procedure intervals, there were no significant difference in health care costs between groups (**Table 1**). Mean [median] cumulative cost for patients alive at 1-year were C\$ 91,571 [52,003] versus C\$ 103,740 [83,242], p<0.01 for open (n=264), and endovascular (n=206) TAAA repair, respectively. On multivariable analysis, older age (p<0.01), non-elective procedures (<0.01), and pre-operative stroke (p=0.05) were associated with increased costs at 1 month.

Conclusions: While devices led to higher 1-month costs of endovascular TAAA repair, total cumulative health care costs after the first month and up to 1-year were not significantly different, including re-interventions. Higher 1-month costs occurred with older age, pre-operative stroke, and non-elective procedures.

Table 1: Health care costs of Endovascular vs. Open Thoracoabdominal Aortic Aneurysm Repair

	Pre propensity score matched			Post propensity score matched		
	Open	Endovascular		Open	Endovascular	
Cost	Mean [Median]	Mean [Median]	p-value	Mean [Median]	Mean [Median]	p-value
1 month	46,575 [36,647]	72,581 [64,892]	<0.01	46,556 [33,605]	72,786 [64,892]	<0.01
1-3 months	19,826 [2,024]	11,292 [1,977]	0.62	18,828 [1,832]	11,454 [1,992]	0.61
3-6 months	12,289 [1,173]	11,453 [1,508]	0.16	9,456 [1,144]	12,153 [1,298]	0.84
6 months-1year	11,985 [2,427]	12,087 [2,998]	0.97	8,840 [2,524]	12,016 [3,050]	0.34

Evaluation of Aortic Zone 2 Landing Accuracy During TEVAR Following Carotid-Subclavian Revascularization

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Objectives: The thoracic aorta distal to the left subclavian artery (LSA) is prone to dissection, aneurysmal degeneration and traumatic injury. Therefore, zone 2 landing during thoracic endovascular aortic repair (TEVAR) is commonly required but can prove to be challenging due to its often tortuous and angulated anatomy. Our objective was to determine the landing accuracy of zone-2 targeted endografts following carotid-subclavian revascularization (CSR), which is routinely performed at our institution.

Methods: Retrospective review of patients that underwent CSR for zone 2 endograft delivery at Vancouver General Hospital between Jan 1st 2007-Oct 1st 2018 was carried out. Patient demographics and comorbidities as well as indication, urgency and imaging modality of treatments were documented. Accuracy of zone 2 delivery was evaluated by two independent reviewers using postoperative CT scans.

Results: TEVAR with CSR was performed in 55 patients for treatment of aneurysms (45.5%), dissections (34.5%) or trauma (20%). Mean age was 62.2 ± 19.4 years, with 72.7% males. Urgent cases (< 24 hrs) occurred in 52.7% of cases. Eight (14.5%) cases required immediate rescue procedures: 4 (7.3%) proximal cuffs due to type 1a endoleak and 4 (7.3%) immediate left common carotid artery (LCCA) revascularization with retrograde stent. Thirty (54.5%) cases of LSA stump filling were noted on follow-up imaging. Average proximal endograft landing distance from the LCCA was 12.1 mm. Cases performed using built-in fluoroscopy machine compared to mobile C-arm were associated with higher chance of proximal cuff extensions (OR 12.3; 95%CI 1.15-131.11). The need for immediate rescue procedures was not associated with pathology, urgency of surgery or post-operative mortality.

Conclusion: Using current endografts and imaging modalities, zone 2-targeted TEVARs have suboptimal technical accuracy with high rates of immediate revision and inadequate seal of the LSA.

Local and Regional Management Variation after Acute Type B Aortic Dissection Accompanies Regional Disparities in Post Dissection Mortality in Ontario

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Objective: To assess current regional treatment paradigms for acute Type B Aortic Dissection (TBAD) in Ontario and gauge the impact of changes to surgical strategies on patient mortality after TBAD.

Methods: A population-based retrospective cohort study utilizing Ontario administrative databases was performed on patients presenting with acute TBAD between 2005 and 2016. Regional variation was assessed across Local Health Integration Networks (LHIN), the health authorities responsible for regionalization of healthcare in Ontario. Patient demographics, specific hospital and LHIN practices regarding medical, surgical intervention, and patient outcomes were compared. Management strategies were assessed against in-hospital and follow-up mortality up to 11 years post diagnosis.

Results: The cohort of acute TBAD patients totalled 2068. While long-term medical therapy typified TBAD management in Ontario (90%), the incidence of surgery during index admission for TBAD was more prevalent in urban areas (5.1% vs 2.5%; $p < 0.01$). Surgery after medical

failure was more common among rural Ontarians (7.2% vs 4.1%; $p<0.01$). Treatment strategies varied significantly depending on hospital type, with surgery during index admission offered more commonly in teaching hospitals ($p<0.01$). Significant differences in the number of index TBAD presentations between LHINs were observed, however, the percentage of patients treated surgically at any time of follow-up was equivalent. In-hospital mortality varied from 11.4% to 32.5%, demonstrating significant variation by LHIN ($p<0.05$). Patient 30-day mortality ranged from 17.1% to 42.5% with significant inter-LHIN variability, and differences in mortality over the entire follow-up period ($p<0.05$).

Conclusions: Variation in the management strategy of acute TBAD on the basis of patient location and treating hospital was observed across Ontario, with mortality post-diagnosis varying significantly based on LHIN. These results suggest that mortality after acute TBAD is multifactorial. Access to optimal initial care and diagnosis, in-hospital management, and ongoing access to specialised follow-up care are paramount to achieving favourable long-term outcomes.

Impact of Thoracic Endovascular Aortic Repair Timing on Aortic Remodeling in Type B Aortic Intramural Hematoma

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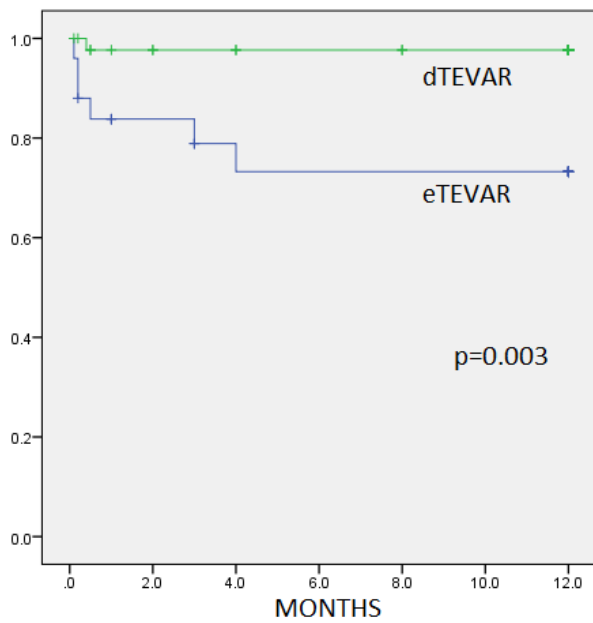
Objective: Optimal timing for TEVAR in the management of acute type B aortic intramural hematoma (IMH) has not been described. The aim of this study was to evaluate TEVAR timing on post-operative aortic remodeling.

Methods: A retrospective chart review was performed on patients who underwent TEVAR for acute type B IMH from January 2008 to September 2018. True lumen diameter (TLD) and total aortic diameter (TAD) at the site of maximal pathology were evaluated. Primary endpoint was aortic remodeling evidenced by a TAD/TLD ratio closest to 1.0. Secondary outcome was occurrence of aortic-related adverse events and mortality (AREM). Patients undergoing emergent TEVAR (within 24 hours, 'eTEVAR') were compared to the remainder – delayed TEVAR ('dTEVAR').

Results: 70 patients underwent TEVAR for acute type B IMH: 25 eTEVAR and 45 dTEVAR. Patients did not differ in presenting IMH thickness (12.6 ± 3.1 mm vs. 11.3 ± 4.1 mm, $p=0.186$) nor presenting TAD/TLD ratio (1.51 ± 0.48 vs. 1.52 ± 0.40 , $p=0.913$) for eTEVAR and dTEVAR groups, respectively. eTEVAR patients had larger average presenting maximal descending aortic (DTA) diameter (44.0 ± 11.8 mm vs. 38.5 ± 6.8 mm, $p=0.017$) and higher incidence of penetrating aortic ulcer (PAU) on presenting CT angiography (44.0% vs 20.0%, $p=0.033$). There was no difference between groups for 30-day mortality. Postoperative aortic remodeling was more complete in the dTEVAR group (1.23 ± 0.12 vs. 1.33 ± 0.15 , $p=0.004$). In the eTEVAR group, there were 6/25 (24.0%) AREM and there was 1/45 (2.2%) in the dTEVAR group. At 12 months, freedom from AREM was higher in the dTEVAR group (Fig 1, 97.8% vs. 76.0%, $p=0.003$). Postoperative TAD/TLD ratio was the best predictor for late aortic-related adverse events (AUROC=0.805, $p=0.009$).

Conclusion: TEVAR for acute type B IMH within 24 hours of admission is associated with lower aortic remodeling and higher occurrence of late aortic related adverse events and mortality. Delaying TEVAR when clinically possible could improve aortic remodeling and aortic-related outcomes.

Figure I: Kaplan-Maier curve showing freedom from late aortic-related adverse events and mortality at 12 months between the dTEVAR and eTEVAR groups, $p=0.003$.



	1	3	6	12
dTEVAR	39	35	34	32
eTEVAR	20	17	13	12

Performance Assessment of a Novel Steering Catheter for Crossing Peripheral Arterial Occlusions

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Objective: Peripheral arterial percutaneous vascular interventions have high immediate technical failure rates (~20%). The most common mode of failure is the inability to cross lesions. The purpose of this study is to demonstrate the feasibility using a novel steering catheter (CathPilot) for crossing peripheral arterial chronic total occlusions (CTOs).

Methods: A prototype CathPilot device was manufactured (**Figure 1**). 3D-printed lesions were placed within an arterial phantom to simulate a CTO. 4 operators were blinded to the lesions and attempted to cross the lesion with a conventional guidewire and KMP catheter and with a guidewire/CathPilot. The crossing time was measured. Aluminum foil was mounted on the surface of another lesion, and users were asked to puncture as much of the lesion surface as possible within 5 minutes using a guidewire and conventional KMP, Oscor steering catheter, and the CathPilot catheter. The mean puncture force delivered was also measured and compared.

Results: Where users failed to cross lesions with a conventional approach (15-minute time limit), all users succeeded with the CathPilot in < 5 minutes. The CathPilot was effective at covering more of the surface of the lesion compared with KMP and Oscor catheters (**Figure 2**). The guidewire delivered on average 43.7 g of force with the CathPilot compared with 12.7 g with a KMP 16.9 g with the Oscor (**Figure 2**).

Conclusion: Crossing CTOs may be challenging due to the inability to effectively aim the guidewire tip and apply sufficient force to the lesion surface. The Cath-Pilot enables shorter crossing times with precise steering and can generate more puncture force compared with conventional catheters and currently commercially available steering catheters. Future work will determine if the CathPilot can be used to cross arterial lesions in-vivo.

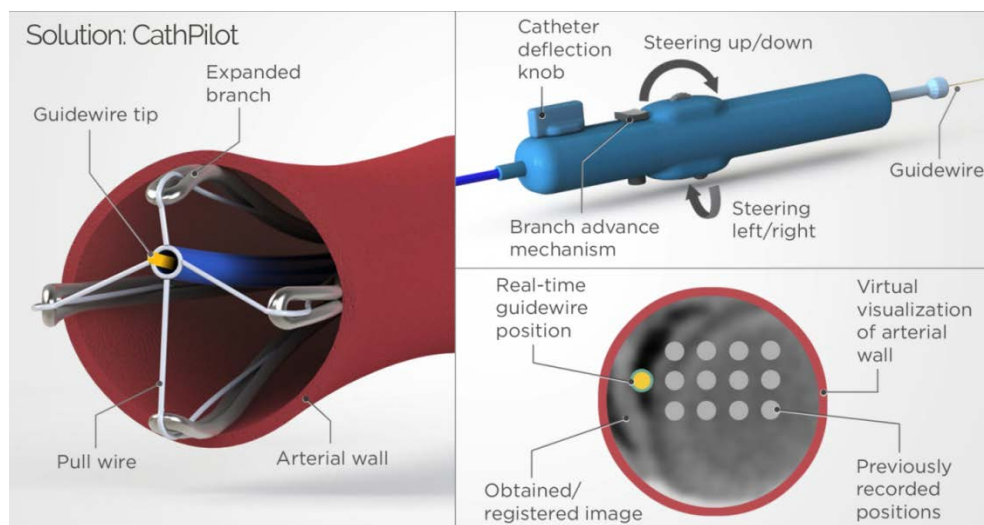


Figure 1: Cath-Pilot device specifications.

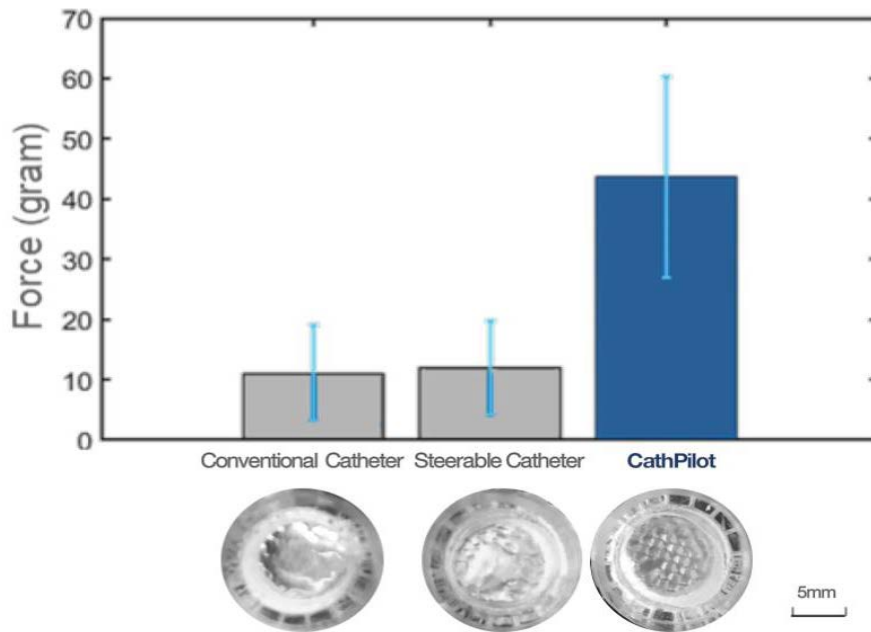


Figure 2: Guidewire puncture forces and surface area coverage using conventional (KMP) catheter, Oscor steering catheter and Cath-Pilot. The KMP catheter placed the guidewire tip on only the periphery, the Oscor catheter covered less surface area compared with the CathPilot.

Physiologic Response Predicts Freedom from Reintervention More Accurately than Angiogram following Endovascular Revascularization for Peripheral Vascular Disease

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Objectives: Endovascular therapy (EVT) is emerging as the primary treatment modality for Peripheral Vascular Disease (PVD). Unfortunately, EVT has a limited success rate and high rate of reintervention. We investigated the association between hemodynamic changes, clinical improvement, and the need for re-intervention, after EVT for PVD.

Methods: This retrospective cohort study identified all EVT procedures for de-novo PVD lesions in Ottawa between 2012-2018, which had ankle (ABI) and toe (TBI) hemodynamic measurements before and after EVT. Comorbidities, anatomic, and physiologic results were assessed. Limbs were clustered by patient and analyzed with random effects models. Ideal thresholds for hemodynamic improvements were determined by Youden's method, and reinterventions assessed with multivariate Cox survival analysis with competing risks for mortality.

Results: Eligible procedures on 137 legs of 118 patients were identified. Critical limb ischemia was the indication for 52% of procedures. Follow-up ABI and TBI measurements occurred at a median of 49 days following EVT. The Rutherford clinical severity score improved after 64% of procedures. Chronic renal failure (OR 0.28 p<0.01) and poor tibial runoff (OR 0.82 p=0.04) were associated with lack of clinical improvement. After adjusting for symptom severity, treated vessel, and baseline factors, residual stenosis after EVT significantly improved model performance (p<0.01). Adding change in ABI or TBI measurements further improved the model (p<0.01) (Figures 1 and 2).

The optimal threshold for change in ABI was 0.13 (Positive LR=5.7, Negative LR=0.24), and 0.11 for TBI (Positive LR=13.2, Negative LR=0.07). In follow-up, 31% of limbs required endovascular reintervention, including 22% that did not involve the initial lesion. The thresholds for ABI and TBI improvement provided significant added benefit for predicting re-intervention (HR 0.19 $p<0.01$ and HR 0.10 $p<0.01$ respectively).

Conclusion: Clinical outcomes after EVT are better predicted when considering physiologic measurements in addition to anatomic results. These results support the investigation of real time physiologic-guided decision making into the operating room.

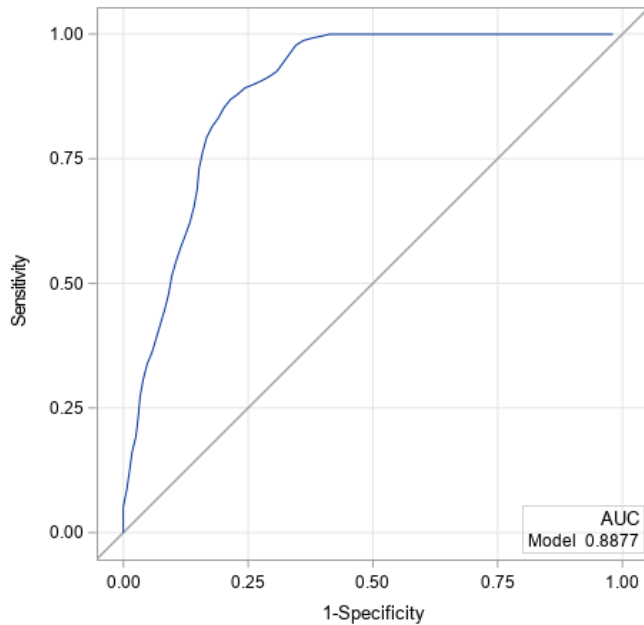


Figure 1: Receiver-Operator Characteristic (ROC) Curve of multivariate Cox proportional hazards model at 2 years post-index procedure. Using Youden's method, the optimal threshold improvement in TBI to discriminate limbs that experienced Rutherford's score improvement was 0.11 (Positive LR=13.2, Negative LR=0.07).

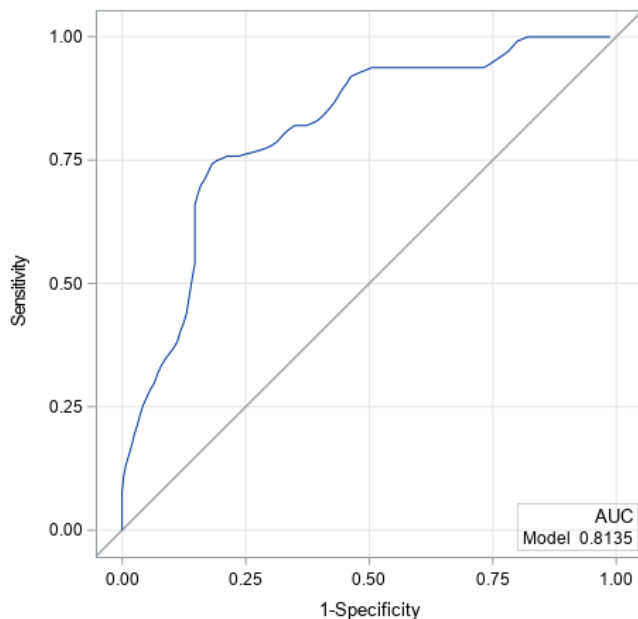


Figure 2: Receiver-Operator Characteristic (ROC) Curve of multivariate Cox proportional hazards model at 2 years post-index procedure. Using Youden's method, the optimal threshold improvement in ABI to discriminate limbs that experienced Rutherford's score improvement was 0.13 (Positive LR=5.7, Negative LR=0.24).

Concomitant Iliac Endovascular Procedure Does Not Adversely Affect Outcomes During Lower Extremity Infrainguinal Bypass

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Objective: To compare the results of concomitant iliac endovascular procedure and infrainguinal bypass with bypass alone.

Methods: Retrospective review of a prospectively collected vascular surgery database. Patients undergoing infrainguinal bypass were compared to those undergoing bypass and concomitant iliac endovascular procedures. Outcomes including mortality, amputation rates, patency, and MACE were compared using univariate statistics and Kaplan-Meier curves with log-rank test.

Results: From 2012-2017, 312 patients underwent infrainguinal lower extremity bypass, with 42 patients undergoing concomitant iliac endovascular procedures at the time of bypass. Patients with concomitant iliac procedures were more commonly done for critical limb ischemia (88.1% vs 71%, $P=0.04$), but had similar ages when compared to the bypass alone group (68 yrs vs 67 yrs). Patients with iliac procedures and bypass had more extensive disease and more commonly required femoral endarterectomy (66.7% vs 31.1%, $P<0.001$), and had lower rates of venous conduit (66.7% vs 83.3%, $P=0.01$). While both groups had similar distal targets and run-off scores. There was a trend towards higher perioperative mortality with the hybrid procedures but this difference did not reach statistical significance (4.8% vs 1.5%, $P=0.18$). Both groups had similar rates of graft occlusion at 90 days (9.5% vs 7%, $P=0.56$) and perioperative MACE (4.8% vs 2.6%, $P=0.35$). Mean follow-up was similar for both groups at roughly 26 months. Primary patency at 24 months was similar between both groups at 82% (Figure 1). Amputation rate during follow-up was similar as well between groups (16.7% vs 17.1%, $P=0.95$), as was amputation-free survival (Figure 2).

Conclusions: Despite having more extensive disease at the time of surgery, patients who undergo concomitant bypass with iliac endovascular procedures have similar results to patients undergoing infrainguinal bypass alone. With patency rates of 82% at 2 years, inflow lesions should be treated at the time of bypass surgery to maximize outcomes in these challenging patients with extensive disease.

Figure 1. Kaplan-Meier curve of primary patency comparing bypass and concomitant inflow endovascular procedure and bypass alone (log-rank $P=0.87$)

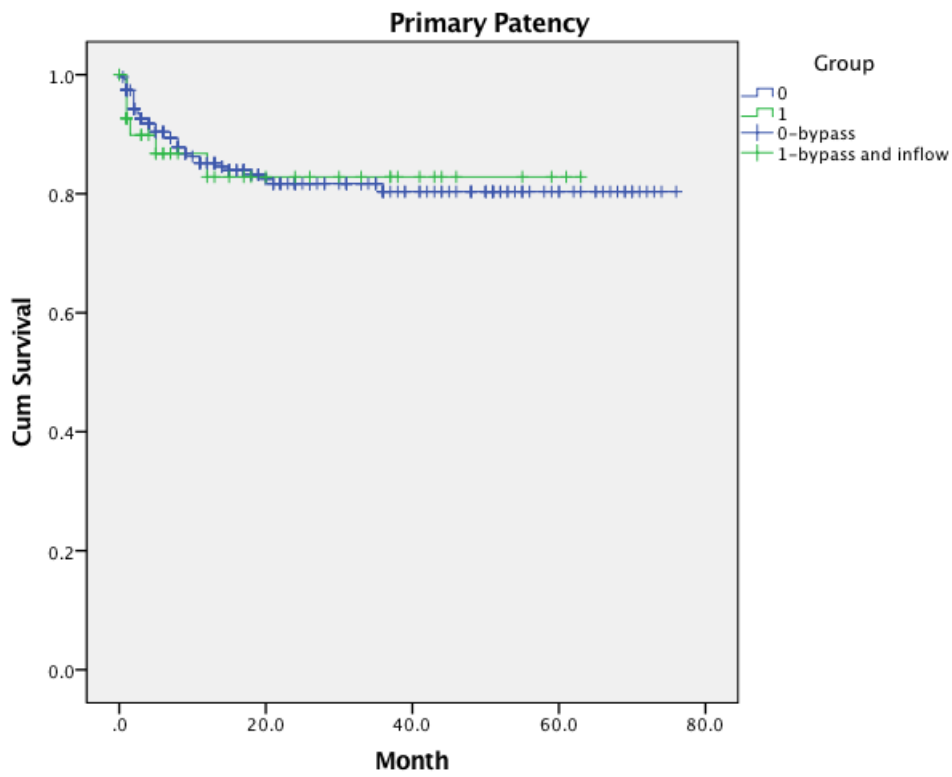
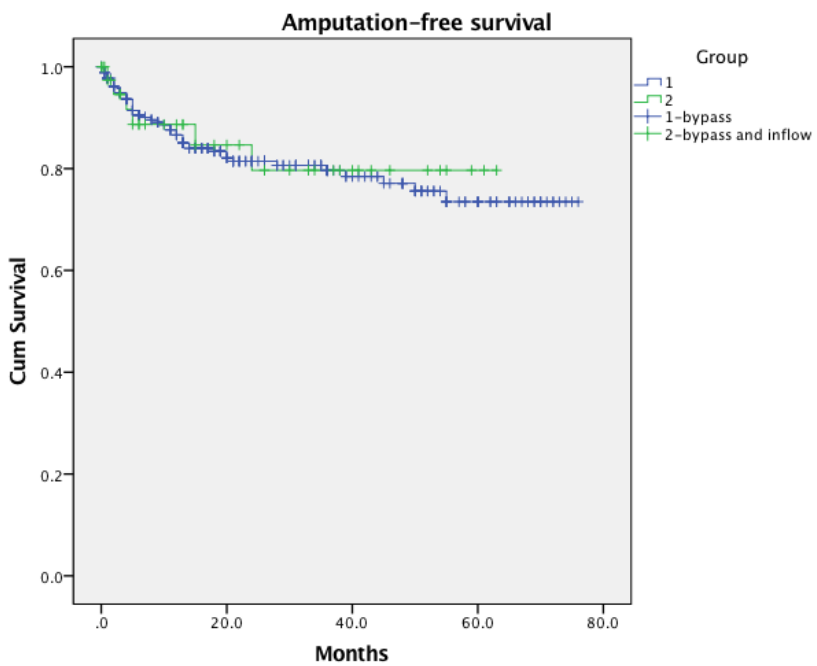


Figure 2. Kaplan-Meier curve of amputation-free survival comparing bypass and concomitant iliac inflow procedure with bypass alone (log-rank P=0.84).



Type of Anesthesia For Lower Extremity Arterial Revascularization Surgery: A Population-Based Comparative Effectiveness Study

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Objective: We hypothesized that use of neuraxial instead of general anesthesia in patients undergoing lower extremity arterial revascularization surgery (endarterectomy or bypass) may decrease adverse patient outcomes and resource use. The study objective was to identify whether the type of anesthesia provided to these patients was associated with mortality, complications, length of stay (LoS), readmissions, and health system costs at 30-days.

Methods: We conducted a comparative effectiveness study in Ontario, Canada using linked, population-based health administrative data. We identified Ontario residents 18 years-of-age or older who underwent lower extremity arterial revascularization surgery. Multilevel, multivariable regression was used to determine associations between type of anesthesia and mortality, perioperative complications (pneumonia, acute coronary syndrome, cardiac arrest, heart failure, venous thromboembolism, and acute kidney injury), LoS, hospital readmissions, and health system costs at 30-days. The association between 30-day mortality was also examined in sensitivity analyses using propensity score and instrumental variable analyses.

Results: In total, we included 20,988 patients who underwent lower extremity arterial revascularization surgery, including 6,453 who received neuraxial and 14,535 who received general anesthesia. In multilevel, multivariate analyses, administration of neuraxial instead of general anesthesia was associated with a lower odds of 30-day mortality [odds ratio (OR)=0.68; 95% confidence interval (CI)=0.57-0.83]. This association remained consistent in propensity score and instrumental variable analyses. Multilevel, multivariable analyses also suggested that neuraxial anesthesia was associated with a lower odds of complications (OR=0.73; 95% CI=0.63-0.85) and hospital readmissions (OR=0.92; 95% CI=0.83-0.98); a median 0.5 (95% CI=0.3-0.6) day shorter LoS; and a \$2,819 (95% CI=\$2,566-\$3,089) per patient cost savings to the Ontario health system.

Conclusions: In this population-based comparative effectiveness study, use of neuraxial instead of general anesthesia in patients undergoing lower extremity arterial revascularization surgery was associated with decreased mortality, complications, and readmissions; a shorter LoS; and reduced costs to the health care system.

Friday, September 13th, 2019

PAPER SESSION III: PRACTICE MANAGEMENT

Future Demands For Vascular Care: A Census-Based Analysis

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Objectives: The 2016 Canadian Census identified the age group of 65 plus as making up a larger population percentage than those aged 15 years and younger. This demographic shift, as well as the information revolution, may impact the demand for vascular services and vascular disease management. The aims of this study are 1. To identify the national /provincial population size, 2. Link population to vascular disease data and 3. Link disease data to resource requirements.

Methods: Population data regarding size and distribution of disease was sourced from StatsCan 2016 census data. The epidemiology of vascular risk factors, recognized disease and determinants for intervention was sourced from a variety of academic sources. Resource requirements were inferred from the data with sensitivity analysis applied to variable assumptions. Subgroup selection was applied for Ontario (ON). The results were compared to the data from the 2012 census and other provinces to assess accuracy as a reference point.

Results: Canada's population is approximately 36M; Ontario's population is 13.5M. The population is growing at 4.6%. The vascular target population of patients 55 – 80 years of age is growing more rapidly. In Ontario, the subgroups by 5-year cadres ranges from 375 – 850 K with a total of 3.2M. The prevalence of risk factors ranges from 17 – 52%; the need-for-care ranges from 8 – 32%. Assuming a ratio for vascular specialists (VS) of 1:100-180K, ON would need 71 -126 VS on an on-going basis. Diagnostic and interventional resources will increase by 22 – 52% over time.

Conclusion: Increasing population, population at risk, disease prevalence and triggers for intervention will lead to dramatic increases in the need for vascular related resources. Changes in VS scope of practice, involvement of other specialties and non-physician practitioners and changing technology will all impact on assumptions regarding manpower and other resources for the care of vascular patients.

Medicolegal Claims in Vascular Surgery in Canada from 2009-2018

Dr. Stephan Mostowjy; Division of Vascular Surgery, Kelowna General Hospital, Kelowna, BC

Objective: To establish the incidence and causes of medicolegal claims that were closed involving Vascular Surgeons in Canada from 2009-2018 and to elicit from the outcomes of these closed cases the educational needs for Vascular Surgeons.

Methods: Details from the Canada Medical Protection Association were analyzed looking at Vascular Surgeons in any setting (in or out of the hospital) involved in legal cases from 2009-2018 that are closed.

Results: There were 11,107 CMPA civil-legal cases closed between 2009-2018. Less than 1% (82/11,107) involved a Vascular Surgeon. 73% (60/82) had a favourable medical-legal member outcome and 27% (22/82) had an unfavourable member outcome. Analysis identified the most common surgical procedures 94% (77/82) were arterial followed by 6% (5/82) venous surgical procedures. 83% (68/82) experienced healthcare related harm that usually had a negative effect on their health or quality of life. In 52% (43/82), peer experts were critical of the clinical care they received. Analysis on 70% (57/82) categorized the contributing factors as provider, team or system. In 47% (27/57) was a provider factor like deficiencies in clinical decision-making. Other physician factors included deviations from a clinical care policy or procedure in 7% (4/57). Deficient medical record keeping was the most common team factor (23%; 13/57). Breakdowns in communication between the surgeon and the patient including inadequate consent discussion or discharge instructions (16%; 9/57). Other communication breakdowns (14%; 8/57) occurred between physicians involved in the patient's care. System factors were identified in 19% (11/57) which included inadequate resources and deficiencies in office or hospital.

Conclusions: Educational efforts for Vascular Surgeons have to be taken to reduce medicolegal claims further. There are provider, team, and system factors to consider. The need for better

communication with the patient and team plus improved record keeping is emphasized. Recognition of the areas of highest risk may limit future claims.

Discrepancies in Research Productivity Among Canadian Surgical Specialties

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Objective: Explore differences in publication metrics between surgical specialties in Canada to establish benchmarks and identify predictors of productivity.

Methods: Academic surgeons were identified through Departmental web-pages and their scholarly metrics were collected through Scopus in a standardized fashion. We collected total number of documents, citations, H-index, and average number of publications/year (last five years). We explored whether presence of training program, graduate degree, academic rank, and size of clinical group affected productivity metrics. Linear regression was used for multivariable analysis.

Results: We collected data on 2172 surgeons from 15 separate academic centers across Canada. Wide variability existed in metrics between specialties with cardiac (CS) and neurosurgery (NS) being the most productive, on average, while vascular surgery (VS) and plastic surgery (PS) were the least productive (Table 1). For VS, average number of total publications was 25.7 and average number of publications/year was 1.4/year; while CS had 71 total publications and 3.4 publications/year ($P < .001$). Similarly, average H-index for VS was 8.3 versus 18.7 for CS. Our multivariable model identified academic rank, surgical specialty, graduate degree, presence of training program, and larger size of clinical group as positive predictors of increased academic productivity. The average productivity metrics per academic rank differed greatly between specialties as well (Table 2).

Conclusions: There exists in Canadian academic surgery a wide variability in average research productivity. Obtaining a graduate degree, being part of a larger clinical group, and the presence of a training program were all associated with higher productivity even after adjusting for academic rank and specialty. Vascular surgery underperforms academically relative to other specialties. Strategies to improve this should be developed, such as changing institutional culture, better protected time and networking opportunities.

Table 1. Research productivity metrics by surgical specialty in Canada (*arranged by average total number of documents from highest to lowest*)

Total N = 2172	Total number of publications mean (SD)	H-index mean (SD)	Average #Publications/year mean (SD)	# publications/5 years mean (SD)
Neurosurgery (n=189)	72.4(126.1)	16.9(23.4)	4.1(7.6)	20.7(38.2)
Cardiac surgery (n=145)	71.4 (85.8)	18.7(16.1)	3.4(4.8)	17.2(24.0)
Urology (n=218)	60.7(88.0)	14.2(15.1)	3.6(5.4)	18.3(27.2)
Pediatric surgery (n=31)	55.4 (85.1)	12.9(13.1)	3.3(4.4)	16.7(21.9)

Thoracic surgery (n=74)	52.1(77.7)	13.6(14.4)	3.3(5.3)	16.4(26.7)
Orthopedic surgery (n=631)	31.3 (59.8)	9.3(11.8)	2.0(3.8)	10.1(19.1)
General surgery (n=590)	28.3 (55.8)	8.8(12.2)	1.6(3.0)	7.7(15.2)
Vascular surgery (n=92)	25.7(40.2)	8.3(8)	1.4(2.4)	7.1(11.9)
Plastic surgery (n=202)	24.1(43.5)	7.7(9.2)	1.4(2.5)	6.8(12.5)

Table 2. Academic metrics by rank and specialty

Specialty	Assistant Professor			Associate Professor			Professor		
	Total*	H-index	Avg/yr	Total	H-index	Avg/yr	Total	H-index	Avg/yr
Neurosurgery	30.8	9.9	2.3	51.5	14.5	3.6	189.4	34.7	9.3
Cardiac Surgery	21.1	7.6	1.7	56.2	15.7	3.9	98.3	32.1	5.1
Urology	19.5	5.6	1.6	56.8	15.5	4.3	143.3	29.2	6.9
Pediatric Surgery	26.5	6.9	2.5	41.2	12.8	2.9	249.7	41	8.7
Thoracic Surgery	14.4	5.8	1.3	46.3	13.9	3.5	136.0	28.5	7.7
Orthopedics	14.5	5.1	1.5	41.2	12.4	3.3	138.2	31.1	6.9
General Surgery	9.7	4.3	0.8	23.2	8.2	1.6	117	28.0	4.7
Vascular Surgery	13.1	5.5	1.1	27.5	9.8	1.2	68.5	16.8	2.7
Plastic Surgery	8.7	3.8	0.7	24.9	9.0	1.5	66	17.6	3.3

The Physical Toll of Working in Operating Rooms: A Survey of the Canadian Society of Vascular Surgery

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Objective: Occupational injuries and disability is increasingly being recognized as a source of surgeon burnout. The purpose of this study was to assess work-place musculoskeletal (MSK) complaints and challenges faced by Canadian vascular surgeons and trainees and its implications on surgical practice and occupational longevity.

Methods: We designed and distributed an online survey to members of the Canadian Society of Vascular Surgery including residents, fellows and staff vascular surgeons. The survey collected

data on surgeon demographics, operative volume, technical preferences and work-related MSK symptoms.

Results: An online survey was distributed to 189 surgeons and trainees. After three e-mailings, 110 surveys were returned for a 58% response rate. Of the responders, 87% were male, 50% were 45 years or older, and 55% had been in practice for ten or more years. Work-place MSK symptoms was reported by 83% of the responders; the most common symptom locations were pain in the low back (78%), neck (74%) and shoulder (31%). 80% of the responders believed that these symptoms were directly related to their operative environment. 48% sought medical care for this including physiotherapy (22%), massage therapy (30%) and surgery (7%). As a result of these MSK symptoms, 25% experience chronic pain with 8% requiring analgesics and 8% reporting time off work as a consequence. Another 11% reported an impact on their operative performance with 14% considering early retirement. A lack of operating room system changes in order to prevent workplace injury and disability was noted by 85% of the responders although only 3% reported their disability to their department.

Conclusion: Occupational MSK symptoms and disability is higher amongst Canadian vascular surgeons than other surgical specialties. Aside from raising awareness, further research is needed to design and validate a dedicated ergonomics program aimed to preventing these disorders in order to promote surgeon longevity and quality-of-life.

Incidence of Diagnostic Error in Peripheral Vascular Disease Among Primary Care Physicians

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Objective: In Canada, vascular surgeons are also vascular specialists, as there does not exist a corresponding medical specialist who manages vascular disease. They are responsible for the diagnosis, medical, surgical and endovascular management of peripheral vascular disease. With an aging population, this places a large burden on the vascular surgeon. It is postulated that many referrals sent to the vascular surgeon are misdiagnosis from the referring physician. As such, this paper sets out to evaluate the diagnostic accuracy of primary care physicians when diagnosing peripheral vascular disease.

Methods: A retrospective chart review of new consults was conducted over a 6-month period from January to June of 2018 from four vascular surgeons operating in an academic hospital. Information regarding demographics, comorbidities, specialty of the referring physician, number of years in practice of the referring physician, referral diagnosis, and the vascular surgeon's diagnosis were collected. Univariate statistical analyses using Pearson's χ^2 was performed.

Results: A review of the medical records yielded 200 cases in which 60.8% of patients were male, and the average age was 69 years (SD 12.8). Overall, 142 patients (70.5%) had a referring diagnosis that matched the vascular surgeon's diagnosis. A total of 84 patients were referred for lower limb ischemia in which 54 patient (60.7%) were diagnosed correctly. Patients diagnosed with an abdominal aortic aneurysm had a high diagnostic accuracy (92.7%), whereas those referred for a carotid artery stenosis (12 patients), only 2 patients were symptomatic and required an intervention (16.7%). The number of years of experience of the referring physician was not associated with diagnostic accuracy when comparing those with more or less than 5 years of clinical practice ($p = 0.702$).

Conclusion: Peripheral arterial disease referrals from primary care physicians generally had a moderately high rate of diagnostic accuracy. However, misdiagnosis of lower limb ischemia was

relatively high. Furthermore, the majority of referrals for carotid disease were asymptomatic or unrelated to a carotid pathology. There exist an educational opportunity to increase diagnostic accuracy within the primary care setting in the context of vascular disease.

Friday, September 13, 2019
POSTER SESSION

Population-based long-term outcomes of open versus endovascular aortic repair of ruptured abdominal aortic aneurysms

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Objective: Existing data regarding endovascular aortic repair (EVAR) of ruptured abdominal aortic aneurysm (rAAA) are limited by short-term follow-up. The purpose of this paper was to determine the long-term outcomes of EVAR versus open surgical repair (OSR) for treatment of rAAA.

Methods: A population-based retrospective cohort study of all patients ≥ 40 years that underwent OSR or EVAR of rAAA in Ontario, Canada from 2003 to 2016 was conducted. The propensity for repair approach was calculated using a logistic regression model including all covariates and used for inverse probability of treatment weighting (IPTW). Cox proportional hazards regression was conducted using the weighted cohort to determine the survival and major adverse cardiovascular event (MACE) free survival of EVAR relative to OSR for rAAA.

Results: A total of 2,692 rAAA [261 (10%) EVAR and 2,431 (90%) OSR] repairs were recorded from April 1, 2003 to March 31, 2016. Median survival was 2.7 years overall, and 2.5 and 3.7 years for OSR and EVAR patients, respectively. There were no significant baseline differences between EVAR and OSR patients after IPTW. EVAR patients were at lower risk for all-cause mortality (HR 0.55, 95% confidence interval (95% CI) 0.43,0.70, $p < 0.01$), and MACE (HR 0.54, 95% CI 0.43,0.68, $p < 0.01$) within 6 months of repair. However, EVAR patients demonstrated higher risk for all-cause mortality between 6 months and 6 years following repair (HR 1.45, 95% CI 1.05,2.0, $p < 0.01$).

Conclusion: EVAR demonstrated lower risk for all-cause mortality and MACE within 6 months of operation, but an increased risk from 6 months to 6 years. More work is needed to accurately characterize the long-term outcomes of rEVAR and rOSR.

A systematic review and meta-analysis of the long-term outcomes of endovascular versus open repair of abdominal aortic aneurysm

Ben Li, BHSc,^a Shawn Khan, BHSc,^a Konrad Salata, MD,^a Mohamad A. Hussain, MD, PhD,^a Charles de Mestral, MD, PhD,^a Elisa Greco, MD, MEd,^a Badr A. Aljabri, MD,^{a,b} Thomas L.

Forbes, MD,^c Subodh Verma, MD, PhD,^d Mohammed Al-Omran, MD, MSc,^{a,b}, ^a Division of Vascular Surgery, Li Ka Shing Knowledge Institute of St. Michael's Hospital, and University of Toronto, Toronto, ON, Canada, ^b Department of Surgery, King Saud University, Riyadh, Kingdom of Saudi Arabia, ^c Division of Vascular Surgery, Peter Munk Cardiac Centre & University Health Network, and University of Toronto, Toronto, ON, Canada, ^d Division of Cardiac Surgery, Li Ka Shing Knowledge Institute of St. Michael's Hospital, and University of Toronto, Toronto, ON, Canada

Objective: Given the recent accumulation of long-term outcome data comparing endovascular aneurysm repair (EVAR) to open surgical repair (OSR) for abdominal aortic aneurysm (AAA), we aimed to synthesize the literature comparing the long-term (5-9 years) and very long-term (≥ 10 years) all-cause mortality, re-intervention, and secondary rupture rates between EVAR and OSR.

Methods: MEDLINE, Embase, and CENTRAL were searched from inception to May 2018 for studies comparing EVAR to OSR with a minimum follow-up of 5 years. Study selection, data abstraction, and quality assessment were conducted by two independent reviewers, with a third author resolving discrepancies. Study quality was assessed using the Cochrane and Newcastle-Ottawa scales. Pooled odds ratios with 95% confidence intervals were calculated using random-effects models. Heterogeneity was quantified using the I^2 statistic and publication bias was assessed using funnel plots.

Results: Our search yielded 3,431 articles. Three RCT's and 68 observational studies comparing 151,092 EVAR to 148,692 OSR patients were included. Inter-rater agreement was excellent for screening ($\kappa=0.78$) and full-text review ($\kappa=0.89$). Overall, the risk-of-bias was low-to-moderate. EVAR was associated with higher long-term all-cause mortality (OR 1.19, 95% CI 1.06-1.33, $p=0.003$, $I^2=91\%$), re-intervention (OR 2.12, 95% CI 1.67-2.69, $p<0.00001$, $I^2=96\%$), and secondary rupture rates (OR 4.84, 95% CI 2.63-8.89, $p<0.00001$, $I^2=92\%$). For very long-term outcomes, there was no mortality difference between groups, but EVAR was associated with higher re-intervention (OR 2.47, 95% CI 1.71-3.57, $p<0.00001$, $I^2=84\%$) and secondary rupture rates (OR 8.10, 95% CI 1.01-64.99, $p=0.05$). Sub-analysis of recent studies (last year of patient recruitment ≥ 2010) demonstrated no long-term mortality differences between groups.

Conclusion: EVAR is associated with higher long-term all-cause mortality, re-intervention, and secondary rupture rates compared to OSR. In the very long-term, EVAR is also associated with higher re-intervention and secondary rupture rates. Notably, EVAR mortality has improved over time. Vigilant surveillance following EVAR is recommended.

Association Between Prosthetic Graft Infections and Postoperative Procedures After Aortic Repair: A Retrospective Cohort Study

Mark Rockley¹, Derek J. Roberts¹, Anika Mohan¹, Brendan Levac¹, Prasad Jetty¹ ¹University of Ottawa

Objectives: Abdominal prosthetic graft infection after open or endovascular aortic repair is a rare but devastating complication. We sought to identify risk factors for prosthetic vascular graft infection after aortic repair for occlusive or aneurysmal disease.

Methods: We conducted a retrospective cohort study of all patients who underwent open or endovascular aortic repair using a prosthetic vascular graft in Ottawa between October 2000 and January 2016. Medical and surgical procedures conducted among these patients were identified

via their electronic medical record. We confirmed graft infection using microbiological cultures. The association between potential risk factors (included in models as cumulative time-varying variables) and prosthetic graft infections were analyzed using univariate and multivariate Cox proportional hazard models.

Results: In total, we included 3020 patients in the study. Their mean age at the time of operation was 73 years, and 78% were male (Table 1). Open aortic repair was performed in 59% of the cases, and 28 (0.9%) grafts became infected, most often by staphylococcal species (35%). Significant baseline risk factors for infection included femoral anastomosis, ruptured aneurysm repair, occlusive disease, and age. After adjusting for baseline factors, vascular reinterventions were significantly associated with graft infection (HR 2.8 [95% CI=2.0-3.7]). There was a stronger association between graft infection and open instead of endovascular reintervention (HR 4.3 versus 1.5, $p<0.01$), and when the graft was exposed versus not exposed (HR 3.1 versus 2.0, $p<0.01$). Non-vascular operations, gastrointestinal endoscopy, and bronchoscopy were not associated with prosthetic graft infection (Figure 1).

Conclusion: Reinterventions on abdominal vascular grafts are strongly associated with development of infection, especially open procedures which exposure the graft. Unrelated procedures such as scopes did not demonstrate strong association with graft infections. Additional preventive efforts should be considered when vascular reinterventions are indicated.

	Controls	Cases	Overall
Number	2994	28	3022
Median Follow-Up (Years)	1.6	4.7	1.7
Any Mortality (%)	15.7	19.2	15.8
Baseline			
Age	72.6	66.9	72.5
Male	78.4	65.4	78.3
Occlusive Disease	4.8	23.1	4.9
Emergent Surgery	18.2	30.8	18.4
Index Surgery			
Open Repair (%)	58.6	76.9	58.8
Femoral Anastomosis (%)	7.1	34.6	7.3
Hypogastric Embolization (%)	3.4	3.9	3.4
Operative Time (hrs)	3.4	3.5	3.4
Length of Stay (days)	19.0	21.5	19.1
In-Hospital Mortality (%)	8.4	19.2	8.5

Table 1: Baseline characteristics of the cohort sample.

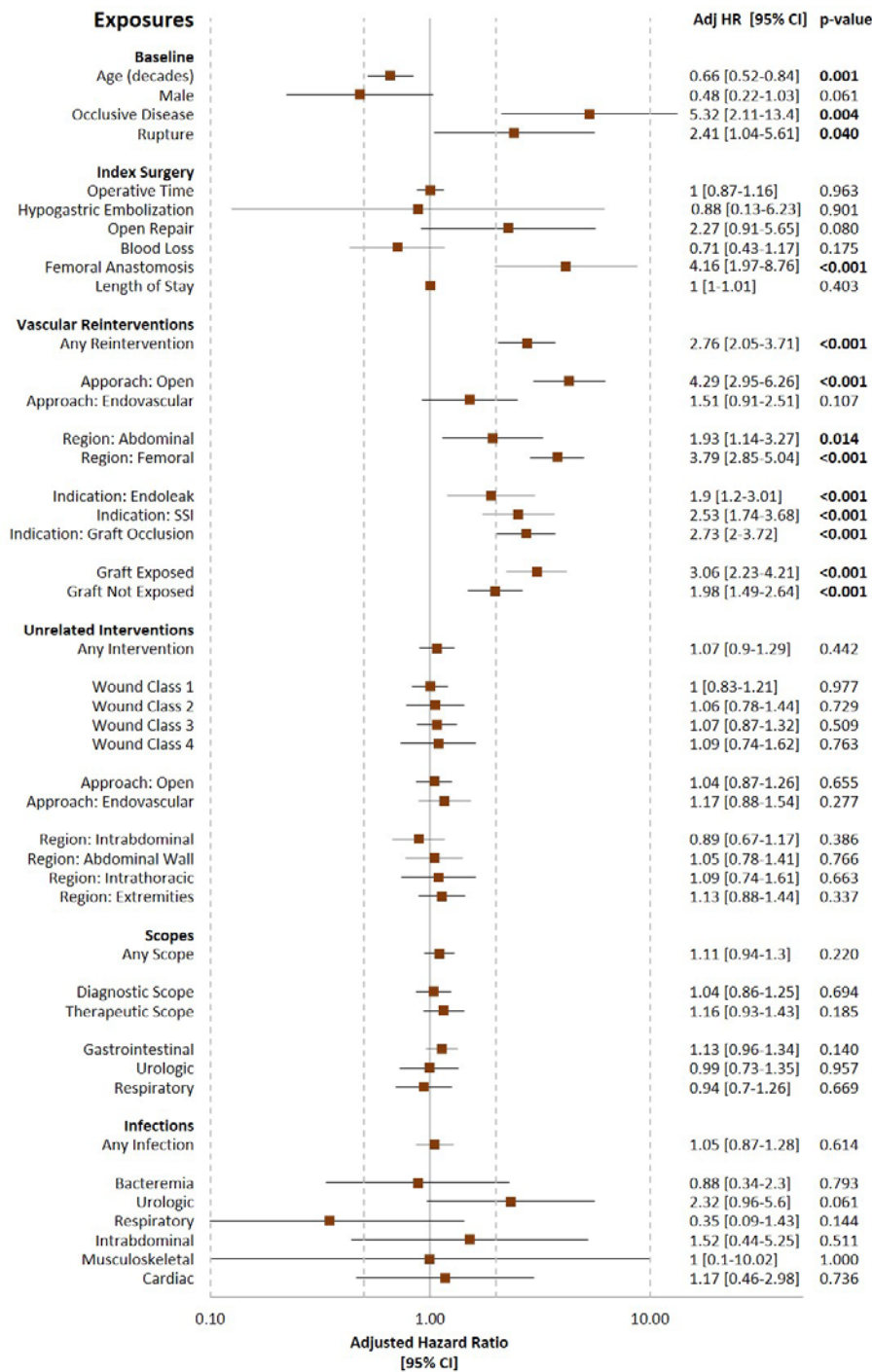


Figure 1: Association between risk factors and abdominal vascular graft infections, using Cox proportional hazards accounting for competing risk of mortality, and treating postoperative exposures as cumulative time-varying variables. All estimates are adjusted for femoral anastomosis, occlusive disease, rupture repair, and age. Vascular reinterventions are defined as interventions performed as a direct result of the index surgery, whereas unrelated interventions occurred as a result of an independent process.

The Correlation of Regional Health Care Utilization and Rates of Amputation Due to Diabetes and Peripheral Arterial Disease

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Objective: We hypothesize that integrating regional amputation prevention efforts can save limbs for patients with diabetes and peripheral arterial disease (PAD). This ecological study explored the correlation between regional health care utilization and amputation rates for these patients in a single-payer public healthcare system.

Methods: All major (above ankle) lower extremity amputations in patients over the age of 40 with diabetes or PAD were identified between April 1, 2007 and March 31, 2017 in Ontario, Canada. Age and sex-adjusted amputation rates, counts of health providers and measures of health care utilization prior to first (index) amputation were determined for each of fourteen administrative health regions. Correlation between these measures and regional amputation rates was quantified through linear regression (R-squared).

Results: A total of 11,658 major amputation patients were identified (79% diabetes, 97% PAD). The adjusted rate of major amputation ranged from 2.53-11.77 per 100,000 person-quarters across regions. Receipt of endovascular and open vascular intervention showed the strongest correlation with regional amputation rates, following an inverse relationship. The number of providers correlated poorly with amputation rates as did other health care utilization with the exception of seeing a vascular surgeon (inverse relationship). These findings were similar when restricting the analysis to diabetic amputees.

Conclusions: These results support the integral role of vascular surgery in regional amputation prevention for patients with diabetes and PAD.

Correlation of Regional Health Provider Counts and Health Care Utilization with Regional Major Amputation Rates		
	Range of Values Across 14 Regions	R-squared
Potential Access to Health Providers within Each Region		
Count of Vascular Surgeons ¹	0 - 1.9	0.19
Count of General Surgeons ¹	8.0 - 16.5	0.19
Count of Chiropractors-Podiatrists ¹	3.7 - 36.6	0.14
Count of Vascular, General and Orthopedic Surgeons ¹	14.1 - 33.4	0.07
Count of Orthopedic Surgeons ¹	5.5 - 15.0	0.03
Health Care Use or Interventions - Within 1 Year Prior to Index Amputation Hospitalization		
Endovascular or Open Vascular Intervention	6 - 28%	0.72
Endovascular Intervention	3 - 19%	0.66
≥1 Vascular Surgeon Visit ²	6 - 59%	0.42
≥1 General Surgeon Visit ²	10 - 43%	0.29
Open Vascular Intervention	4 - 20%	0.24
Outpatient Nursing Care	49 - 80%	0.22
Total Health Care Costs	\$45,103 - \$69,483	0.15
≥1 Specialist Physician Visit ²	91 - 95%	0.12
Minor Amputation	8 - 20%	0.12
≥1 Vascular, General or Orthopedic Surgeon visit ²	57 - 82%	0.09
≥1 Orthopedic Surgeon Visit ²	16 - 33%	0.06
≥1 Hospitalization	58 - 71%	0.01
Median Count - General Practitioner Physician Visits ²	10 - 13	0.01
Index Amputation Hospitalization		
Endovascular or Open Vascular Intervention	4 - 21%	0.67
Open Vascular Intervention	2 - 14%	0.50
Endovascular Intervention	3 - 13%	0.43

¹ per 100,000 residents ≥40 years of age

² Excluding 30 days prior to amputation

Platelet Function Analyzer - An Effective Tool in Predicting Aspirin Sensitivity in Patients with Peripheral Artery Disease

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Objective: Aspirin (ASA) is a commonly prescribed antiplatelet medication, however 25-60% of PAD patients have a lower than normal ability to inhibit platelet aggregation after standard dosing. We evaluated Platelet Function Analyzer (PFA-200) for its ability to detect a patient's response to antiplatelet therapy, using Light Transmission Aggregometry (LTA) as gold standard.

Methods: 42 patients, PAD (ABI <0.9) and non-PAD controls (ABI = 0.9-1.2) were recruited to this study. Patients were stratified into the following groups: PAD on ASA (n=15), PAD on Clopidogrel (n=6), PAD not on ASA (n=5), non-PAD on ASA (n=4), and non-PAD not on ASA (n=7). For each patient sample, ASA response was analyzed by PFA-200 and validated with LTA.

Results: Using PFA-200 and after validation via LTA, we found that 67% of PAD patients taking ASA, 42% of PAD patients taking Clopidogrel and 50% of non-PAD taking ASA had activated platelets despite antiplatelet therapy. As expected, 100% of patients within the PAD not on ASA and non-PAD not on ASA groups had normal activated platelet responses.

Conclusions: Our data suggests that PFA-200 can be used to detect ASA insensitivity but compliance may be leading to a lower than normal ability to inhibit platelet aggregation.

The Development and Validation of a Simulated Competency Assessment in Diabetic Wound Management

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Objective: Diabetic foot wounds comprise a third of diabetes-related healthcare expenditures, and are the primary cause of amputation in Canada. Few studies focus on how to teach or assess wound management. Given the importance of ‘assessment for learning’ in Competency by Design, we aimed to develop and validate a simulated competency assessment for use on junior trainees.

Methods: We organized our assessment development and validation process using Kane’s validity framework. The Nominal Group Technique was used to build consensus amongst 9 Canadian experts in diabetic wound management on the assessment tool and 2 testing scenarios. Commercially available wound simulators were modified to fit these scenarios. Validity evidence was built by assessing 74 clinician participants’ (61 physicians, 13 non-physicians) performance on the scenarios: 44 novices (< 50 cases), 17 intermediates (50 - 500) and 13 experts (> 500). Two assessors independently rated participants using the assessment tool. Overall reliability was evaluated using Generalizability Theory. Internal consistency was measured using Cronbach’s Alpha. Test-retest reliability and inter-rater reliability were calculated using Intra-class Correlation Coefficients [ICC]. Scoring differences between experience groups were evaluated using ANOVA.

Results: Using the performance data collected, we were able to show that our assessment exhibits high internal consistency (Alpha=0.953). Test-retest reliability was also excellent – ICC=0.943 for single measures and ICC=0.971 for average measures. Pooled inter-rater reliability was fair for single measures with ICC=0.705 and good for average measures ICC=0.827. The tool differentiated between novices and the other two groups well (p<0.01) but not between intermediates and experts (p=0.339). Our Generalizability and Phi coefficients were 0.871 and 0.866 respectively, indicating very good reliability both for ranking participants and making criterion-referenced (eg. Pass/fail) decisions.

Conclusion: The accumulated validity evidence suggests competency assessment can be used to assess junior physicians’ competence in diabetic wound management during simulated cases.

Do initial radiographic results of atherectomy predict requirement for reintervention?

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Objective: To report single centre short-term outcomes of lower extremity atherectomy.

Methods: A single centre retrospective review was performed on 22 patients undergoing rotational atherectomy (TurboHawkTM) in Winnipeg, Manitoba, between July 2017 to October 2018. All patients were heparinized, had filter devices (SpiderFXTM), and had paclitaxel-coated balloon angioplasty post-atherectomy.

Results: Patient characteristics are listed in Table 1. Eleven of 28 lesions were chronic total occlusions, 13 were severe (70-99% stenosis), and 4 were moderate (50-69% stenosis). Fourteen patients had lesions in the superficial femoral artery (SFA) only, 3 in the SFA and popliteal arteries, 3 in the popliteal artery only, and 2 in the peroneal artery only. Five patients had complications (intimal flap, thrombosis requiring lysis, vasospasm, etc.). Twenty-three lesions had an excellent radiographic result (residual stenosis 0-49%) (Figure 1). Three lesions had residual stenosis between 50-69%. Two lesions were impassable – one patient underwent bypass and one underwent below knee amputation. No lesions were stented. Fourteen patients had resolution of symptoms. Non-resolution of symptoms demonstrated re-occlusion in 3 patients. At follow-up, 7 patients required repeat interventions - 3 bypasses, 1 atherectomy, and 3 major amputations. In patients requiring reintervention, 4 of 8 lesions had an initially excellent (0-49%) angiographic result, compared with 20 of 21 lesions in the non-reintervention group. Patients requiring reintervention had higher rates of coronary disease, congestive heart failure, and chronic kidney disease.

Conclusion: Lower rates of re-intervention post-atherectomy appear to be associated with initial post-treatment lesion appearance. In selected patients, atherectomy appears to be a promising treatment; however, longer term follow-up is required to identify patients for whom this treatment can be utilized to maximal benefit.

Table 1: Patient characteristics.

Characteristic	
Age* (mean ± SD)	68.4 ± 11.2
Female (%)	10 (45)
Rutherford Class (%)	
1	1 (5)
2	2 (9)
3	3 (14)
4	4 (18)
5	10 (45)
6	2 (9)
Comorbidities (%)	
CAD	8 (36)
CHF	2 (9)
CVA	2 (9)
Dyslipidemia	14 (64)
HTN	18 (82)
Current Smoker	9 (41)
Former Smoker	8 (36)

Non-Smoker	5 (23)
COPD	6 (27)
DM	16 (73)
CKD	5 (23)
Medications (%)	
Antiplatelet	13 (59)
ACEi/ARB	12 (55)
Statin	11 (50)
Anticoagulant	1 (4)
Previous Interventions (%)	
Ipsilateral Angioplasty/Bypass	11 (50)
Contralateral BKA/AKA	3 (14)
Lesion Length (cm) (mean ± SD)	
All lesions	9.3 ± 8.0
Lesions requiring reintervention	10.8 ± 5.6
Lesions not requiring reintervention	8.4 ± 8.7

*at presentation. SD = standard deviation; CAD = coronary artery disease; CHF = congestive heart failure; CVA = cerebrovascular accident; HTN = hypertension; COPD = chronic obstructive pulmonary disease; DM = diabetes mellitus (includes type 1 or 2); CKD = chronic kidney disease (including end stage on any renal replacement therapy); ACEi = angiotensin converting enzyme inhibitor; ARB = angiotensin II receptor blocker.

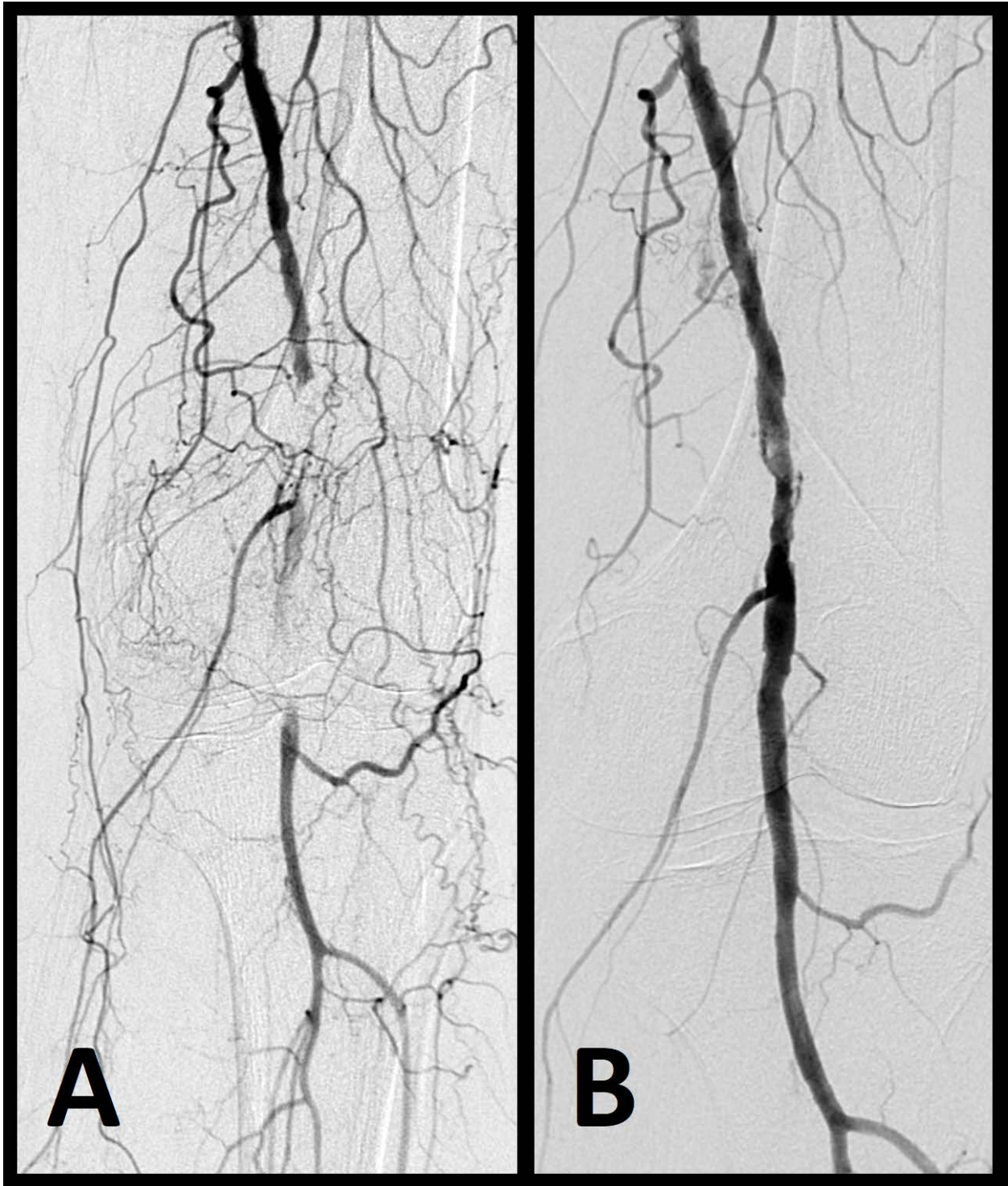


Figure 1: 11 cm chronic total occlusion lesion before (Figure 1A) and after (Figure 1B) atherectomy and drug-coated balloon angioplasty with an excellent (0-49%) radiographic result.

PHARMACOLOGIC LEG PAIN: AN UNRECOGNIZED CAUSE OF CLAUDICATION
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Background Claudication is a symptom of leg pain with ambulation. Classically, it is described as being either arteriogenic (from intraluminal or extraluminal causes) or neurogenic. Another possibility is described.

Case report A 63 year-old male patient with a 10-year of chronic hypertension was well controlled on Olmetec (olmesartan minoxidil). In 2018, when Olmetec came off patent, generic versions became available. For four months while on generic olmesartan, the patient noted unusual episodic, fleeting pain localized in the lateral distal or upper calf, lower or upper thigh but always highly variable with its location and intensity. The pain was aching, like a vise. It could occur at rest but was dramatically worsened with exercise, primarily walking. When it occurred with exercise, the patient needed to stop walking. After resting, the patient could walk again for the same variable distance. Physical examination of the lower extremities including pedal pulses and ABI was normal. CPK and LDH was normal. X Rays of the hips and back showed normal changes related to age. An MRI of the head and spine was also normal. When the pain caused progressive shortening of the walking distance and rest pain that woke the patient from sleep, olmesartan was voluntarily stopped. Within 5 days, the pain had significantly reduced and the patient was able to walk any distance without stopping. However, the patient's blood pressure had increased, so the patient resumed the medication. Again, within 5 days, the same left lower extremity symptoms returned (the right lower extremity was always asymptomatic) as before. When this occurred a second time, the patient stopped the generic medication completely and informed his family physician. Olmetec was restarted.

Conclusion Pharmacologic claudication should be considered after arteriogenic and neurogenic causes of claudication have been excluded. The cause of this is unknown.

AUTOLOGOUS STEM CELL TREATMENT FOR CLI PATIENTS WITH NO REVASCLARIZATION OPTIONS: AN UPDATE OF THE HEMOSTEMIX ACP-01 TRIAL WITH 4.5 YEAR FOLLOWUP

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Background: Patients with critical limb ischemia (CLI) face a high risk of amputation when revascularization options are exhausted. ACP-01 are autologous angiogenic stem cells derived from the patient's peripheral blood. The Hemostemix Phase II trial is an ongoing international multicentre randomized double-blind placebo-controlled clinical study to assess the safety and efficacy of ACP-01 injected into the lower extremity of 95 CLI patients who have no revascularization options. The study's primary endpoints are time to major amputation or death, and a composite safety endpoint. We present the blinded long-term follow up of all concurrent patients enrolled at the first two clinical sites.

Methods: Blinded review of all patients entered into the Hemostemix Phase II trial with follow-up of at least 1 year. Study subjects were randomized 2:1 to direct injection into predefined areas in the lower extremity with autologous angiogenic precursor cells or placebo.

Results: Twelve patients with CLI and no interventional options were enrolled (10 male, 2 female, mean age 76 years). Prior to treatment with ACP-01 or placebo, 3 patients had ischemic rest pain, 8 patients had ulceration, and one patient had gangrene. Post treatment, one patient

with unremitting rest pain and toe gangrene required a below knee amputation, and one patient with gangrene of the first to third toes required a forefoot amputation. Healing of ulcers and resolution of ischemic rest pain occurred in the other 10 (83%) patients. There were no clinically significant safety issues. Outcomes have been maintained for up to 4.5 years (3.5 years for 2 patients, 3 years for 1 and 1 patient died after ulcer healing secondary to congestive heart failure at 6 months).

Conclusions: Preliminary long-term results of ACP-01 autologous stem cell treatment in CLI patients with no revascularization options are encouraging. Enrollment in the study is ongoing at medical centers in Canada and the US. We recommend Vascular surgeons to discuss this study with their CLI patients who have no further revascularization options available.

Risk Factors for Surgical Site Infection After Lower Extremity Arterial Revascularization Surgery: A Systematic Review and Meta-Analysis

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Objective: Surgical site infections (SSIs) after lower extremity arterial revascularization surgery are associated with increased morbidity, mortality, and limb loss. We sought to identify evidence-informed risk factors for SSI after lower extremity arterial revascularization surgery to stratify patients into risk groups based on prognosis.

Methods: We searched electronic bibliographic databases (MEDLINE, EMBASE, and Evidence-Based Medicine Reviews from 1950 to February 16, 2019) and reference lists of included articles for observational studies reporting adjusted risk factors for SSI among adults who underwent lower extremity arterial revascularization surgery. Identified risk factor estimates were meta-analyzed on log-transformed scales using DerSimonian and Laird random-effects models.

Results: Among 4,166 unique citations identified, we included 36 observational studies, 78% of which were published on or after the year 2009, which enrolled 169,416 patients (median patients per study=1,880). The studies evaluated 262 potential risk factors for SSI, which were each adjusted for a median of 8 (interquartile range=4-12) other prognostic or potentially confounding factors. Adjusted risk factors with pooled evidence supporting an increased odds of SSI among patients undergoing lower extremity arterial revascularization surgery included obesity [odds ratio (OR)=2.02; 95% confidence interval (CI)=1.76-2.31; n=5 studies]; diabetes (OR=1.33; 95% CI=1.04-1.70; n=8 studies); chronic obstructive pulmonary disease (OR=1.28; 95% CI=1.11-1.49; n=4 studies); critical limb ischemia (OR=1.26; 95% CI=1.12-1.42; n=2 studies); redo-groin incision (OR=3.74; 95% CI=1.59-8.80; n=2 studies); use of a synthetic graft (OR=1.20; 95% CI=0.97-1.49; n=2 studies); intraoperative blood transfusion (OR=1.23; 95% CI=0.96-1.59; n=2 studies); and an operation lasting more than 3- (OR=1.53; 95% CI=1.03-2.27; n=2 studies) or 4-hours (OR=1.75; 95% CI=1.44-2.11; n=5 studies).

Conclusions: This study identified a number of evidence-informed risk factors for SSI after lower extremity arterial revascularization surgery. Our findings may be used to design SSI risk scoring systems and identify patients who may benefit most from strategies intended to prevent infection in these patients.

Pulsed and Heated Perfusion in a Human Cadaveric Model: A Reliable and Reproducible Device for Improving Endovascular Skills

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Objective : The use of cadaveric human subjects has proved its benefit in the continuous surgical training. Knowledge of evolving endovascular techniques is currently inherent in the daily practice of vascular surgeons. The aim of our study was to develop a human cadaveric model with pulsatile and heated antegrade perfusion for reliable and reproducible endovascular simulation.

Methods : The agreement of the ethics committee was obtained. Thiel-embalmed cadavers then salt-preserved bodies were cannulated in the apex of the heart and perfused with designed solution at 37° Celsius from the ascending thoracic aorta to the femoral arteries (Fig.1). The pulsatile flow rate of four liters per minute was obtained with an economical prototype pump designed by biomedical engineers (Fig.2). Then efficient pulmonary capillary perfusion was obtained with catheterization of pulmonary arterial trunk after orotracheal intubation. Monitoring of perfusion pressure was provided by the intensive care devices.

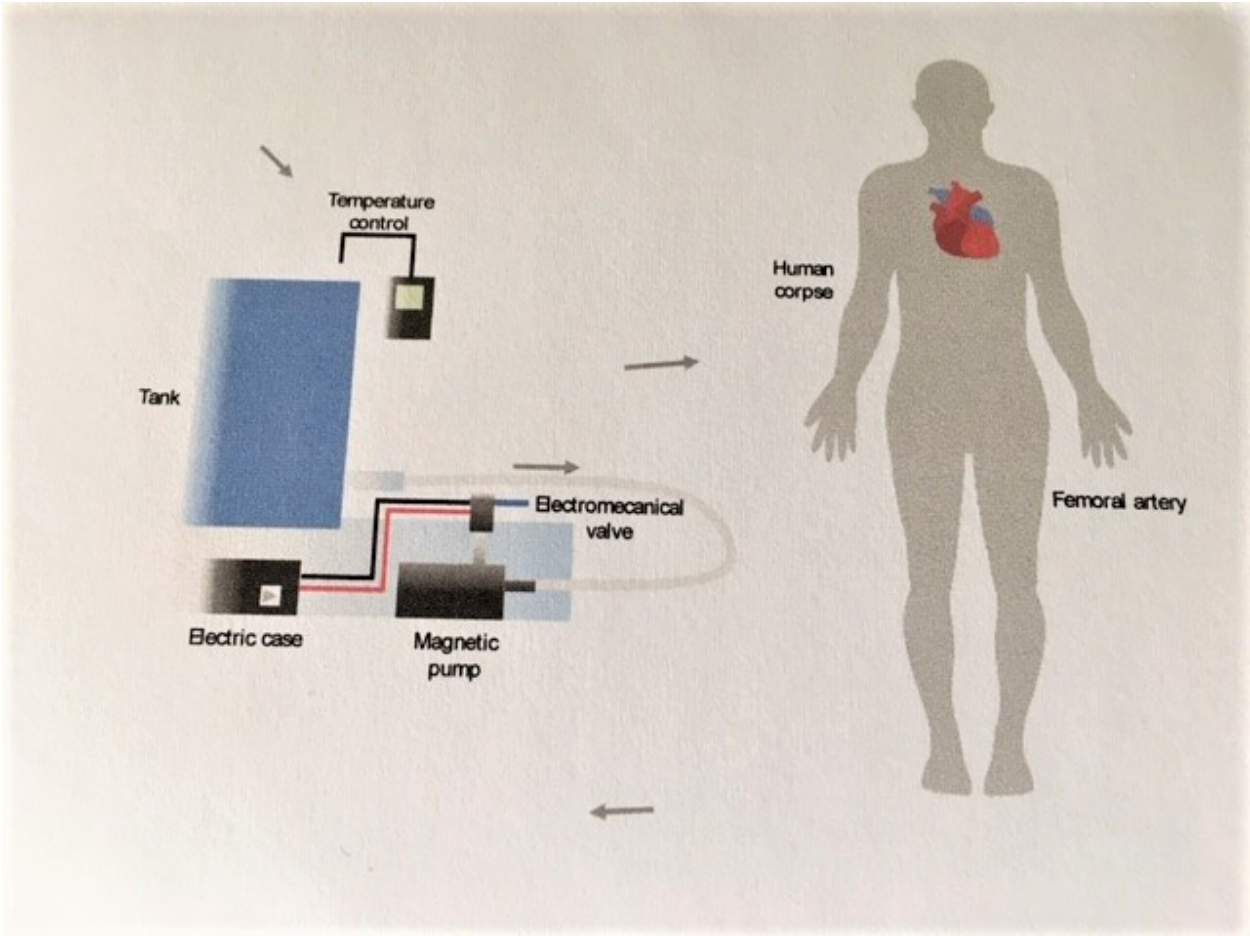
Results : An effective cadaveric perfusion can be achieved for several hours not only with an arterio-arterial way but also with a transpulmonary circulation. The arterial pressures reached and in situ temperatures restored physiological conditions. Realistic accuracy of this new model has led to technical successes of complex endovascular procedures such as the placement of iliac endograft and stent-grafts in the peripheral arteries, overseen by pressure and thermal monitoring. Salt preserved bodies and specific designed pump improve the cost effectiveness competitiveness. To our knowledge it is the first time such a model is described in Canada.

Conclusion : Endovascular simulation on human cadaver, optimized thanks to the pulsatile and heated perfusion system, is part of the modern dynamics for surgical training and initiation to new devices. This reproducible teaching tool could thus be relevant in each surgical school.

Figure 1. - Pulsatile and heated perfusion from the ascending thoracic aorta to the femoral arteries



Figure 2. - Schematic drawing of the cadaveric circulatory system with the prototype pump



Remote video-based assessment of open vascular skills

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Background: Time constraints and staff variation make it difficult for vascular residents to obtain feedback about their progress in the OR. This study aims to determine whether basic surgical skills can be reliably assessed from smartphone videos. This would facilitate remote or delayed assessment of procedural competence.

Methods: Study participants of varying experience were asked to complete an end-to-side anastomosis on a bench-top model. A tripod-mounted smartphone was used for recording. Evaluation was performed by three independent experts: one in-person assessor and two independent video assessors using the previously validated Vascular Objective Structured Assessment of Technical Skills (OSATS).^{1,2}

Results: Three junior residents, PGY 1-3; five seniors, PGY 4-5, and fellows; and three staff surgeons participated. Mean task duration was 14.2 min (11-22 min). A broad range of OSATS scores were observed ($\mu = 44 \pm 11$, 24-60). Assessments were relatively easy for both live and video-based ratings on a 5-point Likert scale ($\mu = 2.2 \pm 0.8$, $p=0.15$). There was a significant correlation between assessment score and training level ($p=0.005$). Video assessments differed between live, in-person assessments (ICC 0.186, $p = 0.047$). Using Friedman's test, all three assessors appeared to have a consistent difference between ratings ($p = 0.001$). Difficulty in assessment strongly correlated with poorer assessment scores ($r^2 = -0.75$, $p<0.001$).

Conclusions: *Smartphone video ratings were perceived as easy but were not equivalent to in-person ratings.* This difference may be driven by variable assessor standards, though factors specific to video assessment cannot be ruled out. Additional work is needed before video-based assessments are deemed valid and reliable for vascular anastomosis. Future studies must address variability between assessors as a requirement for objective evaluations.

The burden of Academic Spam

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Objective: Researchers and physicians often receive academic invitations that are unsolicited, from unknown senders, and do not relate to their field of study. This study aims to determine the prevalence and impact of academic spam amongst physicians in a Canadian academic centre.

Methods: Staff and residents were voluntarily recruited for this study through email invitation. The participants were asked daily to direct all emails considered to be "academic spam" to the research team for the duration of 1 week. The criteria for spam includes: Invitations for academic activities that are unsolicited; AND do not pertain to the recipient's area of work/research; OR that are from illegitimate sources. These emails were accepted or rejected for the study based on this criteria. These submissions were then analyzed for type, congruence, cost, repetition, and suppressibility.

Results: 15 participants accepted the invitation to partake in the study with 8 (53%) individuals consistently forwarding academic spam emails each day of the study's duration. The weekly spam average was 70 emails per week, with an average of 9 emails per day. Out of 538 spam submissions, 46.3% were notifications from journals, 21.8% were invitations to conferences,

7.8% were invitations to serve on an editorial board, 9.7% were newsletter alerts, 5.9% were invitations for webinars/courses, 5.4% were paid products/services, and 3.5% were other academic invitations or requests. The majority of academic spam originated from open access publications. A total of 12.8% of spam emails referenced a fee, largely related to processing costs for publications, ranging from “waived” to “GBP \$650”. Only 13% of the spam collected somewhat mirrored the participants’ academic interests. Some invitations were removed by the institutional spam filter, so we may have underestimated the amount of spam

Conclusion: Academic spam invitations are common and irritating, often duplicates, and of little relevance to the recipient.

Malnutrition and Mortality in Frail and Non-Frail Older Adults Undergoing Interventions for Peripheral Arterial Disease

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Background: Older adults undergoing interventions for peripheral arterial disease (PAD) may be at risk for malnutrition. This study sought to determine the association between preprocedural nutritional status and all-cause mortality.

Methods: This was a post-hoc analysis of the Frailty Assessment In Lower Extremity arterial Disease (FRAILED) prospective cohort including 2 centers recruiting patients between July 1st, 2015 and October 1st, 2016. Individuals who underwent vascular interventions for Rutherford class 3 or higher PAD were enrolled. The Mini Nutritional Assessment (MNA)-Short Form was assessed by trained observers preprocedure, with scores ≤ 7 of 14 considered malnourished and scores 8 to 11 of 14 considered at risk for malnutrition. The modified Essential Frailty Toolset (mEFT) was simultaneously assessed to measure frailty, with scores ≥ 3 of 5 considered frail. The primary endpoint was all-cause mortality at 12 months after the procedure. Multivariable logistic regression was used to adjust for potential confounders.

Results: There were 148 subjects with 39.2% females, a mean age of 70 years, and a mean body mass index of 26.7 kg/m². In the cohort, 59 (40%) had claudication and 89 (60%) had chronic limb threatening ischemia (CLTI) with 98 (66%) undergoing endovascular revascularization and 50 (34%) undergoing open or hybrid revascularization. Overall, 3% of subjects were classified as malnourished and 33% were at risk for malnutrition. There were 9 (6%) deaths at 12-months. Mini Nutritional Assessment-Short Form scores were modestly correlated with the mEFT scores (Pearson’s $R = -0.48$, $P < 0.001$). Patients with malnourishment or at risk of malnourishment had 2.5-fold higher crude 1-year mortality compared with those with normal nutritional status. In frail patients with mEFT scores ≥ 3 (41%), malnutrition was associated with all-cause mortality (adjusted OR: 2.08 per point decrease in MNA scores; 95% CI: 1.03 to 4.35); whereas in nonfrail patients with mEFT scores < 3 (59%), MNA scores had no effect on mortality (adjusted OR: 1.05; 95% CI: 0.56 to 2.00).

Conclusions: Preprocedural nutritional status is associated with mortality in frail older adults undergoing interventions for PAD. Clinical trials are needed to determine whether pre- and postprocedural nutritional interventions can improve clinical outcomes in these vulnerable individuals.

Development and endovascular optical imaging of a porcine model of advanced atherosclerosis

Patrick Z McVeigh^{1,2,3}, Graham Roche-Nagle^{3,4}, Brian C Wilson^{1,5}, Mark Wheatcroft^{3,6} 1.

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Objective: To develop a porcine model of advanced atherosclerosis and visualize the endovascular appearance using a novel high-resolution optical imaging system.

Methods: Carotid atherosclerosis was established in swine using a surgical injury model combined with a high-cholesterol diet and diabetes induction. Angiography and high-resolution scanning fiber angiography were used to assess the lesions - technical elements such as depth of field, flush rates, and image resolution were recorded. Plaque features such as adherent thrombus, endothelial coverage, apparent lipid content, and degree of vessel stenosis were assessed to compare with ex-vivo pathology.

Results: Persistent hyperglycemia was successfully induced in 66% of animals (mean glucose 515mg/dL, base 87mg/dL). Serum cholesterol also increased following diabetes induction (mean >520mg/dL, base 105mg/dL). 1-month angiograms demonstrated a persistent induced stenosis and post-stenotic dilatation. Clear angioscopic images were obtained using a revised optical flushing system that utilizes smaller volumes of saline by increasing the tubing diameter connected to the imaging catheter and a volumetric infusion pump for precise rate control. In all cases the pre-stenotic region of the vessel wall had morphologic and color changes visible on angioscopy (Figure 1) that were not observed on the corresponding conventional angiogram. Pathologic analysis of these regions demonstrated AHA grade III-Vc plaques with significant subintimal myoproliferation and calcification.

Conclusions: This carotid stenosis model produces atherosclerotic changes in swine at 1-month follow-up that is concentrated in the pre-stenotic region of the artery. Plaque morphology and timeline to development is accelerated by the induction of diabetes, which also increased circulating cholesterol levels. Clear optical imaging is possible in such high-flow arteries without occlusion by making use of a higher pressure flush delivery system and low flow rates. Changes in endothelial appearance corresponding to areas of pathology are detectable using the angioscope that cannot be appreciated on conventional angiography alone.

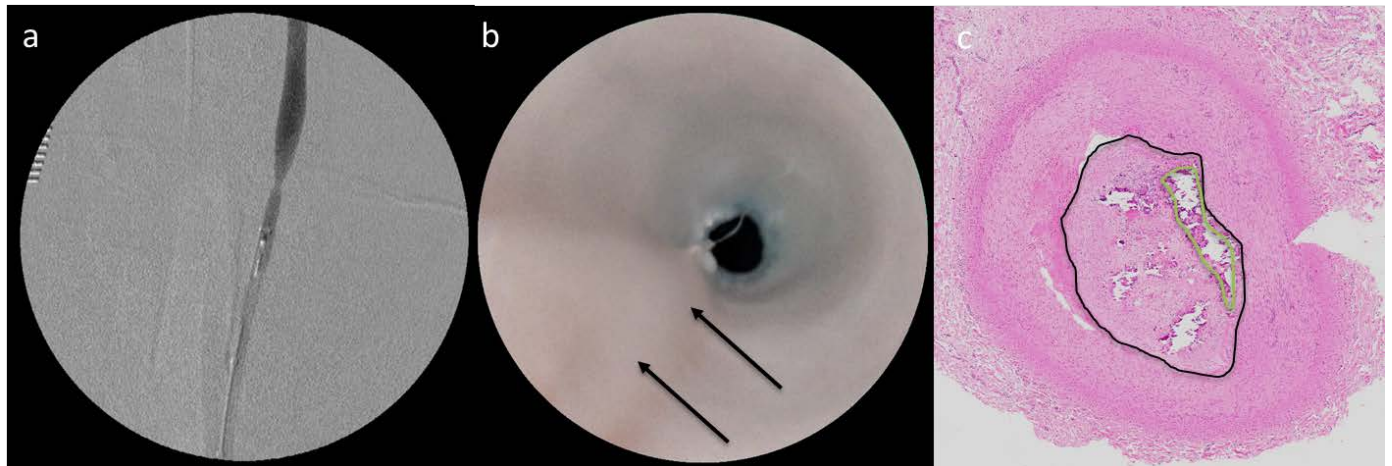


Figure 1. Induced carotid atherosclerosis characterization. (a) Angiogram demonstrating focal lesion and post-stenotic dilatation, (b) scanning fiber angioscopic image showing subintimal plaque (arrows) not visible on fluoroscopy along with distal region of stenosis, and (c) H&E-stained arterial section through plaque (black) showing dense myoproliferation and calcification (green).

Saturday, September 14th, 2019

PAPER SESSION IV: PRE-OPERATIVE MEDICINE

Exploring the Utility of Brain Natriuretic Peptide Measurement in Vascular Surgery

Bill Y Huang, Gary K Yang, Sandra Strandberg, York Hsiang, Division of Vascular Surgery, Vancouver General Hospital, Vancouver, BC

Objective: The Canadian Cardiovascular Society 2016 guidelines recommend pre-operative measurement of brain natriuretic peptide (BNP) to risk-stratify patients for a 30-day composite outcome of death, myocardial infarction (MI), or asymptomatic myocardial injury after noncardiac surgery (MINS). Whether this practice affects outcomes is unclear. The aim of this study was to examine the clinical utility of BNP and MINS.

Methods: Analysis of a prospectively-maintained database identified all elective open vascular surgery cases at an academic teaching hospital from January 2015 to December 2018. Pre-operative BNP values were available from June 2018 onward after becoming institutionally-mandated. Co-morbidities were also collected to stratify patients using the Revised Cardiac Risk Index (RCRI). The composite outcome of 30-day mortality, MI, or asymptomatic MINS was determined.

Results: Prior to BNP becoming an institutionally-required test, data was available from 1176 open cases; 30-day mortality was 1.3% (15/1176) and post-operative MI was 2.3% (27/1176). BNP measurements were collected in 91 consecutive patients. Ten patients (11%) experienced the composite outcome of mortality, MI, or asymptomatic MINS. Elevated BNP was associated with increased odds of the composite outcome (OR 4.25, 95% CI 1.02-17.74, $p < 0.05$), but not with mortality or MI alone. RCRI score was not predictive of outcomes. The majority of patients who qualified for the composite outcome experienced only an asymptomatic troponin rise (80%).

Two patients met the universal definition of MI, one of whom died. No other deaths occurred within 30 days. Detection of asymptomatic MINS did not result in any significant changes to patient management.

Conclusion: Elevated BNP correlates with increased MINS. An asymptomatic troponin rise is the most commonly observed event, with unclear clinical implications. BNP and RCRI may over-estimate surgical risk. Further studies on the long-term outcomes of elevated BNP and MINS are required before widely adopting this strategy in vascular surgery patients.

Optimizing Preoperative Cardiac Risk Stratification for Aortic Surgery

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Despite aggressive risk factor modification and meticulous operative technique, perioperative cardiovascular complications dominate the morbidity and mortality of aortic surgery. Individual surgeons' preferences as well as various societal guidelines vary widely with respect to the ideal preoperative cardiac risk stratification scheme to minimize this.

Objectives: This study was designed to describe current preoperative cardiac risk stratification practice at a tertiary vascular centre, evaluate these schemes in real world practice, and propose an optimized approach.

Methods: We conducted a retrospective analysis of prospectively collected data from our Vascular Quality Initiative (VQI) database from 2010-2017. Open surgical abdominal aortic aneurysm repairs (OSRs) were queried, and adverse cardiac events (myocardial infarction, myocardial injury after noncardiac surgery (MINS), new arrhythmia, new CHF, or cardiovascular death) along with preoperative cardiac testing results were studied. A selective retrospective chart review was then conducted to investigate details not captured in the VQI database.

Results: 178 OSRs were identified, including 129 elective cases. The majority (62%) of elective patients had preoperative cardiac stress testing. 79% of these stress tests were negative, yet 33% of these patients (vs 48% of those with positive stress tests) experienced an adverse cardiac event. Upon further review, many patients who sustained unanticipated cardiac events had irreversible defects on their stress testing or untreated coronary disease on coronary angiography.

Conclusions: Preoperative cardiac risk stratification with stress testing was only modestly protective against adverse cardiac events undergoing open AAA repair. Alternative strategies including biomarker use or coronary angiography warrant further real-world investigation.

Evaluating the Role of Preoperative Medicine Consults on Clinical Outcomes in Vascular Surgery Patients

Abdalla Butt, Simran Parmar, Abhiram Cherukupalli, Yuda Shih, Gary K Yang, York Hsiang, Division of Vascular Surgery, University of British Columbia, Vancouver, BC

Objective: The Internal Medicine Perioperative Consult Team (IMPCT) was introduced at our institution in 2015 with the goal of improving pre-operative optimization to reduce post-operative complications. The objective of this study was to evaluate the effect of IMPCT on clinical outcomes in patients undergoing vascular surgery.

Methods: A retrospective review of all vascular patients who received pre-operative IMPCT consults between January 2015 and December 2017 at a tertiary care teaching hospital was undertaken. In addition, a control group (2:1) from the same period who did not receive IMPCT consults were matched to the IMPCT cohort based on age, sex and surgical intervention. Patient demographics, co-morbidities, and post-operative complications including troponin levels were

collected. The primary outcomes were delays in surgery, post-operative complications, and length of stay.

Results: Two hundred patients were identified, 71 IMPCT and 129 control patients. Average age, sex and surgical procedure were no different between the two groups. Delay in surgery was not significantly different between IMPCT (22%) and control groups (26%, $p=0.09$). Average days of delay was also similar, 4.89 vs. 4.94 ($p=0.97$). Post-operative complication rate in the IMPCT group was higher than the control group but did not reach significance, 59.1% vs 19.3% ($p=0.09$). Cardiac complications were the most common in both groups, 31.0% and 30.2%, ($p=0.13$), respectively. The IMPCT group had higher elevated post-operative troponin levels compared with the control group, 20% vs. 16% ($p<0.05$). Length of stay trended towards higher for IMPCT compared to control patients, 16.2 vs 9.5 days ($p=0.08$).

Conclusion: The introduction of a new perioperative medicine consult service at our institution did not improve vascular surgery patient outcomes but may delay surgery and prolong hospital stay. Prospective studies are needed to determine IMPCT's role in this patient population.

A Shared Decision Making Approach to Prescribing ASA + Anticoagulant Management in Peripheral Artery Disease: The Role of a Vascular Profile

Douglas Wooster¹, Varun Kapila², University Health Network¹, University of Toronto¹, William Osler Health Centre².

Objective: This study aimed to analyze a population with peripheral arterial disease (PAD) to identify those who may benefit from combined aspirin (ASA) and anticoagulant (AC) therapy (ASA+AC), as presented in the COMPASS trial, and assess patients' acceptance of this management.

Methods: All patients presenting with PAD were prospectively assessed for their vascular profile of risk factors, presenting complaints, previous management and vascular disease in other beds and issues related to antiplatelet (AP) or AC use. All patients underwent US testing for PAD and physical examination; assessments of other vascular beds were reviewed. All patients underwent a standardized discussion regarding AP+AC treatment based on estimated risk of cardiac and peripheral arterial events balanced with patients' preferences. As a quality improvement study, expedited REB approval was granted.

Results: 121 patients were entered. The age range was 47 - 97; 64% were male. All patients had at least 1 risk factor; 27% had 4. Associated vascular involvement included coronary artery (28%), carotid (65%) and aortic aneurysm (12%). Potential risks for AP and AC use included intolerance (10%), bleeding (7%), falls (5%), renal dysfunction (4%) and seizures (0%); use of AP (85% ASA, 5% Clopidogrel) or AC (10%) was noted. 36% were considered to be ineligible for ASA+AC treatment. Analysis of presenting features suggested 42% might benefit from combined treatment; 90% declined due to cost or concern regarding potential benefit versus risk.

Conclusion: This assessment of patients presenting with PAD showed that many patients may not be candidates or benefit from combined ASA+AC therapy. Patient concerns further limit implementing this strategy at this time.

Saturday, September 14th, 2019

PAPER SESSION V: VENOUS DISEASE AND AV ACCESS

Endovenous Deep Vein Valve Creation for the Treatment of Chronic Venous Insufficiency

Gary K Yang¹, Jerry Chen¹, Lindsay Machan², Joel Gagnon¹, ¹Division of Vascular Surgery, University of British Columbia, Vancouver, BC, ²Department of Radiology, University of British Columbia, Vancouver, BC

Objectives: To assess the safety and efficacy of endovenous formation of autogenous neo deep vein valves in patients with chronic venous insufficiency secondary to deep vein reflux.

Methods: Patients with deep vein reflux and CEAP classification C4-C6 were treated with the BlueLeaf® endovenous valve formation system in 5 centres in New Zealand, Australia and Canada. Retrograde access to the common femoral vein was obtained followed by contrast venography and intravascular ultrasound to assess suitability of treatment sites. Suitable candidates will then have the valve creation device inserted to form monocuspid valves in the femoropopliteal vein segments spanning 7-11 mm in diameter. Successful valve creation was confirmed by intraoperative imaging. Patients were placed on 6 months of anticoagulation. Clinical outcomes include duplex ultrasound, physical exam and patient questionnaires.

Results: A total of 12 patients have been treated with CEAP classifications in C4 (n=2), C5 (n=5) and C6 (n=5) for both primary (n=8) and secondary (n=3) etiology and 1 undetermined. Successful valve creation occurred in 11/12 patients. Single valve formation was done in 5 patients, 2 valves in 5 patients and 3 valves in on patient. Present follow up ranges from 7 days to 1 year. During this period no occlusive DVT were reported. Access site complications were noted in 8 cases that were self-limiting. Mural thrombus was seen in 3 patients that all resolved by 90 days. Of the subject that reached at least 210 days follow up, 7/9 patients had ≥ 4 point improvement on the venous clinical severity score.

Conclusion: Preliminary data suggest that endovenous deep valve creation is a novel technique that shows promise in treating deep venous insufficiency.

Comparison of Endovenous Interventions versus Stripping and Ligation for Varicose Veins Arising from the Popliteal Fossa

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Objective: Venous insufficiency in the lower extremities is a common clinical complain. Office based DUS has revolutionized varicose vein management by defining precise varicosity anatomy. However, when varicose veins arise at the level of the popliteal fossa, there is marked variation in management. There has not been any comparison on ligation and stripping under local anesthetic with endovenous interventions. The objective of this study is to review the outcomes of varicose veins originating from the popliteal fossa at a single centre.

Methods: Retrospective analysis of varicose vein referrals between Sept 2014 to Sept 2017 to two practising surgeons was performed to screen for varicose veins arising from the popliteal fossa. Patients with CEAP classification C2 or higher were included. Patients were excluded if no procedures were done by the time of analysis or lost after initial consultation. Demographics, pre-operative and post-operative symptoms, operative data, anatomical distribution of varicose veins, symptomatic improvement, complications and re-intervention rates were collected and analyzed.

Results: After screening, 98 patients were identified to have varicose veins originating from the popliteal fossa, and 46 underwent intervention for their varicose veins. Most patients are female (80%) with an average age of 53 years old and average follow up was 34.1 ± 32.0 weeks. There were 21 ligation and stripping of veins and 25 endovenous procedures performed. The average improvement in CEAP clinical score was 2.56 ± 1.12 vs 1.41 ± 0.85 ($p=0.001$). The rate of recurrence is not different between the groups (5% vs 8%, $p=0.58$). There was a low rate of complications (6.3% vs 10% $p=0.69$). Symptomatic improvement was seen in both groups (100% vs 80%, $p=0.69$).

Conclusion: Open surgery under local anesthetic for varicose veins originating from popliteal fossa is a safe and viable option. It is associated with significant reduction of clinical grading compare to endovenous interventions.

Radiographic and Functional Outcomes of Vascular Thoracic Outlet Decompressive Surgery: Is There a Benefit?

Rikesh Parekh¹, Joshua Koulack¹, April Boyd¹, ¹Department of Vascular Surgery, University of Manitoba

Objective: To determine if surgical decompression for vascular thoracic outlet syndrome (TOS) outweighs the risks.

Methods: A retrospective chart review was completed on all vascular TOS procedures performed in Manitoba from 2009-2018.

Results: Twenty-five patients underwent first rib resection from 2009-2018; 4 for arterial TOS (aTOS) (3F, 1M) and 19 for venous TOS (vTOS) (10F, 9M); 2 were lost to follow-up. All aTOS had cervical ribs, and had either aneurysm formation (1) or arterial occlusion (3). Three required arterial reconstruction; at 6 weeks 75% were improved.

All vTOS patients presented with deep vein thrombosis (manifesting mainly as extremity swelling and pain) and were anticoagulated. Eleven patients had an inciting event or activity including lifting weights, skiing, or drumming. Eleven patients underwent thrombolysis and 8 underwent thrombectomy. Preoperative venograms showed 12 with stenosis and one occlusion. Fourteen had either occlusion or worsening stenosis in Adson's maneuver. Operative complications included 9 pneumothoraces; 6 required chest tubes or drain placement. Five had neurologic dysfunction.

At 6 weeks, 13 were symptomatically improved and 3 unchanged. Venograms showed stenosis in 5 and occlusion in 1; 7 demonstrated a positive Adson's. Five patients required venoplasties. At final follow-up, 15 of 18 patients had improved symptoms; 5 without stenosis or positive Adson's, 5 with stenosis, 1 with occlusion, and 6 with a positive Adson's. Of those with improvement, 5 patients had a normal venogram. Of patients that did not improve, 2 had stenoses, and one had a positive Adson's.

Conclusions: aTOS patients did well with bypass when performed, and had excellent outcomes post operatively. Decompression improves symptoms but not radiographic stenosis in vTOS and has high complication rates. Future work includes a follow-up survey regarding ongoing symptoms and satisfaction having undergone decompressive surgery. A prospective series with contemporary venous reconstruction may help determine the utility of vTOS decompression.

Functional Durability of Hemodialysis Access

Mark Rockley¹, Swapnil Hiremath¹, Prasad Jetty¹, ¹University of Ottawa

Objectives: The decision to perform hemodialysis (HD) via arteriovenous access (AV) using either a fistula (AVF) or graft (AVG) or tunneled central venous catheter (CVC) is not well informed by functional durability data. We investigated the functional durability of the first HD access site for patients on chronic HD.

Methods: This retrospective cohort study identified the intended first access site of all patients undergoing chronic HD for over 3 months in the Champlain NephroCare network between 2003-2018. Cumulative access site durability was defined as the functional use of access site despite minor AV revisions or CVC exchange over guidewire. Survival analysis was performed with piecewise Cox regression with competing risk for transplants.

Results: 3068 eligible first dialysis accesses were identified, of which 1438 (46.9%) were AVF, 83 (2.7%) were AVG, and 1547 (50.4%) were CVC. The access site was functional for the

entire duration of HD requirement in 47.4% of AVF, 21.7% of AVG, and 57.3% of CVC ($p<0.01$), and never used in 22.1% of AV compared with 6.2% of CVC ($p<0.01$) (Figure 1).

When used, access median cumulative patency was longest for AVF, followed by CVC and AVG (6.2, 4.5, and 3.5 years respectively, $p<0.01$). Female gender and Indian ethnicity were associated with reduced durability for all access. AV site durability was reduced if there was a history of prior CVC cannulation (HR=1.29 $p=0.01$) or prosthetic graft was used (HR 2.22 $p<0.01$). When adjusted for baseline characteristics, age interacted with probability of access site durability for the entire duration of HD requirement; AVF access was superior in patients younger than 62.2 years old, whereas CVC was superior in older patients ($p<0.01$) (Figure 2). Additionally adjusting for age, CVC site durability was superior in patients with total HD requirement less than 5.1 years, after which AVF access was superior ($p<0.01$).

Conclusion: Age and life expectancy should feature strongly in the selection of HD access. AVF access site maintenance was most durable in patients younger than 62 years old and greater than 5 year HD requirement.

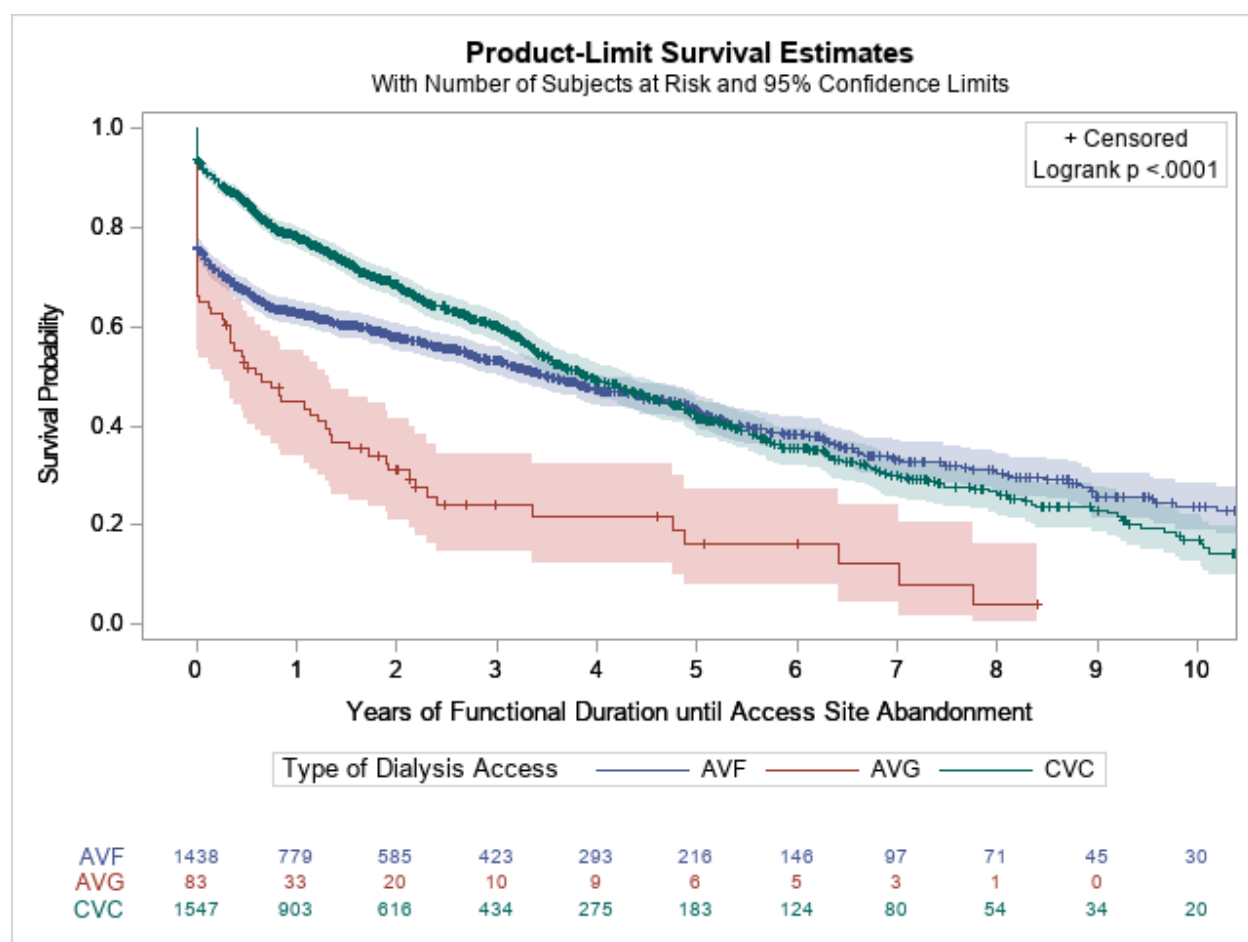


Figure 1: Kaplan-Meier survival curve demonstrating cumulative access site durability over time for AVF (Blue), AVG (Red), and CVC (Green) access. The unadjusted AVF and CVC curves meet at approximately 5 years, echoed by the adjusted interaction analysis demonstrating superior AVF durability after 5.1 years.

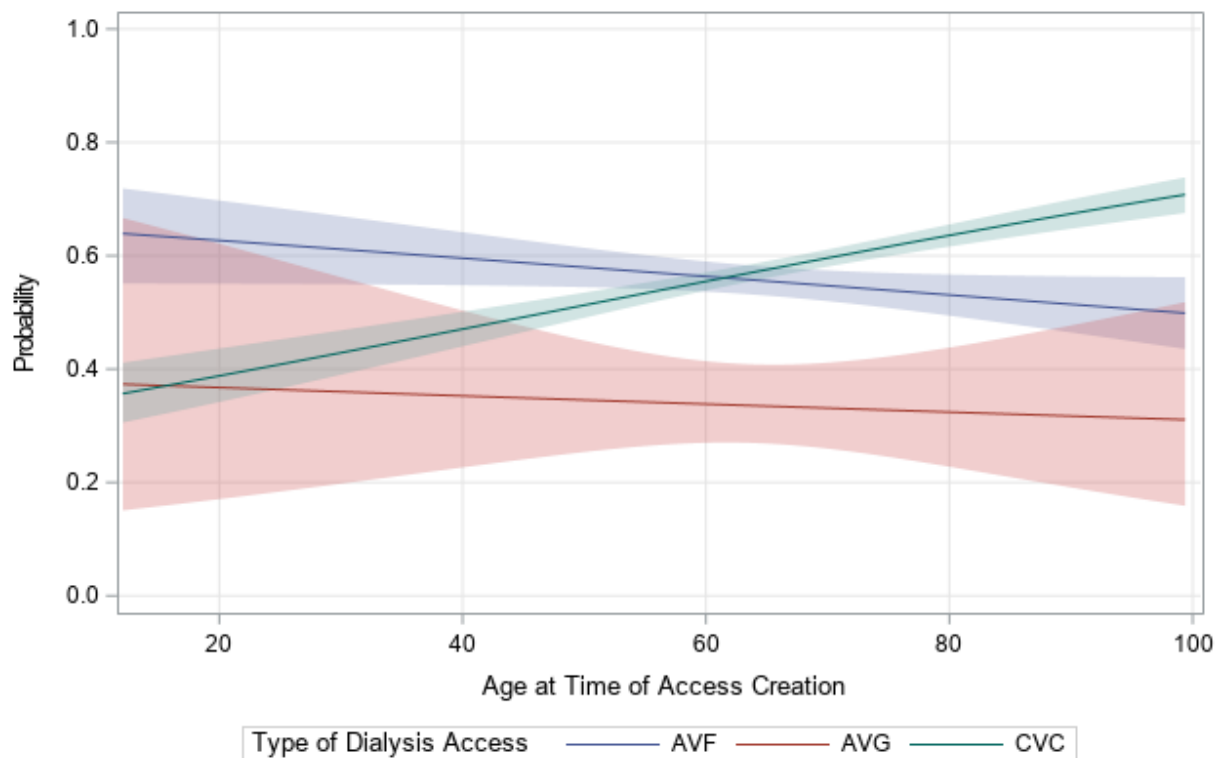


Figure 2: Probability of maintained access site durability for the entire duration of patient HD requirement, by age, for AVF (Blue), AVG (Red), and CVC (Green) access. AVF is more likely to be sustainably durable for patients under 62 years old, while CVC is superior above 62 years old. AVG is either inferior or not statistically different throughout the range of age.

Risk Factors and Outcomes of Revisions on Arteriovenous Hemodialysis Access

Mark Rockley¹, Swapnil Hiremath¹, Prasad Jetty¹ ¹University of Ottawa

Objectives: Arteriovenous access (AV) using either a fistula (AVF) or graft (AVG) for hemodialysis (HD) access is often complicated by poor function requiring revision. We investigated the risk factors and durability of revision on AV access sites for patients on chronic HD.

Methods: This retrospective cohort study identified all patients undergoing chronic HD for over 3 months in the Champlain NephroCare network between 2003-2018. Access creations, revisions, and functionality were documented. Cumulative access site durability was defined as the functional duration of AV access site despite revisions. Cox regression survival analysis was performed with competing risks for transplants.

Results: 2018 eligible AV access creations in 787 patients were identified, composed of 1808 (90%) AVF and 210 (10%) AVG access sites. 67% of AV received at least one revision, and 12% received two or more revisions. Revisions were most commonly angioplasty (95.8%).

Adjusting for baseline factors, AVF were less likely to undergo endovascular revision than AVG (HR 0.79, $p < 0.01$). Lower arm AVF were more likely to undergo revision than upper arm AVF (HR 1.46 $p < 0.01$), and prior CVC access almost doubled the revision rate (HR 1.76, $p < 0.01$) (Figure 1).

After revision, the median functional duration was 1.24 years. One revision was associated with AV failure (HR 3.24 $p < 0.01$) which increased to over ten times the hazard after two revisions (HR 11.9 $p < 0.01$). Revisions for restoring patency were less durable than maintaining patency (HR 2.94, $p < 0.01$). Post-revision durability was negatively associated with access in the lower

arm, AVG rather than AVF, and if open revision was required (Figure 2). Sensitivity analyses corroborated findings when only considering the first AV access per patient.

Conclusion: Revisions on AV access are exceedingly common yet sustain limited durability post-procedure. Repeated revisions appear especially futile, especially on lower arm, AVG, or occluded access sites.

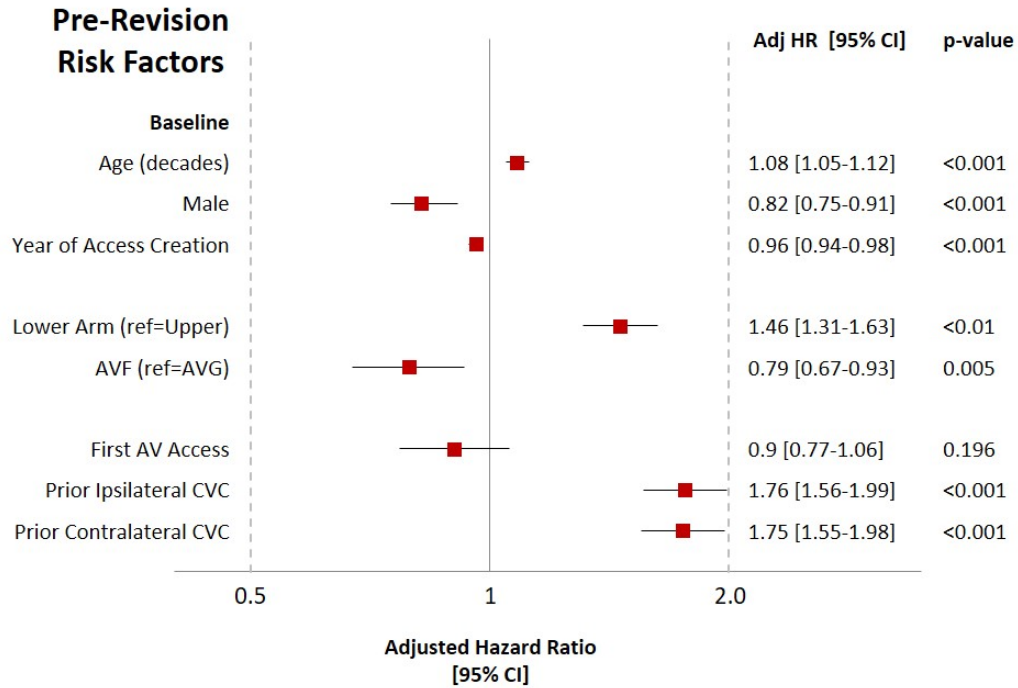


Figure 1: Multivariate Cox survival analysis model of risks associated with need for AV interventions.

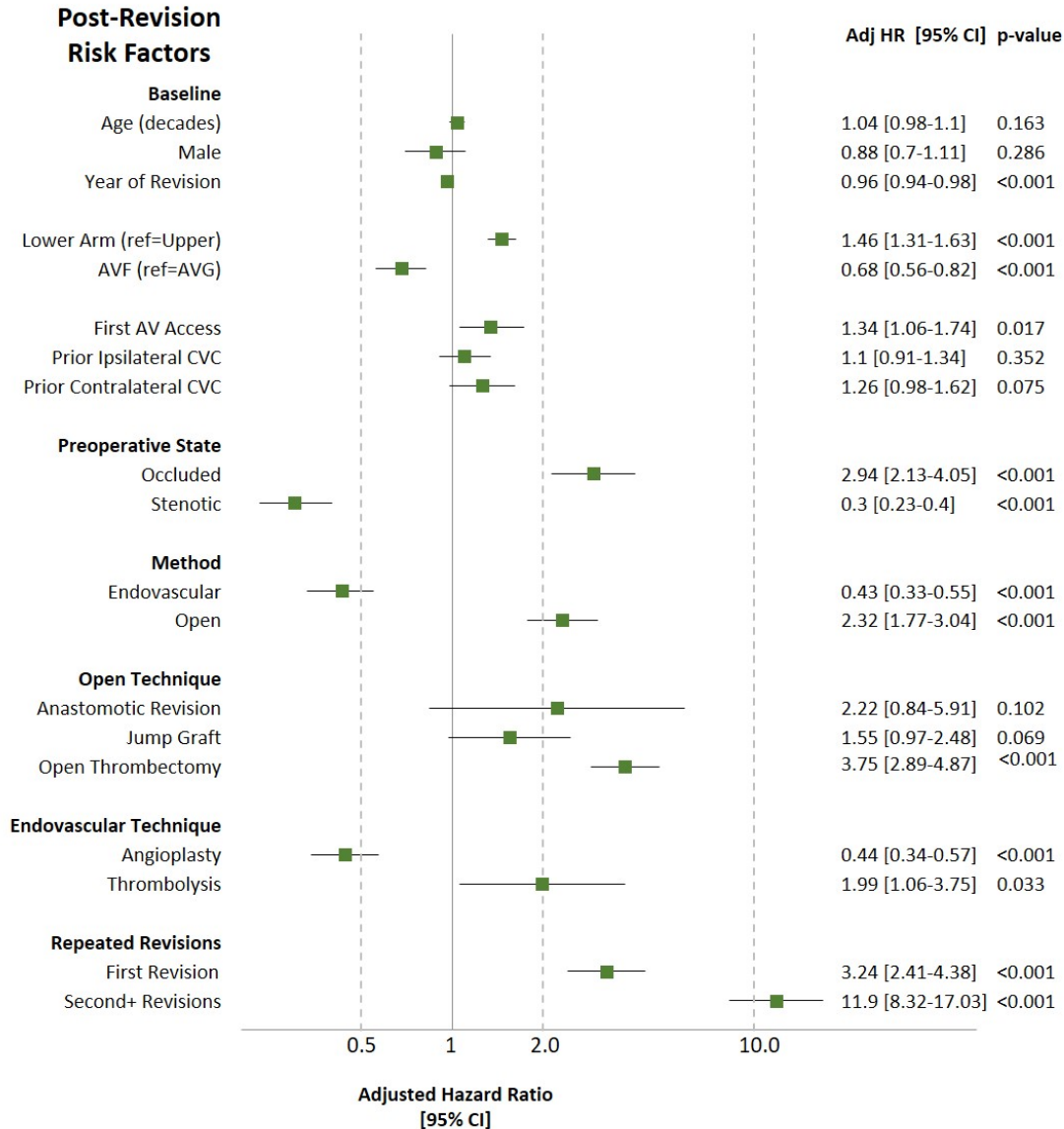


Figure 2: Multivariate Cox survival analysis model of risk associated with failure following AV interventions. Repeated revisions are treated as cumulative time-varying variables. All procedural characteristics are adjusted for baseline risk factors.

Saturday, September 14th, 2019
PAPER SESSION VI: PAD II

The Coagulation Cascade Profile of Peripheral Arterial Disease Patients: Initial Steps to Personalized Medicine

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Objective: Studies have demonstrated that patients with PAD are more prone to thrombotic events. However, the exact mechanism as to why this is the case is unknown. Therefore, we investigated the various regulatory proteins and coagulation factors involved in thrombus formation within a cohort of non-PAD and PAD patients.

Methods: A randomly selected group of 76 non-PAD and PAD patients underwent an assessment of their cytokines, natural anti-coagulants, coagulation factors, markers of thrombin generation, fibrinolysis and endothelial injury. Logistic regression analysis was conducted while controlling for confounding factors.

Results: Our results demonstrate that relative to non-PAD controls, the indicator levels of thrombin generation, thrombin Fragments F1+2 (Frag 1+2) and thrombin-anti-thrombin complex (TAT), were significantly elevated in PAD patients. In particular, Frag 1+2 and TAT levels were escalated primarily in patients with severe PAD or CLI, and not in patients with moderate PAD. Furthermore, CRP, soluble platelet factor 4 (sPF4), Neutrophil gelatinase-associated lipocalin (NGAL) and thrombomodulin (TM) were also found to be significantly upregulated in severe PAD and CLI patients, but not in patients with moderate PAD. Lastly, we observed a significant decrease in coagulation factors FXII, FXI and FIX in all PAD patients relative to control non-PAD.

Conclusion This is the first study that investigates the coagulation cascade as well as the regulators of coagulation in patients with PAD. Our data demonstrates that patients with severe PAD and CLI are more prone to thrombin activation; however, moderate PAD patients have similar levels of circulating bio-markers of thrombin generation as the non-PAD control group. We propose that the enhanced thrombin activation state in advanced PAD is concomitant to increased platelet activation, endothelial injury, and pro-inflammatory state. Our data suggests personalizing anticoagulation treatment for the severe PAD and CLI patient population.

Characteristics of High Cost Inpatients with Peripheral Arterial Disease

Mark Rockley¹, Elizabeth Kunkel¹, Sudhir Nagpal¹, Danial I McIssac¹, Kednapa Thavorn¹, Alan Forster¹, Daniel Kobewka¹, ¹University of Ottawa

Objectives: Inpatient treatment of Peripheral Arterial Disease (PAD) is over six times more costly than the general inpatient population. Our objective is to describe factors associated with cost for patients admitted for PAD, the characteristics of very high cost patients, and their outcomes including amputations and death.

Methods: We performed a retrospective cohort study of admitted patients receiving a procedure for PAD between 2007 and 2017, using The Ottawa Hospital Data Warehouse. Demographic, comorbidity, inpatient events, and hospital cost data during the index admission was collected. A generalized linear model examined overall drivers of cost, and logistic regression models identified features associated with the highest 10% cost patients.

Results: We identified 3,084 eligible patients totaling \$72.2 million in hospital costs. The mean cost of the most expensive 10% patients was \$88,076, over 5 times more than the bottom 90% (\$16,217) (Table 1). High cost patients were more likely to present urgently (OR 1.63 p<0.01). After adjusting for pre-admission factors, high cost patients were more likely to experience an adverse Patient Safety Incident (OR 13.49 p<0.01) including Surgical Site Infection (20.4% vs

2.9% $p<0.01$), amputation (OR 2.79 $p<0.01$), ICU admission (OR 6.42 $p<0.01$), and disposition barriers requiring Alternate Level of Care status (OR 10.44 $p<0.01$). The high cost group was more likely to receive hybrid revascularization (OR 7.07 $p<0.01$) (Figure 1). Amputation on high patients were delayed (Median 11 vs 6 days, $p<0.01$). High cost patients had higher than predicted mortality (18% vs 9.2% $p<0.01$) compared with the low-cost group (3.0% vs 2.7% $p=0.50$) and less than half of high cost patients were discharged home (47.2% vs 87.4% $p<0.01$). **Conclusion:** The most expensive top 10% of patients experienced higher than predicted morbidity and mortality, while costing over five times more per patient than the low-cost patients. Multiple potentially modifiable factors such as adverse events are associated with higher costs.

	Low Cost Bottom 90%	High Cost Top 10%	p-value
Number of Patients	2775	309	
Index Admission Costs (\$)			
Total Cost (mean (SD))	16,217 (10,322)	88,076 (54,720)	-
Direct Cost (mean (SD))	11,679 (7,606)	63,308 (40,420)	-
Indirect Cost (mean (SD))	4,538 (3,078)	24,768 (15,783)	-
Sum of All Patients' Costs	45,002,765	27,215,354	-
Admission Characteristics			
Presentation			<0.001
<i>Elective</i>	1441 (51.9)	83 (26.9)	
<i>Urgent or Emergent</i>	1334 (48.1)	226 (73.1)	
Revascularization			<0.001
<i>Open</i>	1456 (52.5)	125 (40.5)	
<i>Endovascular</i>	551 (19.9)	60 (19.4)	
<i>Hybrid</i>	425 (15.3)	78 (25.2)	
<i>None</i>	343 (12.4)	46 (14.9)	
Patient Safety Incident			<0.001
<i>Non-severe PSI</i>	546 (19.7)	183 (59.2)	
<i>Severe PSI</i>	56 (2.0)	56 (18.1)	
Surgical Site Infection (%)	81 (2.9)	63 (20.4)	<0.001
Length of Stay (median [IQR])	6.0 [3.0, 11.0]	40.0 [29.0, 58.0]	<0.001
ICU Admission (%)	79 (2.8)	73 (23.6)	<0.001
ALC Designation (%)	146 (5.3)	125 (40.5)	<0.001
Amputation During Index Admission			
Days Until First Amputation (median [IQR])	6.0 [2.0, 12.0]	11.0 [4.0, 16.0]	<0.001
Any Amputation During Index Admission (%)	550 (19.8)	123 (39.8)	<0.001
Type of Amputation (%)			<0.001
<i>Minor Amputation</i>	314 (57.1)	40 (32.5)	
<i>Major Amputation</i>	236 (42.9)	83 (67.5)	
Discharge from Index Admission			
Discharge Pathway (%)			<0.001
<i>Routine Discharge</i>	2424 (87.4)	146 (47.2)	
<i>Transferred to Long-Term Care or Rehabilitation</i>	257 (9.3)	106 (34.3)	
<i>Left Against Medical Advice</i>	13 (0.5)	1 (0.3)	
<i>In-hospital Mortality</i>	82 (3.0)	55 (17.8)	

Table 1: Costs and characteristics of the index admission for PVD treated with surgery.

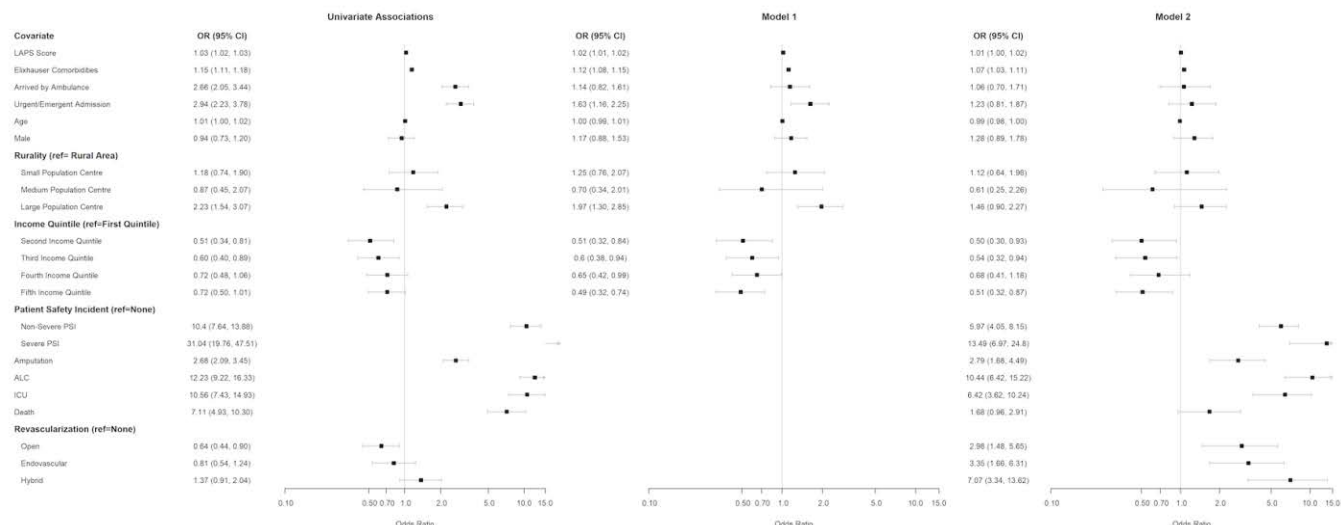


Figure 1: Odds of Top 10% High-Cost status of PVD patients on univariate and logistic regression analyses. Unadjusted, pre-admission covariate adjusted (Model 1), and fully adjusted (Model 2) parameter estimates are shown.

Home Care Nursing After Elective Vascular Surgery: An Opportunity to Reduce Emergency Department Visits and Hospital Readmission

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Background: Events occurring outside the hospital setting are under-evaluated in surgical quality improvement initiatives and research.

Objective: To quantify regional variation in home care nursing following vascular surgery and explore its impact on emergency department (ED) visits and hospital readmission.

Methods: Patients who underwent elective vascular surgery and were discharged directly home were identified from population-based administrative databases for the province of Ontario, Canada, 2006-2015. The index surgeries included carotid endarterectomy, open and endovascular aortic aneurysm repair and bypass for lower extremity peripheral arterial disease. Home care nursing within 30 days of discharge was captured and compared across regions. Using multilevel logistic regression, we characterized the association between home care nursing and the risk of an ED visit or hospital readmission within 30 days of discharge.

Results: The cohort included 23,617 patients, of whom 9,002 (38%) received home care nursing within 30 days of discharge home. Receipt of nursing care after discharge home varied widely across Ontario's fourteen administrative health regions (range 16% to 84%), even after accounting for differences in patient case-mix. A lower likelihood of an ED visit or hospital readmission within 30 days of discharge was observed among patients who received home care nursing following three of four index surgeries: carotid endarterectomy Odd Ratio 0.74, 95% CI 0.61-0.91; endovascular aortic aneurysm repair Odd Ratio 0.85, 95% CI 0.72-0.99; open aortic aneurysm repair Odd Ratio 1.06, 95% CI 0.91-1.23; bypass for lower extremity peripheral arterial disease Odd Ratio 0.81, 95% CI 0.72-0.92.

Conclusion: Home care nursing may contribute to reducing ED visits and hospital readmission and is variably prescribed after vascular surgery.

Development and Initial Evaluation of a Canadian, University-Affiliated, Multidisciplinary Limb-Preservation Clinic

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Objective: In September 2017, The Ottawa Hospital (TOH) Division of Vascular and Endovascular Surgery opened a limb-preservation clinic in conjunction with colleagues from infectious diseases and plastic and orthopedic surgery. We sought to describe services provided by the clinic and evaluate whether it is achieving its mandate of providing excellent wound clinical care, education, and research.

Methods: We prospectively collected data from September 2017 to April 1, 2019 on the number and types of clinic visits and treatments provided within the clinic as well as its academic activities. In June 2018, a specialist wound care nurse also began inputting demographic, wound, and treatment data into how2trak wound management software serially during patient visits.

Results: There have been 2,293 patient visits since the clinic opened, including 791 (34%) in 2017 and 1,502 (66%) in 2018, the majority (71%) of which were from outpatients. Wound therapies provided to these patients include vacuum-assisted wound therapy (33%), surgical debridement (6%), ultrasound debridement (2%), split-thickness skin grafting (1%), and toe or ray foot amputations (1%). The most common types of wounds managed among the 142 patients recorded in how2trak were arterial ulcers (34%), postoperative vascular surgical wounds (29%), diabetic foot ulcers (11%), and venous ulcers (10%). These wounds were most often located on the foot (49%) and had a mean volume of 14.3 (standard deviation=30.4) cm at presentation. Mixed-effects models accounting for clustering of data within patients suggested that mean wound volume decreased by 1.6 (95% confidence interval=0.86-2.27) cm per clinic treatment visit (p<0.001). The clinic has provided elective rotations for four physicians from infectious diseases, dermatology, and palliative care; three nursing preceptorships; and has enrolled 78 patients into two randomized trials.

Conclusions: Our results suggest that the TOH limb-preservation clinic appears to be achieving its mandate of improving wound clinical care, education, and research.

Saturday, September 14th, 2019

PAPER SESSION VII: THE ABDOMINAL AORTA

Combined Neuraxial and General Anaesthesia Significantly Improves Peri-Operative Outcomes Following Elective Open Abdominal Aortic Aneurysm Repair

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Toronto, Toronto, ON, Canada; ³Department of Surgery, King Saud University, Riyadh, Kingdom of Saudi Arabia; ⁴Li Ka Shing Centre for Healthcare Analytics Research and Training (CHART), Li Ka Shing Knowledge Institute, St. Michael's Hospital Toronto, ON, Canada; ⁵Leslie Dan Faculty of Pharmacy, University of Toronto, Toronto, ON, Canada; ⁶Division of Vascular Surgery, Peter Munk Cardiac Centre & University Health Network, and University of Toronto, Toronto, ON, Canada; ⁷Division of Cardiac Surgery, Li Ka Shing Knowledge Institute of St. Michael's Hospital, and University of Toronto, Toronto, ON, Canada.

Objective: Evidence for the use of neuraxial anaesthesia in the context of open abdominal aortic aneurysm repair (AAA) is sparse. The purpose of this study was to determine the 90-day outcomes of combined general and neuraxial anaesthesia (NA) versus general anaesthesia without neuraxial (GA) for elective open AAA repair.

Methods: A retrospective population-based cohort study was conducted using Ontario administrative health data from 2003 to 2016. Patients undergoing open AAA with NA versus GA were identified using diagnostic, procedure and billing codes. A propensity score for NA was used to construct inverse probability of treatment weighted (IPTW) regression models to assess differences in 90-day mortality, major adverse cardiovascular events (MACE), acute kidney injury (AKI), dialysis, respiratory failure, mechanical ventilation days, intensive care unit (ICU) and hospital lengths of stay, and discharge home.

Results: A total of 10,477 elective open AAA repairs were identified, with 9,003 (85%) NA and 1,444 (14%) GA patients. Neuraxial patients had significantly lower hazards for all-cause mortality (HR 0.47, 95% CI 0.37, 0.61, $p<0.0001$), MACE (HR 0.72, 95% CI 0.60, 0.86, $p=0.0002$) and stroke (HR 0.54, 95% CI 0.31, 0.96, $p=0.04$). Furthermore, NA patients were at lower odds for AKI (OR 0.66, 95% CI 0.49,0.89, $p=0.0058$), respiratory failure (OR 0.41, 95% CI 0.36,0.47, $p<0.0001$), and limb complications (OR 0.30, 95% CI 0.25,0.37, $p<0.0001$), with significantly higher odds to be discharged home(OR 1.32, 95% CI 1.15,1.51, $p<0.0001$). Neuraxial anaesthesia was also associated with significant mechanical ventilation and ICU and hospital length of stay benefits.

Conclusion: Neuraxial anaesthesia in open AAA repair patients is associated with reduced risk of 90-day mortality, MACE, stroke, AKI, dialysis, respiratory failure, limb complications, and shorter mechanical ventilation times, ICU and hospital lengths of stay, as well as higher likelihood for discharge home. Neuraxial anaesthesia should be considered as a standard adjunct to general anaesthesia in open AAA repairs.

Safety and Effectiveness of Single Proglide Vascular Access in Patients Undergoing Endovascular Aneurysm Repair (EVAR)

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Objective: To evaluate the safety and effectiveness of single Proglide use per access site for Endovascular Aneurysm Repair (EVAR) of Abdominal Aortic Aneurysms (AAA).

Methods: A retrospective cohort study was performed for all elective percutaneous EVARs from November 2015-December 2017 at the QEII Health Sciences Centre, Nova Scotia. Exposure of interest was number of Proglides used per access site. Outcomes of interest included Vascular Access Site and Access Related Complications 2 (VARC-2) and Bleeding Academic Research Consortium (BARC) criteria. Groups were compared with Fisher exact test, ANOVA or

Wilcoxon rank sum, as appropriate. Logistic regression was used to compare the effect of single Proglide use on VARC-2 and BARC.

Results: A total of 131 cases were included, of which 116 had bilateral single Proglide for access closure. Patient demographic and operative data are presented in Tables 1 and 2, respectively. Groups were similar for all characteristics except smoking status, with an increased proportion of former smokers in the non-single Proglide group. 119 (90.8%) patients had single Proglide use on the right femoral artery and 121 (92.4%) on the left. 16 patients had Proglide deployment issues (12.2%). VARC2 occurred in 8/131(6.11%) of patients: 6/116 (5.17%) with bilateral single Proglides and 2/15(13.3%) with at least two Proglides on one access site. BARC occurred in 6/131 (4.58%) of patients: 5/116 (4.31%) with bilateral single Proglides and 1/15 (6.67%) with at least two Proglides on one access site. Single Proglide use was not associated with a difference in VARC-2 (OR 0.35, 95%CI 0.64-1.94) or BARC (OR 0.63, 95%CI 0.07-6.79). No patients developed pseudoaneurysms or required repeat intervention for bleeding. The median length of stay was 1 day.

Conclusion: Single Proglide use per vascular access site in patients undergoing EVAR is a safe and effective method for access closure.

	Entire Cohort (n=131)		Single Proglide (n=116)	Non-Single Proglide (n=15)			p-value
	n or median	% or IQR	n or median	% or IQR	n or median	% or IQR	
Age	73	68-79	66	74-79	68	72-75	0.318
Sex (Male)	106	80.9	93	80.2	13	86.7	0.735
ASA							0.161
2	28	36.4	23	32.9	5	71.4	
3	45	58.4	43	61.4	2	28.6	
4	4	5.19	4	5.71	0	0.0	
BMI	24	26.9-30.2	26.9	24-30.2	25.1	24.7-28.4	0.504
Comorbidities							
CAD	49	37.4	44	37.9	4	33.3	0.785
HTN	109	83.2	98	84.5	11	73.3	0.280
CKD	16	12.2	15	12.9	1	6.67	0.693
PVD							
DLP	64	48.9	56	48.3	15	100	0.788
DM							

Table 1: Baseline characteristics and comorbidities

Onyx is More Effective Than Coil Embolization for the Treatment of Type II Endoleaks

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Objective There is little evidence for the optimal treatment of type II endoleaks associated with aortic sac growth. Previous studies rarely compare treatment modalities and lack long-term follow-up. The purpose of this study is to compare our results when treating type II endoleaks

with either Onyx (a liquid embolization agent consisting of ethylene vinyl alcohol) embolization or coil embolization.

Methods: A retrospective review of a prospectively collected vascular surgery database was performed to identify all patients who underwent embolization of a type II endoleak for aortic sac growth after EVAR. Onyx and coil embolization groups were compared using univariate statistics.

Results: From 1544 EVARs, 57 patients were diagnosed with a type II endoleak associated with sac enlargement on postoperative surveillance CT. Type II endoleaks were treated with either Onyx embolization (n=26) or coil embolization (n=31). The average aneurysm size at the time of embolization was larger in the Onyx group (77.9mm) compared to coil embolization (73.4mm). Mean follow up was 57 months in the Onyx group and 74 months in the patients treated with coil embolization. In the Onyx group, two patients (7.7%) required graft explantation compared to five patients (16.1%) in the coil embolization group (p=0.33). The coil embolization group had a significantly higher rate of further reinterventions compared to the Onyx group (58% vs 19%, p=0.003). Two patients in each group presented with secondary rupture of the aneurysm sac following attempted embolization (overall risk of rupture 7%).

Conclusions: Type II endoleaks associated with sac growth treated with Onyx are less likely to require further reinterventions than with coil embolization, and there is a trend towards fewer graft explants. With a high rate of further reintervention and potential for sac rupture; diligent follow-up is required after attempted type II endoleak embolization regardless of technique.

The Relationship Between Macrophages, MMP-12, IL-6, and Intraluminal Thrombus in Human Abdominal Aortic Aneurysms

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Objectives: We have previously shown that AAA rupture occurs in regions of low wall shear stress, where flow recirculation and intraluminal thrombus (ILT) deposition predominate. We planned to analyze differential MMP12, and IL-6 levels in human AAA tissue. We hypothesized that AAA with higher ILT will have greater macrophage-mediated elastolytic activity, thus contributing to the differential in sides of the AAA that rupture.

Methods: Tissue was obtained from patients undergoing open infrarenal AAA repair (n=21) or aortobifemoral bypass (control) (n=8). Informed consent was obtained. Full thickness AAA tissue was harvested from stereotyped locations. ILT deposition was measured at stereotyped locations using CT prior to surgery. Control tissue was sampled from normal aorta. Tissue was processed for histological analysis of inflammatory cells and CD68+macrophages; or snap frozen in liquid N₂ and then stored at -80 for MMP-12 and IL-6 immunoassay.

Results: There were no significant differences between AAA and controls at baseline; aside from higher rates peripheral vascular disease and younger age in the control group (p<0.01). There was significantly greater inflammation found in AAA tissue compared to control (p<0.00001). There was also significantly higher CD68+ macrophages counts in ILT-rich regions compared with control (p<0.0001); however, there was no difference in MMP-12 or IL-6 levels between ILT and non-ILT regions, and no correlation between ILT thickness and MMP-12 levels.

Conclusion: Although we demonstrated inflammation and increased CD68+ macrophage levels adjacent to ILT in AAA compared with control; contrary to our hypothesis, there was no difference in macrophage-related elastases and cytokines suggesting that macrophages may have a limited role in AAA degeneration. We did however notice a trend towards higher levels of interleukin in thrombus containing regions compared to non-thrombus regions and control

tissues, suggesting that perhaps macrophage activity may be elevated in the thrombus containing regions of the AAA that tends to rupture.

Systematic review and meta-analysis of preventative strategies for acute kidney injury in patients undergoing elective abdominal aortic aneurysm repair

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Objective: To assess the effect of various preventative interventions, such as remote ischemic preconditioning (RIPC), versus standard therapy or placebo for reducing the incidence of postoperative acute kidney injury (AKI) in patients undergoing elective abdominal aortic aneurysm (AAA) repair.

Methods: We searched the relevant online databases for randomized controlled trials of 10 patients or greater testing preventative interventions versus standard therapy, another intervention or placebo in patients undergoing elective AAA repair using the open or endovascular approach. Risk of bias of included studies was assessed using the Cochrane Collaboration risk of bias tool. Where possible we pooled the results of similar interventions using random effects meta-analysis.

Results: We included 17 trials involving 1443 participants. Most trials were small, single-centre studies, and had varying definitions of AKI. The preventative strategies with possible protective effects were mannitol, a composite of antioxidant supplements, sodium bicarbonate, an open extraperitoneal approach, a low-dose of human atrial natriuretic peptide (hANP) and hydroxyethylstarch combined with crystalloid solutions. Curcumin, methylprednisolone, carbon dioxide contrast medium, hemodynamic monitoring and N-acetylcysteine were found to lack a beneficial effect. Pooling the results of six trials of 355 participants who reported on ischemic preconditioning showed no statistically significant difference between RIPC and standard treatment (OR 1.20, 95% CI 0.37, 3.89). None of the interventions studied significantly reduced mortality or renal replacement therapy (RRT).

Conclusion: No strategy was found to be conclusively beneficial for the prevention of AKI in patients undergoing elective AAA repair. Mannitol, a composite of antioxidant supplements, sodium bicarbonate, hANP and an extraperitoneal approach have all been suggested to be beneficial but their effects need to be confirmed by larger, properly conducted and powered randomized controlled trials.

Effective Post-EVAR Surveillance and Management of Graft Complications Amongst Rural Inhabitants in Manitoba

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Objective: All aortic surgery in Manitoba occurs in Winnipeg at two university hospitals. Given the large geographic catchment area, we hypothesized that patients living rurally would have inferior post-EVAR surveillance. We sought to determine if post-EVAR surveillance and endoleak management differed between urban and rural inhabitants.

Methods: Our project was approved by the ethics board at the University of Manitoba. A retrospective chart review was performed for all patients who underwent EVAR at Winnipeg Health Sciences Centre between 2012-2014. Charts were analyzed from the day of surgery until

December 31st, 2018. Patients living outside of Winnipeg city limits were considered rural. Adequate follow up was defined as a CT-angiogram within one year of surgery and then an annual CT or ultrasound thereafter. The primary outcome measure was adequate follow up. Secondary outcomes included the frequency of endoleaks, re-interventions and death. Univariate statistics were performed.

Results: Eight-six patients underwent EVAR between 2012-2014, accounting for 45% of all EVARs performed in Manitoba during this time period. Forty-nine percent of patients lived rurally. There was no difference in surveillance between patients living in Winnipeg or in a rural location (81% vs 77%; $p=0.64$). There was a similar number of endoleaks (20% vs 23%; $p=0.83$), and re-interventions for endoleaks (11 vs 7 interventions; $p=0.56$) and limb stenosis/occlusion (4 vs 2 interventions; $p=0.5$). There was a non-significant trend towards increased mortality amongst urban patients (41% vs 35%; $p=0.05$). Amongst patients who died, surveillance was similar between groups ($p=0.16$).

Conclusion: The surveillance of patients post-EVAR and the management of graft complications is similar in patients living in Winnipeg and in rural Manitoba. This supports the ongoing centralization of vascular care within Manitoba. The incidence of graft-related complications is consistent with outcomes from other jurisdictions. Future work will characterize the entire provincial caseload during this time period.