Canadian Society for Vascular Surgery
Société canadienne de chirurgie vasculaire

2017 Annual Meeting on Vascular Surgery

BANFF, ALBERTA
September 15-16, 2017
Fairmont Banff Springs Hotel

FINAL PROGRAM – PROGRAMME FINAL

Welcome to Banff!

It is my pleasure to welcome you to the Canadian Society for Vascular Surgery's 39th Annual Meeting. Our theme this year is "Expanding Frontiers, Increasing Responsibility" and it promises to be an exceptional event, featuring timely, insightful, and relevant scientific sessions. Our invited guest speaker, Professor Alan Dardik hailing from Yale University School of Medicine, will be giving two talks during the meeting and many are looking forward to his presentations.

This meeting will provide a forum for continuing medical education for vascular surgeons and others interested in the investigation and treatment of patients with vascular disease. It also provides an opportunity for the exchange of ideas, promotion of education and research and discussion of matters of interest to its members and others. There are also some social activities on tap including the CSVS Annual Dinner at the Stanley Smokehouse located on the Fairmont Banff Springs Golf Course.

An exciting two days awaits giving you an opportunity to stay abreast of vascular developments, network with your peers, and increase your CPD hours.

A special thanks to the members of the Program Committee for putting together an excellent program.

Have a great meeting!

Dr. Rafik Ghali
CSVS President

CSVS EXECUTIVE COMMITTEE

Dr. Rafik Ghali, President,
Dr. Kent MacKenzie, President Elect
Dr. Greg Browne, Past President
Dr. Thomas Forbes, Past Past President
Dr. April Boyd, Secretary
Dr. Keith Baxter, Treasurer
Dr. John Harlock, 2017 Program Chair
Dr. Joel Gagnon, 2017 Assistant Program Chair
Dr. Marie-France Guimond, LOC 2017 Chair
Dr. Guiseppe Papia, Education Committee Chair
Dr. Luc Dubois, Research Committee Chair
Dr. Thomas Lindsay, RCPSC Representative
Dr. Dion Davidson, Member at Large East
Dr. Ricardo Ruz, Member at Large, Central
Dr. David Kopriva, Member at Large, West
Dr. Karim Alibhai, Member at Large (Web)

INTERACTIVE MEETING

Delegates will be actively participating in the meeting by using touchpads to provide feedback via the Audience Response System that will be used during the plenary sessions and VSEP Jeopardy.

INVITED GUEST SPEAKER

The CSVS is pleased to present Dr. Alan Dardik, Yale University School of Medicine, as the 2017 invited guest speaker. Dr. Dardik spends significant effort teaching and doing research at Yale, and is greatly looking forward to sharing some of his findings as well as interacting with all attendees and especially residents, fellows and students.

WHY YOU SHOULD ATTEND!

As the premier meeting of the Canadian Society for Vascular Surgery, this conference provides several unique and engaging educational opportunities for the participants:

- Network with colleagues from across Canada
- Translate scientific discoveries into your practice
- Raise questions, debate the issues, plan follow-up studies, and discuss results;
- Discuss your own research and observation
- Meet with poster presenters to learn about their research objectives; and
- Visit a number of exhibit booths featuring products specifically designed for the treatment of vascular diseases.

TARGET AUDIENCE

The CSVS Annual Scientific meeting is intended for clinicians, researchers, trainees/students, and allied health professionals involved in research, treatment and management of vascular diseases.

CSVS VISION

To Lead Vascular Care in Canada

CSVS MISSION

The Canadian Society for Vascular Surgery is dedicated to excellence in the promotion of vascular health for Canadians through education, research, collaboration and advocacy

ANNUAL GENERAL MEETING

For CSVS members only
Friday, September 15th - 12:00-13:00
Ivor Petrak Room

ACCREDITATION - (Section 1)

This event is an Accredited Group Learning Activity (Section 1) as defined by the Maintenance of Certification program of The Royal College of Physicians and Surgeons of Canada, approved by the Canadian Society for Vascular Surgery. ***The maximal CME credit is 14.5 hours.***

AMA PRA Category 1 Credit™

Through an agreement between the Royal College of Physicians and Surgeons of Canada and the American Medical Association, physicians may convert Royal College MOC credits to AMA PRA Category 1 Credits™. Information on the process to convert Royal College MOC credit to AMA credit can be found at:
www.ama-assn.org/go/internationalcme.

CERTIFICATE OF ATTENDANCE

All participating delegates will receive an email containing their "Certificate of Attendance" following the meeting.

PROGRAM CHANGES AND CANCELLATIONS

CSVS reserves the right to substitute faculty or to cancel or reschedule sessions because of unforeseen circumstances.

MOBILE APP

Download the CSVS2017 annual meeting mobile app to access the full schedule, presenters, podium and poster presentations and be alerted of any changes to the program electronically.
https://eventmobi.com/csvs2017/

DISCLOSURE

Faculty and Moderator Disclosure: Current CME guidelines state that participants should be aware of any affiliation or financial interest that could affect the speaker's presentation(s). Faculty and moderators have completed conflict of interest declarations and those potential conflicts will be announced at the beginning of each session.

The intent of this disclosure requirement is for a speaker to declare the conflict/relationship, in advance, to the audience. It is intended that any conflict be openly identified so that with full disclosure of the facts, attendees may form their own judgments about the presentation.

In addition, all members of the annual scientific program committee have also completed their declaration and have announced at each teleconference or meeting any financial interest in commercial organizations that may have a direct or indirect interest in the subject matter of his/her presentation. A "financial interest" may include, but is not limited to, being a direct shareholder in the organization; being on retainer with the organization; or having research or honoraria paid by the organization. An "affiliation" may be holding a position on an advisory committee or some other role of benefit to a sponsoring organization.

DISCLAIMER

The material presented at this meeting represents the opinion of the speakers and not the views of the CSVS. Attendees participating in this medical education program do so with full knowledge that they waive any claim they may have against the CSVS for reliance on any information presented during these educational activities. The CSVS does not guarantee, warrant or endorse any commercial products or services.

VISIT OUR 2017 SPONSORS AND EXHIBITORS

The CSVS meeting has proven to be a great opportunity for a collegial interchange of ideas and product information between physicians and our corporate partners. The exhibit area is the exclusive room for meals and breaks. The exhibiting companies will provide you with the latest information on products in the field of vascular surgery. Information on our corporate partners is included in the CSVS mobile app. Please visit the exhibit hall in the New Brunswick Room to meet our sponsors. Exhibiting companies are our benefactors and major resource for our annual meetings. We encourage all our members and guest delegates to visit and support our sponsors.

Exhibit dates and times: Friday, September 15th
7:00-7:45am, 9:30-10:00am, 12:00– 1:00pm, 2:30-3:00pm

Saturday, September 16th
7:00-8:00am, 10:15-10:45am, 12:30am – 1:45pm, 3:00-3:30pm

Bard Canada	Booth #7
Biocomposites	Booth #13
Boston Scientific	Booth #14
Canadian Hospital Specialties	Booth #2
Cook Medical	Booth #9/10
Cordis/Cardinal Health	Booth #8
Endologix	Booth #16
Gore & Associates	Booth #4/5
Koven	Booth #6
LeMaitre	Booth #15
Livanova	Booth #11
Medtronic	Booth #1
Perfuse Medtec	Booth #12
Sigvaris	Booth #3

SOCIAL EVENTS

The CSVS will be holding two social events that will provide you with an opportunity to connect with fellow delegates in a more relaxed environment.

- Wine & Cheese and Poster viewing in the Riverview Lounge on Friday, September 15th from 17:15 to 18:15
- CSVS Annual Dinner on Saturday September 16th which will be held at the Stanley Smokehouse located on the Fairmont Banff Springs Hotel Golf Course. Advance ticket purchase required.

Follow us on Twitter! Use **#CSVS2017** to tweet & share what you're learning in Banff!

Educational Objectives of the CSVS 39th Annual Meeting

1) Participants will be able to identify new treatment modalities for diagnosing and treating aortic aneurysms

2) Participants will understand the new imaging modalities that will help to manage peripheral vascular disease

3) Participants will be able identify and discuss the various new treatment options that are available for venous insufficiency management

4) Participants will be able to describe issues relating to wound care and basic vascular biology that will ideally aid in the care of clinical patients.

5) Participants will have an understanding of the organizational and population based issues related to vascular surgery

6) Participants will be able to identify their own knowledge gaps by participating in VESP Jeopardy

This event is an Accredited Group Learning Activity (Section 1) as defined by the Maintenance of Certification program of The Royal College of Physicians and Surgeons of Can*ada, approved by the Canadian Society for Vascular Surgery.* ***The maximal CME credit is 14.5 hours.***

AMA PRA Category 1 Credit™ - *Through an agreement between the Royal College of Physicians and Surgeons of Canada and the American Medical Association, physicians may convert Royal College MOC credits to AMA PRA Category 1 Credits™. Information on the process to convert Royal College MOC credit to AMA credit can be found at: www.ama-assn.org/go/internationalcme*

THURSDAY, SEPTEMBER 14, 2017

1200-1800	**EXHIBITS MOVE IN AND SET UP**	*New Brunswick Room*
1200-1630	**CSVS EXECUTIVE MEETING *(closed)***	*Norquay Room*
1630-2100	**RCPSC SPECIALTY COMMITTEE ON VASCULAR SURGERY MEETING (*closed)***	*DC Coleman Room*
1800-2000	**REGISTRATION OPENS**	*Curio Foyer*

FRIDAY, SEPTEMBER 15, 2017

0700-0500	**REGISTRATION OPENS**	*Curio Foyer*
0700-0745	**BREAKFAST & EXHIBITS**	*New Brunswick*

0700-0740 **The BEST-CLI Trial – Why we Need to Continue to Enroll Patients and What Have We Learned So Far** *Alberta*

Presenters: Dr. Alik Farber, Dr. Matthew Menard

0745-0800 **WELCOME & OPENING REMARKS** *Alberta*

President: Dr. Rafik Ghali
Program Chair: Dr. John Harlock
Secretary: Dr. April Boyd

0800-0930 **PAPER SESSION I – TREATMENT OF PERIPHERAL OCCLUSAL DISEASE**

Moderator: Dr. John Harlock

Learning Objectives - At the end of this session, participants will be able to:
1. Gain an understanding and approach to wound classification
2. Help appreciate the impact of depression on patients with PVD
3. Gather further knowledge on techniques for treatment of PVD

0800-0815 The SVS WiFi Classification Independently Predicts Wound healing in Neuroischemic DFU - Presenter: C. Hicks

0815-0830 Quantitative measurements of real time foot perfusion in patients with CLI - Presenter: O. Mironov

0830-0845 Similar patency and limb salvage rates when comparing primary bypass with bypass following failed endovascular intervention for lower limb arterial occlusive disease - Presenter: S. Hossain

0845-0900 Depression in Older adults undergoing interventions for PAD Presenter: L. Drudi

0900-0915 The treatment of complex aortoiliac and femoral disease using an inguinal approach and Viabahn stents - Presenter: P. Brown

0915-0930 Technique of extended iliofemoral eversion endarterectomy for severe iliofemoral arterial disease - Presenter: G. Sarwal

0930-1000 **REFRESHMENT BREAK & EXHIBITS** *New Brunswick*

1000-1100 **PAPER SESSION II – TREATMENT OF VENOUS DISEASE** *Alberta*

Moderator: Dr. Joel Gagnon

Learning Objectives - At the end of this session, participants will be able to:
1 .Further ones' knowledge on techniques to treat venous ulcers
2. Increase the understanding of the role of biomarkers in venous ulcers

1000-1015 The impact of endovenous thermal ablation on venous leg ulcer healing Presenter: A. Kayssi

1015-1030 Evaluation of biomarkers for predicting wound healing in venous leg ulcer - Presenter: M. Stacey

1030-1045 Influence of arterial and venous diameters on autogenous arteriovenous access patency - Presenter: R. Hamidizadeh

1045-1100 Comparison of cyanoacrylate and RFA for treatment of varicose veins in a Canadian population - Presenter: M. Parapini

1100-1130 **Invited Guest Lecture I - Improving the Outcome of Vein Grafts and Fistulae: Should Surgeons Turn Veins Into Arteries? Alan Dardik, MD, PhD, Yale University School of Medicine**

Learning Objectives - At the end of this session, participants will be able to:
1. Describe the embryology of the vascular system and how Ephrin-Eph interactions contribute to arterial and venous identity.
2. Understand why the PREVENT-III and -IV trials failed and the role of smooth muscle cells in the pathogenesis of neointimal hyperplasia in vein grafts.
3. Gain an understanding of the importance of basic science research to the future of vascular surgery.

1200-1300 **CSVS ANNUAL GENERAL MEETING (Members Only)** *Ivor Petrak Room*

1200-1300 **LUNCH & EXHIBITS (for those not attending AGM)** *New Brunswick*

1200-1300 **Residents/Trainees informal meet & greet with Invited Guest Speaker** *Riverview lounge*

1300-1415 **PAPER SESSION III -ANEURYSMAL DISEASE**

Moderator: Dr. Jacques Tittley

Learning Objectives- At the end of this session participants will be able to:

1. Review factors that affect wall vulnerability in AAA

2. Review different treatment techniques for the care of AAA

3. Review the evidence of statin treatments in AAA

1300-1315 Reserve Aortic Ratio as an index of wall vulnerability for AAAs - Presenter: R. Moore

1315-1330 Percutaneous TEVAR under local anesthesia without CSF drainage Presenter: D. Jiang

1330-1345 EndoAnchors in Thoracic, TAAA, and Complex EVARs: Safe and Effective Presenter: J. Panneton

1345-1400 The impact of statins on AAA growth, rupture, and perioperative outcomes - Presenter: K. Salata

1400-1415 A Canadian Post-Market Study of Zenith Alpha Abdominal EVAR graft - Presenter: T. Forbes

1415-1430 **Update on National AAA Screening Guidelines from the Canadian Task Force for Preventative Health Care - Presenter:** Dr**.** P. Jetty

1430-1500 **REFRESHMENT BREAK & EXHIBITS** *New Brunswick*

1500-1600 **VSEP JEOPARDY** *Alberta*

Moderator: Dr. Guiseppe Papia

*Objective: At the end of this session, participants will be able to elucidate their strengths and weaknesses in knowledge of a variety of vascular topics***.**

1600-1620 **CSVS Human Resources Project: Trainee Survey Results** *Alberta*

Presenters: Dr. P. Petrasek, Dr. T. Lindsay, Dr. K. Rommens

1620-1715 **RAPID 3 MINUTE POSTER PRESENTATIONS** (Brief introduction prior to poster viewing)

Moderator: Dr. Luc Dubois

Learning Objectives - At the end of this session participants will be able to:

1. Describe issues related to and affecting Vascular Surgery

2. Understand advances in various topics in Vascular Surgery

- IFU violation and anatomic factors are strongest predictors of clinically significant type II endoleaks - Presenter: K. Lee
- Surgically Positioned Paravertebral Catheter for analgesia post Retroperitoneal Aortic Aneurysm Repair - Presenter: S. Jessula
- Point of Care Ultrasound (POCUS) use as adjunct to physical exam and its impact on arteriovenous fistula maturation - Presenter: S. Hossain
- Outcomes of Minor Amputations in Patients with Peripheral Vascular Disease at a Tertiary Care Institution - Presenter: A. Chan

- The Effect of Renin-Angiotensin System Blockade on Abdominal Aortic Aneurysm Growth, Rupture and Perioperative Outcomes: A Systematic Review and Meta-Analysis - Presenter: R. Eikelboom
- Hospital Readmission and Emergency Department Visits After Vascular Surgery: A Prospective Cohort Study - Presenter: M. Hussain
- Assessing Patient Preferences for and Ranking of Outcomes Presented in Randomized Trials of Endovascular Aortic Surgery (APPROPRIATE) Presenter: D. Dion
- Establishing the Publication Rate of Abstracts Submitted Between 2012 to 2016 to the Canadian Society for Vascular Surgery Annual Meeting - Presenter: F. Naji
- Computational Simulations to Predict Fenestrated Stent Graft Rotation upon Deployment - Presenter: M. Doyle
- Current practices in venous disease – a survey of Canadian vascular surgeons Presenter: G. Yang
- Temporal Trends of Aortic Custom Medical Device Usage in Canada - Presenter: S. Crawford
- Development of a Semi-Automated FEVAR Planning Technique Presenter: H. Genis
- A novel iliac morphology score predicts procedural mortality and major vascular complication in Transfemoral Aortic Valve Replacement - Presenter: C. Ou
- Posterior Approach to Popliteal Arteray Aneurysm Repair; An Underutilized Technique? - Presenter: J. Patapas
- Reliability and Measurement Error of Digital Planimetry for the Measurement of Chronic Venous Leg Ulcers Presenter: S. Phillips
- Physicians' Peripheral Arterial Disease Knowledge Gap Starts in Medical School Presenter: M. AlHamzah
- Endovascular Repair of Abdominal Aortic Aneurysm (EVAR) in Octogenarians: A Report on Clinical Outcomes Presenter: S. Raju.

1715-1815 **CSVS POSTER SESSION - WINE & CHEESE AMONGST THE POSTERS**
Riverview Lounge

SATURDAY, SEPTEMBER 16, 2017

0700	**REGISTRATION OPENS**	*Curio Foyer*
0700-0800	**BREAKFAST & EXHIBITS**	*New Brunswick*
0700-0800	**RESEARCH COMMITTEE MEETING**	*Angus Room*
0700-0800	**EDUCATION COMMITTEE MEETING**	*Oak Room*

0800-0900 **PAPER SESSION IV – EMERGING TREATMENTS** *Alberta*

Moderator: Dr. David Szalay

Objectives- At the end of this session participants will be able to:

1. Gain a further understanding of potential new treatments for aortic disease

2. Understand the physiology and outcomes of venous arterialization

0800-0815 Early results of Arch pathology treated with Nexus Arch endograft
Presenter: T. Lindsay

0815-0830 Thoraflex Hybrid Endovascular Frozen Elephant Trunk Device for treatment of complex aortic arch disease - Presenter: J.Landau

0830-0845 Venous arterializatin for non-reconstructible lower extremity arterial disease
Presenter: K. Arsenault

0845-0900 Topical oxygen therapy closes chronic DFUs - Presenter: P. Hayes

0900-1015 **PAPER SESSION V – COMPUTATIONAL AND BENCH WORK** *Alberta*

Moderator: Dr. Ted Rapanos

Learning Objectives - At the end of this session participants will be able to:

1. Gain an understanding of the concerns with current TEVAR grafts devices and the potential for air embolism

2. Appreciate the potential uses of computational imaging in endovascular planning

0900-0915 Performance Assessment of RF powered guidewire for crossing peripheral arterial occlusions based on lesion morphology - Presenter: M. Tavallaei

0915-0930 Air Bubbles released from Thoracic aortic endograft deployment: analysis and quantification - Presenter: J. Misskey

0930-0945 Correlation between MMP-9 activity, intraluminal thrombus deposition, and computational pulsatile hemodynamics in human AAAs - Presenter:A. Ducas

0945-1000 Iliac artery torsion and calcification predict endovascular device rotation and severe perioperative complications in advanced EVAR - Presenter: S. Crawford

1000-1015 MRI characteristics of peripheral arterial lesions relate to the difficulty of endovascular procedures - Presenter: T. Roy

1015-1045 **REFRESHMENT BREAK & EXHIBITS** *New Brunswick Room*

1045-1100 **RESEARCH - Canadian Vascular Research Group Update** *Alberta*

Dr. Luc Dubois, Chair, CSVS Research Committee

1100-1130 **PRESENTATION OF 2017 AWARD WINNERS**
Cook & Gore Research Awards (Presented by Dr. Luc Dubois)
John L. Provan Education Award (Presented by Dr. Guiseppe Papia)
2016 Cook, Gore, Provan & AAA research award project updates

1130-1200 **CSVS Invited Guest Lecture II - Systemic Inflammatory Disease Prevents Sac Regression after Endovascular Aneurysm Repair**
Alan Dardik, MD, PhD, Yale University School of Medicine

Learning Objectives - At the end of this session participants will be able to:
1. Describe systemic inflammatory disease
2. Describe the modern understanding and treatments of endoleak after endovascular aneurysm repair
3. Appreciate the importance of systemic inflammatory disease in patients undergoing endovascular aneurysm repair and potential treatment options in these patients

1200-1230 **PRESIDENTIAL ADDRESS -Dr. Rafik Ghali** *Alberta*
Introduction by Dr. Kent MacKenzie

1230-1345 **LUNCH & EXHIBITS** *New Brunswick*

1345-1500 **PAPER SESSION VI - QUALITY AND POPULATION CARE**
Moderator: Dr. John Harlock
Objectives - At the end of this session participants will be able to:
1. Further understand the relationship between surgery volumes and outcomes
2. Explore the costs associated with vascular surgery care in Ontario

1345-1400 Higher surgeon annual volume, but not years of experience, leads to reduced rates of perioperative complications and reoperations following open AAA repair - Presenter: L. Dubois

1400-1415 Evaluating quality metrics and cost after discharge: A population-based study of value in health care following major vascular surgery in Ontario Presenter: C. de Mestral

1415-1430 Increasing mortality trends for open infrarenal and TAAA repairs in the endovascular era - Presenter: B. Levac

1430-1445 Device-specific variability in Aneurysm Sac regression following EVAR based on a comprehensive registry of patients in Eastern Ontario - Presenter: P. Jetty

1445-1500 Do vascular surgery patients investigated with an angiogram first approach receive faster treatment in Saskatchewan vs. those investigated with CTA? - Presenter: J. Herback

1500-1530 **REFRESHMENT BREAK & EXHIBITS** *New Brunswick*

1530-1700 **PAPER SESSION VII - CAROTID AND GENERAL TOPICS** *Alberta*
Moderator: Dr. John Harlock
Objectives - At the end of this session participants will be able to:
1. Determine and understand the relationship between specialty and outcomes in carotid disease
2. Gain insight into the quality of evidence presented at our annual meeting,
3. Further appreciate patient satisfaction with preoperative planning and care

1530-1545 Carotid artery revascularization: Does surgeon or interventionalists specialty matter? - Presenter: M. Hussain

1545-1600 Knowledge, impressions, and use of government-funded physical disability support programs in vascular surgery: a survey of Canadian physicians - Presenter: M. Ingves

1600-1615 Level of Clinical Evidence presented at the CSVS Annual meeting over a 5 year period - Presenter: F. Naji

1615-1630 Break out of the classroom: The use of escape rooms as an alternative learning strategy for surgical education
Presenter: A. Kinio

1630-1645 Risk of intracranial hemorrhage following carotid endarterectomy versus stenting - Presenter: M. Hussain

1645-1700 Is patient satisfaction improved by showing patients their CT and angiographic images prior to undergoing vascular surgery?
Presenter: D. Leblanc

1700 **MEETING ADJOURNMENT - CLOSING REMARKS**

1700-1800 **EXHIBITS DISMANTLING**

1830 **CSVS ANNUAL DINNER**
The Stanley Smokehouse - Fairmont Banff Springs Golf Course-
Cocktail Reception followed by Dinner
Coach Transportation provided
Advance registration and dinner ticket required - (business attire)

Presentation of 2017 Sigvaris President's Award and Josephus C. Luke Awards will be made at the CSVS Dinner

CANADIAN SOCIETY FOR VASCULAR SURGERY
ABSTRACTS
Annual Meeting – September 15-16, 2017
Banff, Alberta, Canada

Friday, September 15th, 2017
PAPER SESSION I: TREATMENT OF PERIPHERAL OCCLUSIVE DISEASE

The SVS WIfI Classification Independently Predicts Wound Healing in Neuroischemic Diabetic foot Ulcers

Caitlin W. Hicks MD MS[1,2], Joseph K. Canner MHS[3], Nestoras Mathioudakis MD MHS[1,4], Ronald Sherman DPM[1,2], Kathryn F. Hines PA-C[1,2], James H. Black III MD[2], Christopher J. Abularrage MD[1,2 1]Diabetic Foot and Wound Service, The Johns Hopkins Hospital, Baltimore, MD, [2]Division of Vascular Surgery and Endovascular Therapy, Department of Surgery, The Johns Hopkins Hospital, Baltimore, MD, [3]Center for Surgical Trials and Outcomes Research, Department of Surgery, The Johns Hopkins Hospital, Baltimore, MD. [4]Division of Endocrinology and Metabolism, Department of Medicine, The Johns Hopkins Hospital, Baltimore, MD.

Objectives: Prior studies have reported correlation between the WIfI classification system and wound healing time (WHT) on unadjusted analyses. However, in the only multivariable analysis to date, WIfI stage was not predictive of wound healing. Our aim was to examine the association between WIfI classification and wound healing after risk adjustment in patients with diabetic foot ulcers (DFU) treated in multidisciplinary setting.
Methods: All patients presenting to our multidisciplinary DFU clinic from 6/2012-06/2016 were enrolled in a prospective database. A Cox proportional hazards model accounting for patient sociodemographics, comorbidities, medication profiles, and wound characteristics was used to assess the association between WIfI classification and likelihood of wound healing at 1 year.
Results: 288 DFU patients were enrolled (mean age 58.5±0.7 years, 60% male, 62% black), including 25% WIfI stage 1, 14% stage 2, 31% stage 3, and 30% stage 4. Mean WHT increased with increasing WIfI stage (stage 1: 97±8 days vs. stage 4: 195±12 days; P<.001). Likelihood of wound healing at 1 year was 95±2% for stage 1 wounds vs. 64±5% for stage 4 (P<.001). After risk adjustment, WIfI stage was independently associated with wound healing (stage 4 vs. stage 1: HR 0.42 [95%CI 0.31-0.58]). Peripheral arterial disease (PAD, HR 0.62), increasing wound area (HR 0.99 per cm^2), and longer time from wound onset to first assessment (HR 0.97 per month) also decreased the likelihood of wound healing, whereas use of clopidogrel was protective (HR 1.48) (Table 1). The two strongest predictors of poor wound healing were WIfI stage 4 (z-score -5.32) and PAD (z-score -3.92), respectively.
Conclusions: Among patients with DFU, the WIfI classification system predicts wound healing at one year in both crude and risk-adjusted analyses. This is the first study to validate the WIfI score as an independent predictor of wound healing using multivariable analysis.

Table 1. Multivariable analysis of factors associated with wound healing time by one year among patients with diabetic foot ulcers

Variable	Wound Healed at 1 Year HR (95% CI)	P-value
WIfI Stage		
1	Ref	
2	1.06 (0.80-1.40)	0.68
3	0.69 (0.54-0.89)	0.004
4	0.42 (0.31-0.58)	<0.001
Age (per year)	1.00 (0.99-1.01)	0.69
Female gender	1.2 (0.94-1.45)	0.16
Race		
White	Ref	
Black	1.07 (0.83-1.38)	0.59
Other	0.53 (0.22-1.31)	0.17
Area deprivation index (quartile)		
1	Ref	
2	0.77 (0.49-1.2)	0.27
3	1.22 (0.86-1.73)	0.26
4	1.17 (0.89-1.52)	0.25
Peripheral arterial disease	0.62 (0.49-0.79)	<0.001
Chronic obstructive pulmonary disease	1.28 (0.88-1.87)	0.20
Clopidogrel	1.48 (1.05-2.09)	0.02
ACE/ARB	1.14 (0.92-1.42)	0.22
Wound area (per cm^2)	0.99 (0.98-0.99)	0.001
Time from wound onset to assessment (per month)	0.97 (0.95-0.99)	0.04

ACE/ARB = angiotensin-converter enzyme inhibitor/angiotensin receptor blocker

Quantitative Measurements of Real Time Foot Perfusion in Patients with Critical Limb Ischemia

Oleg Mironov[1], Rebecca Zener[1], Naomi Eisenberg[2], Kong Teng Tan[1], Graham Roche-Nagle[2]
[1]Division of Vascular and Interventional Radiology, [2]Division of Vascular Surgery, Toronto General Hospital, University Health Network

Purpose: To evaluate the role of real time quantitative measurements of perfusion to the foot among patients with critical limb ischemia.
Materials and Methods: This single center, prospective, cohort study was IRB approved. 41 patients with critical limb ischemia undergoing endovascular treatment were recruited. Patients received intraarterial injections of indocyanine green dye diluted in saline pre and post successful angioplasty. Perfusion Images of the foot were obtained using a SPY Elite System (Novadaq Technologies, Ontario, Canada). Patients were followed for 6 months. Subsequently a logistic regression was performed to determine if intraprocedural perfusion parameters predicted the odds of wound healing.
Results: 28 patients had successful angioplasty. Median age was 69.5±8.3. 75% were men. 64% were diabetic. Rutherford stages were: (4 - 39%, 5 - 57%, 6 - 4%). There was no significant correlation between the ankle brachial index and perfusion parameters. Inflow perfusion rate correlated significantly with Rutherford stage (Spearman rho 0.398 p=0.036). Diabetics had a faster inflow rate, (22.3 vs 7.9;p=0.027) and a trend toward a faster outflow rate (2.7 vs 0.9;p=0.051). Diabetics also had a significantly greater increase in inflow rate following a successful procedure than non-diabetics (170%±290% vs 5%± 85%; p=0.035). After successful angioplasty 39% had a decrease in inflow rate and 57% had a decreased total inflow.
25 patients completed 6 months of follow up. Resolution of rest pain and/or healing of the ischemic wound occurred in 10 (40%) of patients at 1 month, 4 (16%) at 3 months and 2 (8%) at 6 months. 1 patient underwent a

major amputation at 2 months. 8 (32%) patients never healed or had persistent rest pain. None of the real time perfusion variables were significant predictors of wound healing.
Conclusion: Real time perfusion imaging following intra-arterial infusion of indocyanine green does not predict the odds of wound healing.

Similar Patency and Limb Salvage Rates When Comparing Primary Bypass with Bypass Following Failed Endovascular Intervention for Lower Limb Arterial Occlusive Disease

Sajjid Hossain MD[1], Dominic Leblanc[1], Adam Power MD[1], Guy DeRose MD[1], Audra Duncan MD[1], Luc Dubois MD MSc[1,] 1Division of Vascular Surgery, Western University, London, Ontario

Objectives: Patients with infrainguinal peripheral arterial disease often undergo multiple revascularizations procedures. Although many centers have adopted an endovascular-first approach, some are reluctant for fear of damaging outflow and compromising the outcomes of any subsequent bypasses.
Methods: A systematic review was conducted of MEDLINE, EMBASE and CENTRAL databases for studies that compared outcomes of primary infrainguinal bypass to bypass after failed endovascular intervention for peripheral arterial disease. Abstracts and full text studies were screened independently by two reviewers with data abstraction done in duplicate. Dichotomous outcome measures were reported using the odds ratio (OR) and 95% confidence interval (CI) and pooled using random-effects models. Study quality was assessed using the Newcastle Ottawa Scale.
Results: 2112 abstracts were screened with 43 selected for full-text review. Of these, 13 studies involving 7325 patients met the inclusion criteria. Pooling the results of studies comparing primary bypass to bypass after failed endovascular intervention showed no significant difference in primary patency (OR 1.37; 95% CI: 0.61-3.08) (Figure 1) or ipsilateral limb salvage at 1 year (OR 1.37; 95%CI: 0.57-3.28). Similarly, 30-day amputation rates (OR 1.75; 95% CI 0.55-5.59), 30-day mortality (OR 1.04; 95% CI:0.67-1.61), and 1-year secondary patency (OR 0.94; 95%CI 0.47-1.88) were similar between groups. There was a trend towards higher rates of early graft occlusion (OR 4.24; 95%CI 0.81-22.09) and worse 3-year amputation free survival (OR 1.52; 95% CI 0.94-2.45) for patients who failed endovascular intervention, but this was non-significant (Figure 2).
Conclusions: Meta-analysis of the existing literature comparing primary bypass with bypass following endovascular intervention shows no significant difference in patency or limb salvage. The existing published data is limited by observational study design, inconsistent patient selection, and significant heterogeneity yet suggests that bypass following failed endovascular intervention does not conclusively result in inferior outcomes.

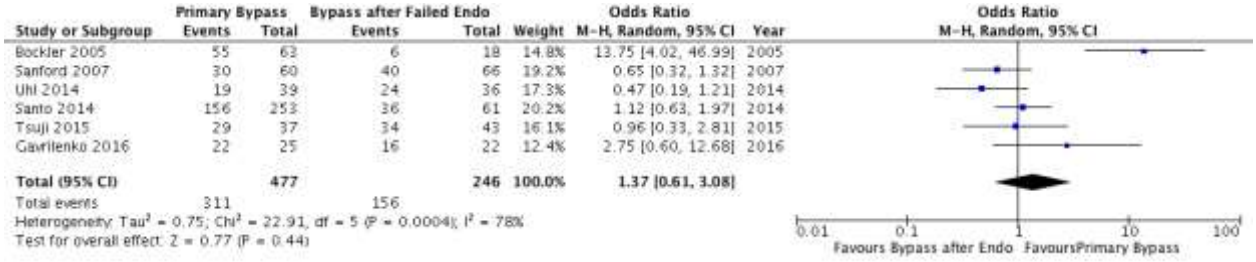
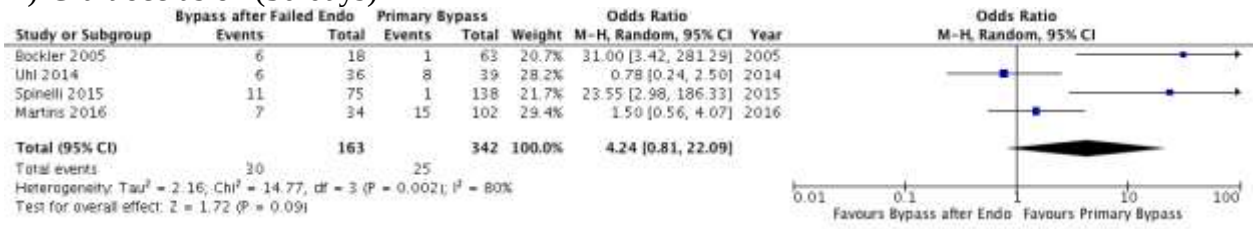


Figure 1. Forrest plot comparing the odds ratio (95% confidence interval) for primary patency at 1-year between primary bypass and bypass after failed endovascular intervention. (OR >1 indicates higher patency rate in primary bypass group).

A)-Graft occlusion (30-days)



B)-Amputation free survival (3-years)

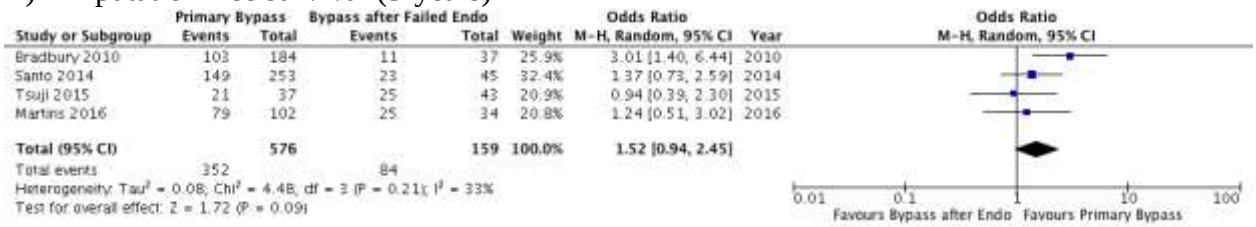


Figure 2. Forrest plot comparing the pooled odds ratio (95% confidence interval) comparing A) early graft occlusion (within 30-days) (OR >1 indicates higher rates of graft occlusion in the bypass after failed endovascular intervention group) and B) Amputation free survival at 3-years (OR >1 indicates higher amputation free survival in the primary bypass group).

Depression in Older Adults Undergoing Interventions for Peripheral Arterial Disease

Laura M. Drudi[1,2*], Catherine Boudrias[1*], Matthew Ades[1], Rita Mancini[1], Heather L. Gill[2], S. Marlene Grenon[3], Oren K. Steinmetz[2], Jonathan Afilalo[1,4], [1] Center for Clinical Epidemiology, Lady Davis Institute, Montreal, QC, Canada, [2] Division of Vascular Surgery, McGill University, Montreal, QC, Canada, [3] Division of Vascular and Endovascular Surgery, University of California San Francisco, San Francisco, California, [4] Division of Cardiology, Jewish General Hospital, Montreal, QC, Canada

Objective: The objective of this study was to investigate the association between depression and mortality in older adults undergoing endovascular or open interventions for peripheral arterial disease (PAD).
Methods: This was a pre-planned analysis of the FRaily Assessment In Lower Extremity arterial Disease (FRAILED) prospective cohort study including 2 centers in Montreal, Canada, designed to examine frailty in patients with PAD. Consecutive patients undergoing endovascular or open interventions for PAD (Rutherford class 3 or higher) were enrolled. Depression was assessed before the intervention using the 15-item Geriatric Depression Scale Short Form (GDS-SF), with a score >5 being consistent with depression. The primary outcome was all-cause mortality at 6-months. The secondary outcomes were readmission or need for re-intervention.
Results: Among 149 older adults with a mean age of 70.3±11.1 years, 54.7% received endovascular interventions and 45.3% received open interventions. The prevalence of screened depression was 28.4% (N=42), whereas this had been documented in only 3.3% (N=5) of patients in the clinical chart. The incidence of all-cause mortality was 10.0% (N=15) in the depressed group and 1.3% (N=2) in the non-depressed group. Univariate analysis demonstrated that depressive symptoms were associated with low appetite, weight loss, and anemia. After adjusting for relevant covariates, worsening depression scores were found to be independently predictive of 6-month mortality (OR 1.48, 95% CI: 1.08 to 2.29), but not of vascular re-intervention (OR 1.11, 95% CI: 0.99 to 1.26) or readmission (OR 1.16, 95% CI 0.96 to 1.39).
Conclusion: Depression is under diagnosed in older adults undergoing endovascular or open interventions for PAD. Worsening depression scores using the GDS-SF were found to be predictive of all-cause mortality 6-months after

the intervention. The effect of depression on mortality did not appear to be mediated by a higher risk of re-intervention or readmission.

The Treatment of Complex Aortoiliac and Femoral Disease Using an Inguinal Approach and Viabahn Stents

[1]Peter Brown, MD, [2]Ben Mussari, MD, [1]Department of Surgery, Queen's University, Kingston, Ontario, [2]Department of Radiology, Queen's University, Kingston, Ontario

Introduction and methods: Although endovascular procedures have been a mainstay for limited aortoiliac disease, aortobifemoral bypass has been the standard for extensive complex aortoiliac femoral occlusive disease. Because of significant disadvantages of an extensive open operation we began hybrid procedures in 2014 for most cases of complex aortoiliac and femoral disease. Thirty hybrid procedures were performed between August 2014 and March 2017. Inguinal repairs with autogenous patching were completed prior to Viabahn stent insertions. All patients had significant common femoral disease. 20 patients had complete aortic or iliac occlusions. 10 patients had severe aortoiliac stenosis without occlusion. 28/30 patients had procedures for limb salvage.

Results: All occlusions were successfully traversed except for one patient requiring open endarterectomy via a flank incision. To date, there have been no stent occlusions. Only one amputation was necessary (with patent hybrid repair). Length of stay was 2 days or less in 16/30 patients. Two postoperative deaths occurred, related to severe cardiac disease. There has been a marked shift from traditional aortobifemoral or femoral femoral bypasses since the hybrid program began in 2014, as shown in Table 1.

Conclusions: Early results are extremely encouraging. It would appear that more patients are now treatable for complex aortoiliac and femoral diseases because of the lower morbidity associated with avoiding an abdominal incision. Longterm follow-up is required to determine whether hybrid procedures will largely replace the aortobifemoral open bypass as the gold standard for complex aortoiliac and femoral disease.

Table 1: Procedures for aortoiliac femoral occlusive disease

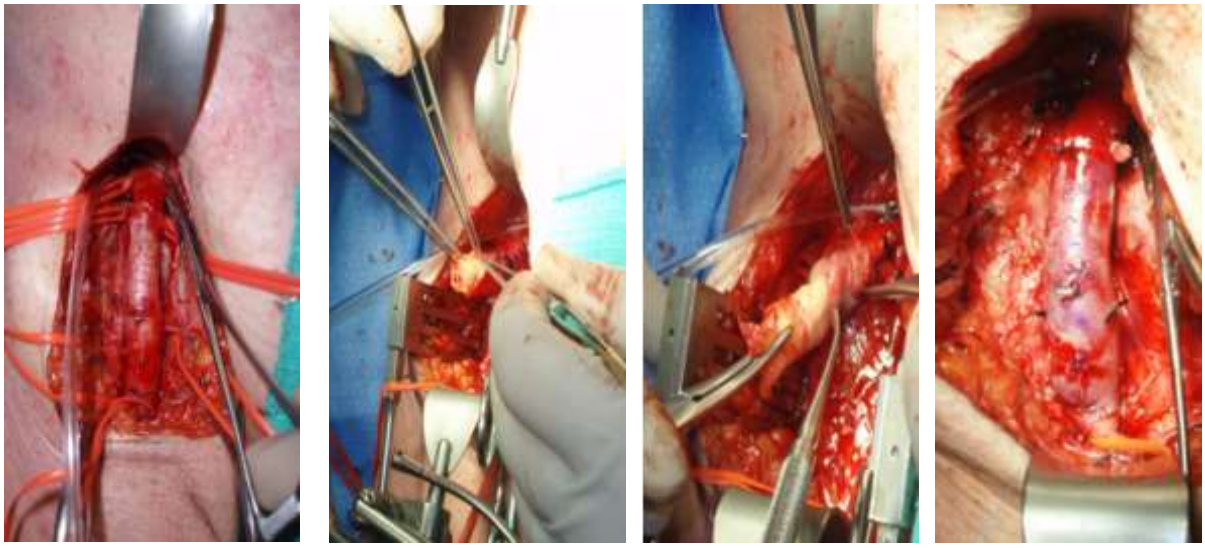
Year	Aorto-bifemoral	Fem-femoral	Hybrid
2011	4	2	0
2012	3	5	0
2013	6	3	0
2014	1	2	2
2015	1	1	13
2016	2	1	12
2017	0	0	3

Technique of Extended Iliofemoral Eversion Endarterectomy for Severe Iliofemoral Arterial Disease

Gautamn Sarwal, MD,[1] Jonathan Misskey, MD MEd,[2] John D.S. Reid, MD FRCPC,[3] Ravindar Sidhu, MD MEd FRCPC,[3] Peter S. MacDonald, MD FRCPC[3], [1] PGY-2 Vascular Surgery, University of British Columbia, Vancouver, British Columbia, Canada, [2] PGY-5 Vascular Surgery, University of British Columbia, Vancouver, British Columbia, Canada, [3] Division of Vascular Surgery, St. Paul's Hospital, Vancouver, British Columbia, Canada

Objective: To demonstrate our novel approach to managing severe iliofemoral arterial disease, with an extended iliofemoral eversion endarterectomy (IFEE).
Methods: We performed a retrospective review of all patients undergoing IFEE from 2007 to 2015 at our institution. This included patients who underwent IFEE, with or without an additional procedure for inflow or outflow improvement.
Surgical Technique: The common femoral artery (CFA) and external iliac artery (EIA) are exposed via a vertical or oblique groin incision. All side branches are ligated and proximal control achieved with balloon occlusion. The CFA is then transected at its bifurcation and everted superiorly to the EIA. The endarterectomized segment is then re-anastamosed in an end-to-end fashion onto the CFA bifurcation or its branches, thus providing an autologous arterial reconstruction.
Results: 112 patients underwent IFEE with a total of 140 limbs over eight years. 59 limbs (42.1%) presented with critical limb ischemia. Mean age was 72.1 years and the American Society of Anaesthesiologists grade was three. A vertical incision was used in 93 cases. Post endarterectomy, the iliofemoral segment was re-anastamosed to the CFA bifurcation in 68 limbs (48.6%), PFA in 70 limbs (50%) and SFA in two limbs (1.4%). 49 procedures (35%) involved an additional profunda femoris or superficial femoral artery endarterectomy. 72 patients had adjunctive re-vascularization procedures including iliac stenting (40%) or distal bypass (31%). The 30-day mortality was 5%, one of whom died secondary to an underlying malignancy. We noted 15 (10.1%) systemic complications and 16 (11.4%) minor complications. Systemic complications included three myocardial infarctions, one stroke, seven cases of sepsis and four cases of acute limb ischemia requiring thrombectomy. There was one patient with technical failure due to chronic occlusion. Local complications included four groin infections, six wound dehiscences, and six surgical site collections, all managed conservatively. We report no amputations.
Conclusion: IFEE is an alternative means of treating iliofemoral arterial disease with patency and efficacy to be analyzed in a future study.

Figure 1: Iliofemoral eversion endarterectomy: A: Vertical or oblique groin incision to expose the CFA and its bifurcation. Renal vein retractor under inguinal ligament to expose the EIA; B: Transection of CFA at the bifurcation; C: Extended eversion endarterectomy with inferior traction on the endarterectomized plaque, carried up till the CIA bifurcation; D: All autogenous reconstruction of the CFA bifurcation post endarterectomy.



A **B** **C** **D**

Friday, September 15th, 2017
PAPER SESSION II: TREATMENT OF VENOUS DISEASE

The Impact of Endovenous Thermal Ablation on Venous Leg Ulcer Healing
Ahmed Kayssi, Homayoun Hashemi, Kapil Gopal, Richard Neville, Dipankar Mukherjee,
Inova Heart and Vascular Institute, Fairfax, VA

Purpose: The role of endovenous thermal ablation modalities, such as radio-frequency ablation (RFA) of the saphenous veins, in the treatment of active venous ulcers remains unclear. The aim of this study was to assess the impact of endovenous thermal ablation on venous leg ulcer healing.
Methods: A retrospective chart review was carried out of all patients undergoing radiofrequency ablation (RFA) at a single institution for active venous leg ulcers in the years 2015-2017. Baseline patient characteristics, healing rates, and time to healing were assessed.
Results: Thirty-seven patients were identified. The majority were male (68%), and the median age was 65 years (range: 33-95). All ulcers were refractory to treatment by a wound care specialist, and the median duration of wounds prior to RFA treatment was 6 months (range: 1 to 120). Venous leg ulcers were present on the left (54%) and right (41%) legs, and bilaterally (5%). The great saphenous vein (68%), short saphenous vein (14%), and both great and short saphenous veins (19%) were treated, where evidence of reflux was present. Three patients (8%) had undergone prior venous therapies on the affected limb. Complete ulcer healing occurred in 72% of patients, at a median of 2 months after the procedure (range: 0.25-8).

Conclusion: RFA therapy is beneficial in successfully treating active venous ulcers in some patients. A prospective randomized controlled trial is needed to adequately assess whether this treatment modality should become a standard of care in this patient population.

Evaluation of Biomarkers for Predicting Wound Healing in Venous Leg Ulcer

Michael Stacey[1,3], Steven Phillips[1], Forough Farrokhyar[1,2], Jillian M. Swaine[3,4]
[1] Department of Surgery, McMaster University, 237 Barton St. East, Hamilton, ON, L8L 2X2 Canada, [2] Department of Health, Evidence, Impact, McMaster University, 39 Charlton Avenue East, Hamilton, Ontario, L8N 1Y3, Canada, [3] School of Surgery, University of Western Australia, 35 Stirling Hwy, Crawley, 6009, Western Australia, [4] Institute of Health Research, University of Notre Dame Australia, 19 Mouat St., Fremantle 6160, Western Australia

Objectives: This study looked to examine a panel of biomarkers in healing and non-healing chronic venous leg ulcers in order to determine if a biomarker exists that can accurately predict healing in these wounds.
Methods: Wound area and wound fluid were collected in 42 patients weekly for 14 weeks. Wounds were classified as healing or non-healing by using a three consecutive weekly measurements, where the middle time point of three with decreasing wound sizes was classified as healing, and with increasing sizes was classified as non-healing. Wound fluid from each week was then analyzed for a variety of biomarkers using multiplex ELISA assays.
Results: A total of 32 healing time points and 27 non-healing time points in which wound fluid was available were included in the analysis. Independent t-test of biomarkers in healing and non-healing wounds demonstrated 13 biomarkers which held a significant difference between healing and non-healing wounds ($p<0.1$). These markers were then included in a multivariable regression model, in which 2 biomarkers demonstrated a significant difference between healing and non-healing wounds ($p<0.01$). Receiver operating curves and optimal cut-off points using Youden's J statistic were then used to determine the accuracy, sensitivity and specificity of these biomarkers. The first biomarker demonstrated a 92% accuracy in discriminating between healing and non-healing wounds, and its optimal cut-off value had a sensitivity of 96% and a specificity of 81%. The second biomarker held a 78% accuracy in discriminating between healing and non-healing wounds, and the optimal cut-off demonstrated a sensitivity of 92% and a specificity of 61%.
Conclusions: Our study has found 2 biomarkers which can accurately discriminate between healing and non-healing chronic venous leg ulcers, with one of the biomarkers having over 90% predictive accuracy.

Influence of Arterial and Venous Diameters on Autogenous Arteriovenous Access Patency

Ramin Hamidizadeh BSc[1†], Jonathan Misskey[1,2] MD, Jason Faulds[2,3]MD MSc, Jerry Chen[2,3] MD MSc, Joel Gagnon[2,3] MD, York Hsiang[2,3] MB ChB MHSc, 1. Faculty of Medicine, University of British Columbia, Vancouver, Canada, 2. Division of Vascular Surgery, University of British Columbia, Canada, 3. Division of Vascular Surgery, Vancouver General Hospital, Vancouver, British Columbia, Canada

Objective: The autogenous arteriovenous fistula (AVF) is the standard procedure for patients requiring chronic hemodialysis. To enhance its success, preoperative Duplex ultrasound has been used to determine fistula location based on venous and arterial diameters. Previous authors have suggested that a minimum outflow vein diameter (MOVD) and perianastomotic arterial diameter are associated with successful maturation. The goal of this study was to determine anatomical and clinical variables that may influence access patency to guide optimal autogenous access configuration selection.
Methods: AVF created from 2010-2016 were analyzed from data entered into a prospective database. Pre-procedure duplex mapping data of venous and arterial diameters, and demographic and clinical variables were collected. Kaplan Meier and Cox Hazards analysis were used to assess patencies, maturation, and identify independent predictors of access failure.

Results: Five hundred thirty-five AVF were created (median follow-up 17.0 months; range 0 - 73). Of these, 265 (49.5%) were radiocephalic, 221 (41.3%) were brachiocephalic, and 49 (9.2%) were brachiobasilic. AVF with a MOVD <3mm were associated with inferior primary patencies at 12 (43±4% vs. 54±4%; P = 0.009) and 36 months (19±4% vs 33±4%), and secondary patencies at 12 (75±3% vs. 91±2%, p<0.001) and 36 months (63±4 vs. 78±4%; P<0.001). Arterial diameter <2mm for radiocephalic AVF was associated with impaired maturation at 12 months in diabetics vs. nondiabetics (53±9% vs. 87±8%), with no differences observed in maturation rates with radial artery diameters > 2mm (84±5% vs. 85±4%) (P = 0.019). On multivariate regression, MOVD (HR 0.02; 95% CI 0.01-0.23, P = 0.002) female sex (HR 1.75 95%CI 1.12-2.73) and diabetes (HR 1.67; 95% CI 1.00 – 2.79; P = 0.048) were associated with secondary patency loss.
Conclusions: MOVD is strongly predictive of autogenous access patency. Radial artery diameter <2mm was predictive of radiocephalic AVF failure to mature, but only in diabetic patients.

Comparison of Cyanoacrylate (VenaSeal) and Radiofrequency Ablation for Treatment of Varicose Veins in a Canadian Population

Gary K Yang, Marina Parapini, Joel Gagnon, Jerry Chen, Division of Vascular Surgery, University of British Columbia, Vancouver, BC

Objective: To compare clinical outcomes of cyanoacrylate (CA) and radiofrequency ablation (RFA) in the treatment of varicose veins at our institution.
Methods: Between January 2014 to December 2016, 335 patients with 476 venous segments were treated with either CA (n=148) or RFA (n=328) for varicose veins at the Vancouver General Hospital vascular clinic. Charts were reviewed to assess patient demographics, location and severity of disease, treatment details and outcome at short- and mid-term follow-ups. Outcome parameters included treatment success and presence of short- and mid-term complications.
Results: The average age of patients were 57 ± 1 years with the majority being female (78%) and an average BMI of 24.8 ± 0.5. CEAP classes were 2 (49%), 3 (26%), 4a (22%) and >4b (3%). Of the 148 segments treated with CA, the vein types were as follows: 112 greater saphenous vein (GSV), 24 short saphenous vein, 2 accessory greater saphenous vein and 8 perforator veins. The average amount of CA delivered for GSV treatment was 1.8 ± 0.1 ml with a treatment length of 43 ± 1 cm. Subgroup comparison was done for GSV segments. Treatment success was 100% in CA and 99% in RFA. Superficial phlebitis was the most common complication noted at mid-term follow-up in 5% of CA and 16% of RFA treatments. There was one patient in each group that had asymptomatic proximal thrombus extension treated with anticoagulation for two weeks. Three superficial glue protrusions were noted in the CA group requiring minor incision and drainage. Five patients in the RFA group had persistent numbness and 2 had non-healing wounds at the access site.
Conclusion: CA is a minimally invasive endovenous technique for treating varicose veins without the need of tumescent analgesia. In our experience, CA offers equivalent success rates with lower mid-term complication rates as RFA.

Friday, September 15th, 2017
PAPER SESSION III: ANEURYSMAL DISEASE

Reserve Aortic Ratio as an Index of Wall Vulnerability for AAAs

Elena Di Martino[1], Flavio Bellacosa Marotti[1], Richard Beddoes[1], Arianna Forneris[1], Robert Shepherd[1], Randy D Moore MD[2], [1]University of Calgary, Schulich School of Engineering. [2]University of Calgary Department of Surgery

Introduction: Maximal aortic diameter for AAA cannot provide the clinician with an accurate assessment of the individual patient's risk for aortic rupture. We describe a novel aortic wall vulnerability index called reserve aortic ratio (RAR) that provides a non-invasive prediction of the propensity for rupture of an aortic aneurysm. RAR strongly correlates with the local wall strength, enabling a highly individualized and topographically accurate risk assessment for AAAs (*i.e.*, inter- and intra-patient RAR assessment).
Methods: The protocol was approved by the University of Calgary Conjoint Health Research Ethics Board and all patients provided consent for participation in the study. Seven patients having elective open aortic aneurysm repair were imaged pre-operatively with cardiac-gated dynamic CT scans. Using proprietary algorithms, an RAR plot (see Figure 1) was derived from a 3-dimensional geometrical model of the aneurysm. Patients had complete aortic resection extending from the infrarenal aorta to the iliac bifurcation, with standard end-end aortic graft interposition and omental flap coverage of the exposed graft. After aortic resection, the specimen was resected with samples corresponding to the pre-operative RAR map (see Figure 1). Specimens were then placed in PBS for ex-vivo assessment of the mechanical (tensile rupture testing) and histological analysis.
Results: RAR accurately localized areas at reduced strength due to elastin and collagen degeneration. (R2 = 0.70)
Discussion: RAR will compound the existing vascular diagnostic tools, such as diameter and rate of growth, allowing a more robust and evidence-driven management of these complex patients. This novel index of aortic wall vulnerability can be derived rapidly from standard CT technology, and will allow for a more accurate customized determination of aortic rupture risk for the patient with AAA.

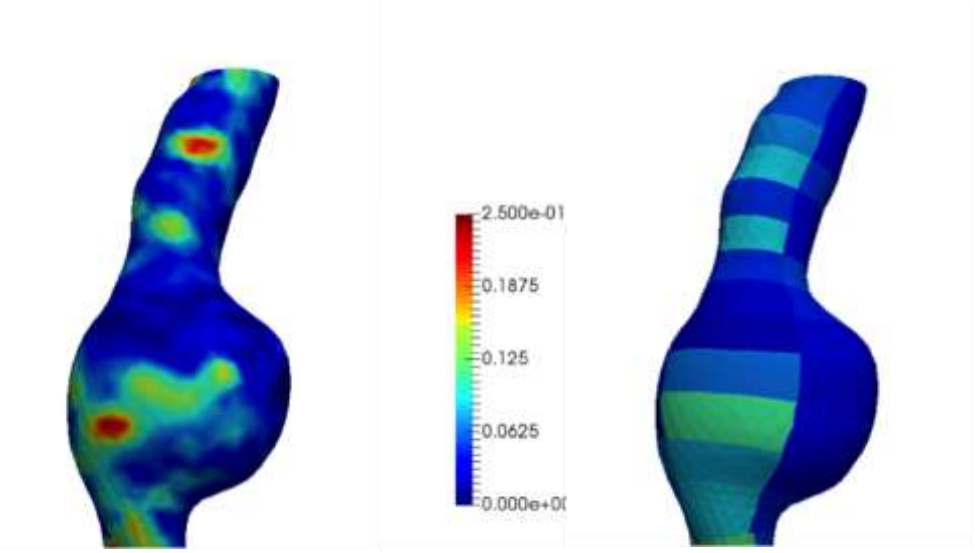


Figure 1: (left panel) RAR for one representative AAA case – red areas are at elevated risk of rupture; right panel) RAR averaged on the surgical map for specimen collection.

Percutaneous TEVAR Under Local Anaesthesia Without Cerebral Spinal Fluid Drainage

Dennis Jiang, Ivica Vucemilo, Division of Vascular Surgery, University of Toronto, Toronto, Ontario, Canada

Objective: The objective of this study was to assess the safety of performing thoracic endovascular aneurysm repair (TEVAR) under local anesthetic without cerebral spinal fluid drainage (CSF) drainage.
Methods: A retrospective review of consecutive TEVAR cases performed at Trillium Health Centre. Exclusion criteria included spinal anesthesia and ruptured aortic pathology. These cases were analyzed with respect to the type of anesthesia (general vs local) and the use of CSF drainage.
Results: This retrospective case-series identified 45 patients of which 8 were excluded. 18 patients were performed under GA and 19 patients were performed under LA. Patients performed under LA had significantly more co-morbidities with 78% (n=11) having ≥ 3 co-morbidities relative to 36% (n=4) in the GA group. There were no significant differences in aneurysm size or extent of aortic coverage between the two groups. Spinal drains were placed preoperatively in 78% (n=14) of patients performed under GA and in 32% (n=6) of patients performed under LA. There were no cases of paralysis or stroke following TEVAR in either group. One patient under the LA group required a carotid-subclavian bypass after displaying global paralysis. Other 30 day complications included 1 NSTEMI and 1 pneumonia in the GA group and 1 NSTEMI and 1 wound infection in the LA group. There was a trend towards shorter length of stay in the LA group at 5.5 days vs 8.5 days with a GA.
Conclusions: The routine insertion of a prophylactic spinal drain prior to TEVAR cases is controversial and likely provides minimal if any benefit in patients at low risk of spinal cord ischemia. This is supported by our systematic review of the literature. In this study, there was no increased risk of paralysis or stroke in patients performed under local without CSF drainage. The use of local anaesthesia in this setting enables continuous intraoperative assessment of neurologic function and allows for appropriate and timely intervention if required.

EndoAnchors in Thoracic, Thoracoabdominal and Complex Abdominal Endovascular Aortic Repairs: Safe and Effective

Sarah B. Ongstad, MD, Christine Ou, DO, and Jean M. Panneton, MD, Division of Vascular Surgery, Eastern Virginia Medical School, Norfolk, VA

Objectives: Thoracic endovascular aortic repair (TEVAR) and complex endovascular abdominal aortic repair (CEVAR) are performed despite anatomic constraints and complicated aortic pathology. Utilizing Heli-FX EndoAnchors for endograft fixation in the infrarenal aorta has been described. This study was to assess the applicability and outcomes of EndoAnchors in TEVAR and CEVAR.
Methods: A retrospective review of endovascular aortic repairs performed with EndoAnchors between 2012-2016. Primary study endpoints included freedom from migration and type I endoleak requiring reintervention.
Results: Total of 101 patients underwent 54 TEVARs and 47 CEVARs with EndoAnchor. Twenty-two patients (21.8%) were treated for thoracic aortic aneurysm, 35 (34.7%) for thoracoabdominal aneurysm, 22 (21.8%) for pararenal aneurysm and 22 (21.8%) for infrarenal aneurysms with hostile neck anatomy. Forty-five cases (44.6%) were performed as index operations and 56 (55.4%) were redos. TEVAR endografts were deployed in zones 0 or 1 in 40.1% of patients, requiring adjunctive procedures (*arch debranching* = 20, *in-situ arch fenestration* = 9, *supra-aortic trunk chimney* = 4, *visceral debranching* = 2). In CEVAR patients, 1 visceral vessel was treated in 25 patients (24.8%), 2 in 6 patients (5.9%), 3 in 24 patients (23.8%), and 4 in 5 patients (5.0%). EndoAnchors were placed for therapeutic indications in 41.6% of cases and for prophylactic in 58.4%. Technical success of deployment was 99.6%. Mean follow-up was 14.3±11.0 months. At 2 years, freedom from type I endoleak requiring reintervention was 93.8% for thoracic aneurysms, 100% for thoracoabdominal aneurysms and 94.1% for abdominal aneurysms with no significant difference in freedom from type I endoleak between redo (93.7%) and index (96.7%) operations (p=0.752).

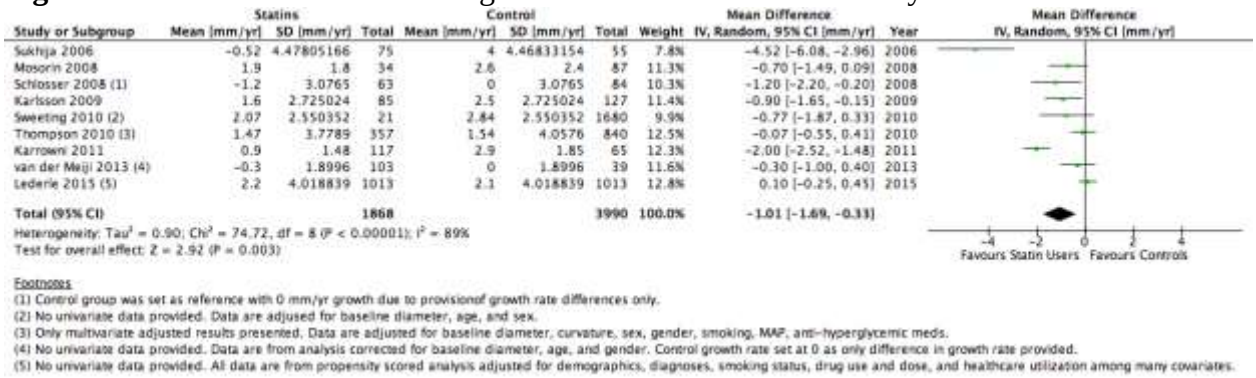
Conclusions: EndoAnchors can be safely utilized in TEVAR and CEVAR and can decrease rates of graft migration and type I endoleak. Additional data and long-term follow-up are needed to further define the use of this technology.

The Impact of Statins on Abdominal Aortic Aneurysm Growth, Rupture, and Perioperative Outcomes: A Systematic Review and Meta-Analysis

Konrad Salata[1,3], MD; Muzammil Syed[2]; Mohamad Hussain[1,3], MD; Norah Alsaif[3], MD; Subodh Verma[1,4], MD, PhD, FRCSC, FAHA; Mohammed Al-Omran[1,3], MD, MSc, FRCSC, [1]Department of Surgery, University of Toronto, Toronto, Canada; [2]Faculty of Science, McMaster University, Hamilton, Canada; [3]Division of Vascular Surgery, St. Michael's Hospital, Toronto, Canada; [4]Division of Cardiac Surgery, St. Michael's Hospital, Toronto, Canada.

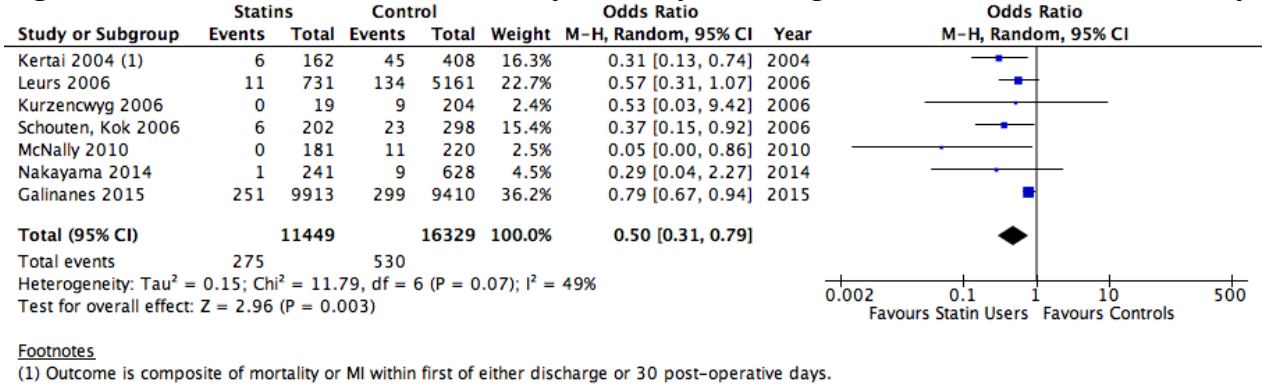
Objectives: To summarize the literature regarding the effects of statins on human AAA growth, rupture, and peri-operative mortality.
Methods: We conducted a systematic review in accordance with PRISMA guidelines. Our review protocol was registered at the International Prospective Register of Systematic Reviews (PROSPERO 2017:CRD42017056480). We searched MEDLINE, EMBASE, and The Cochrane CENTRAL databases from inception to 2017 for studies examining the effects of statin treatment on AAA growth, rupture or peri-operative mortality. Review, abstraction, and study quality assessment steps were conducted in duplicate, and a third author resolved any discrepancies. We assessed study quality using the Cochrane, and Newcastle-Ottawa scales. Random effects models were used to calculate pooled mean differences and odds ratios (OR) with 95% confidence intervals. Heterogeneity was quantified using the I^2 statistic.
Results: Our search yielded 827 articles. Two case-control and 21 cohort studies involving 45834 patients were included. Inter-rater agreement was moderate (κ=0.67), and risk of bias was low to moderate. Two studies assessed rupture, 8 assessed 30-day mortality, and 13 studies assessed AAA growth. Statins reduced AAA growth rate by a mean of 1.01 mm/yr (95% CI 0.33,1.69, p=0.003, I^2=89%) (Figure 1), which translated into a reduced rupture risk (OR 0.5, 95% CI 0.28, 0.90, p=0.02, I^2=86%). Pre-operative statin use also halved 30-day mortality following elective AAA repair (OR 0.50, 95% CI 0.31, 0.79, p=0.003, I^2=49%) (Figure 2). Subgroup analysis revealed the former effect to be driven by the 30-day mortality following open AAA repair (OR 0.31, 95% CI 0.17, 0.58, p=0.0002, I^2=0%), whereas the effect of statins was lost in the EVAR subgroup (OR 0.25, 95% CI 0.02, 2.60, p=0.24, I^2=65%).
Conclusion: Statins reduce AAA growth rates and consequently rupture rates. Furthermore, they improve peri-operative outcomes in elective open AAA repair patients. Statin pharmacotherapy should be considered in all patients with small AAAs.

Figure 1: The effect of statin use on growth of abdominal aortic aneurysms



Footnotes
(1) Control group was set as reference with 0 mm/yr growth due to provisionof growth rate differences only.
(2) No univariate data provided. Data are adjused for baseline diameter, age, and sex.
(3) Only multivariate adjusted results presented. Data are adjusted for baseline diameter, curvature, sex, gender, smoking, MAP, anti-hyperglycemic meds.
(4) No univariate data provided. Data are from analysis corrected for baseline diameter, age, and gender. Control growth rate set at 0 as only difference in growth rate provided.
(5) No univariate data provided. All data are from propensity scored analysis adjusted for demographics, diagnoses, smoking status, drug use and dose, and healthcare utilization among many covariates.

Figure 2: The effect of statin use on 30-day mortality following elective abdominal aortic aneurysm repair



Footnotes
(1) Outcome is composite of mortality or MI within first of either discharge or 30 post-operative days.

A Canadian Post-Market Study of Zenith Alpha Abdominal Endovascular Graft

Thomas L. Forbes[1], Jerry Chen[2], John Harlock[3], Christine Herman[4], Thomas F. Lindsay[1], Adam H. Power[5], Divisions of Vascular Surgery, [1]Peter Munk Cardiac Centre, University Health Network & University of Toronto, Toronto, ON; [2]Vancouver General Hospital & University of British Columbia, Vancouver, BC; [3]Hamilton Health Sciences Centre & McMaster University, Hamilton, ON; [4]Halifax Infirmary & Dalhousie University, Halifax, NS; [5]London Health Sciences Centre & Western University, London, ON

Objective: To report the initial results of a multicentre, Canadian study evaluating the performance of the Zenith Alpha abdominal endovascular graft in the post-market setting. The Zenith Alpha device, based on the Zenith platform (modular system, suprarenal fixation), is delivered through a lower profile introduction system (16 or 17 French) with an ergonomic rotation handle that requires fewer procedural steps. Compared with previous generation devices this low profile system is expected to enable EVAR in a wider patient population.
Methods: This is a prospective, multicentre, non-randomized clinical study being performed at five Canadian vascular centres, collecting data under commercial clinical use conditions in patients with nonruptured abdominal aortic or aortoiliac aneurysms with anatomy suitable for endovascular repair. The primary endpoint is device success, defined as technical success plus freedom from rupture, conversion, Type I or III endoleak, graft limb occlusion, or aneurysm size increase > 0.5 cm. Secondary endpoints include assessment of procedural variables, clinical utility measures, major adverse events, aneurysm size change, occurrence of endoleaks, device integrity, patency, migration and secondary intervention. In addition to anatomical criteria specified in the IFU, exclusion criteria include the presence of Marfan's Syndrome or any other known connective tissue disorder, symptomatic or ruptured aneurysms, and mycotic or inflammatory aneurysms.
Results: 100 patients will be enrolled in this study at five Canadian centres. Enrollment is expected to be completed within one year. Patients will be followed up to two years after their aneurysm repair with routine clinical and radiologic examinations according to each centre's standard of care. Total study duration is expected to be three years. Patient enrollment will begin very shortly at several sites.
Conclusions: This report will provide an early update on this Canadian multicentre study describing a country-specific experience with the Zenith Alpha endograft.

Saturday, September 16th, 2017
PAPER SESSION IV: EMERGING TREATMENTS

Early Results of Arch Pathology treated with Nexus Arch Endograft

Thomas Lindsay, Maral Ouzounian and Kong Tan, Divisions of Vascular Surgery, Cardiovascular Surgery and Interventional Radiology, University Health Network and the Division of Vascular Surgery, University of Toronto, Toronto, Ontario.

Objective: To describe the results of five consecutive cases of aortic arch pathology repaired using the novel Nexus arch endograft.
Introduction: Aortic arch pathology poses a technical and anatomical challenge for endovascular repair. Durable aneurysm exclusion and procedural related complications including strokes account for some of these challenges. We report five consecutive cases of arch pathology (aneurysm and dissection) treated with the Nexus arch endograft.
Methods: Charts were reviewed retrospectively from the prospective data collection with current follow-up. All cases had life sized aortic model constructed to facilitate preoperative case planning and simulated graft deployment prior to each implantation. Study was approved by UHN research ethics board.
Results: There were three saccular aneurysms of the aortic arch and two patients with dissection, one required proximal coverage for an expanding thoracic aneurysm secondary to a Type B dissection and one with a previous type A dissection repair and expansion of the descending thoracic aorta.

Variable	Mean
Age	74.6
Aneurysm size	68.4
Innominate to aneurysm distance	10.4 mm
Bypass Length of stay	7.8 days
Nexus Length of Stay	8.4 days
Contrast Volume	125.4 ml
Fluoroscopy Time	38 minutes

All patients had significant comorbidities (age, impaired LV function, previous aortic surgery, ulcerative colitis, morbid obesity). Each patient underwent carotid-carotid and carotid subclavian bypass prior to the arch endo grafting. Key clinical variables are seen in the table. No peri procedural strokes or renal dysfunction occurred; however, one patient was noted on post-operative imaging to have an ascending aortic hematoma that progressed to require ascending aortic replacement. Follow-up has ranged from 1.5 to 13 months. No endoleaks have been noted in early or later follow up. Aneurysm shrinkage has been observed in 2 cases.

Conclusion: Our early experience with the Nexus arch graft has been successful in treating challenging arch aneurysmal pathology without stroke or mortality in a high risk population.

Thoraflex Hybrid Endovascular Frozen Elephant Trunk Device for Treatment of Complex Aortic Arch Disease

John H Landau[1], Luc A Dubois[1], Adam H Power[1], Audra Duncan[1], Guy Derose[1], Michael WA Chu[2], [1] Divison of Vascular Surgery, Schulich School of Medicine, University of Western Ontario, [2] Division of Cardiac Surgery, Schulich School of Medicine, University of Western Ontario

Objective: To describe our experience illustrating the utility of the Thoraflex hybrid frozen elephant trunk prosthesis (Figure 1) in the multidisciplinary treatment of complex aortic arch and thoracoabdominal aortic disease.
Methods: Prospective data was collected on 15 patients treated with the Thoraflex hybrid frozen elephant trunk prosthesis between 2014 and 2016. Data captured includes Indications for repair, type of repair, subsequent distal aortic reconstruction, cardiopulmonary bypass data, length of ICU stay, length of hospital stay, and perioperative morbidity or mortality.
Results: Aortic pathology at the time of treatment included acute or chronic aortic dissection, thoracoabdominal aortic aneurysm, ascending aortic aneurysm, persistent Type 1a endoleak after TEVAR for thoracic aneurysm (Figure 2), proximal thoracic aortic pseudoaneurysm, intramural hematoma, and penetrating aortic ulcer. Two patients were known to have a diagnosis of collagen vascular disease. 10 patients were treated electively (67%) and 5 were treated emergently (33%). 11 required carotid-subclavian bypass (73%) as an adjunct either preoperatively or intraoperatively. The graft was configured to allow for antegrade cerebral perfusion in all 15 cases. Median ICU length of stay was 1 day. Median hospital length of stay was 10 days. There was one death secondary to post-operative myocardial infarction (7%). Two patients suffered transient spinal cord ischemia (13%) which recovered, and one patient had transient acute kidney injury requiring hemodialysis (7%). No strokes or TIA's occurred and there were no endoleaks visible on post-operative surveillance imaging. A description of techniques used for second-stage TEVAR with proximal sealing in the stent-graft portion of the Thoraflex device is included.
Conclusions: Using a multidisciplinary approach involving both cardiac and vascular surgeons, the Thoraflex Hybrid Frozen elephant trunk presents a novel option for treating complex aortic arch and more extensive aortic disease. The hybrid construction of the device provides flexibility in planning further aortic reconstruction using either endovascular or open techniques. Unlike other methods of hybrid and total endovascular arch repair, this technique appears to carry a very low stroke risk.

Figure 1 – The Thoraflex device pictured fully deployed. The proximal Dacron arch component is connected to the distal nitinol ring-supported stent-graft by a collar for attachment to the proximal descending thoracic aorta.

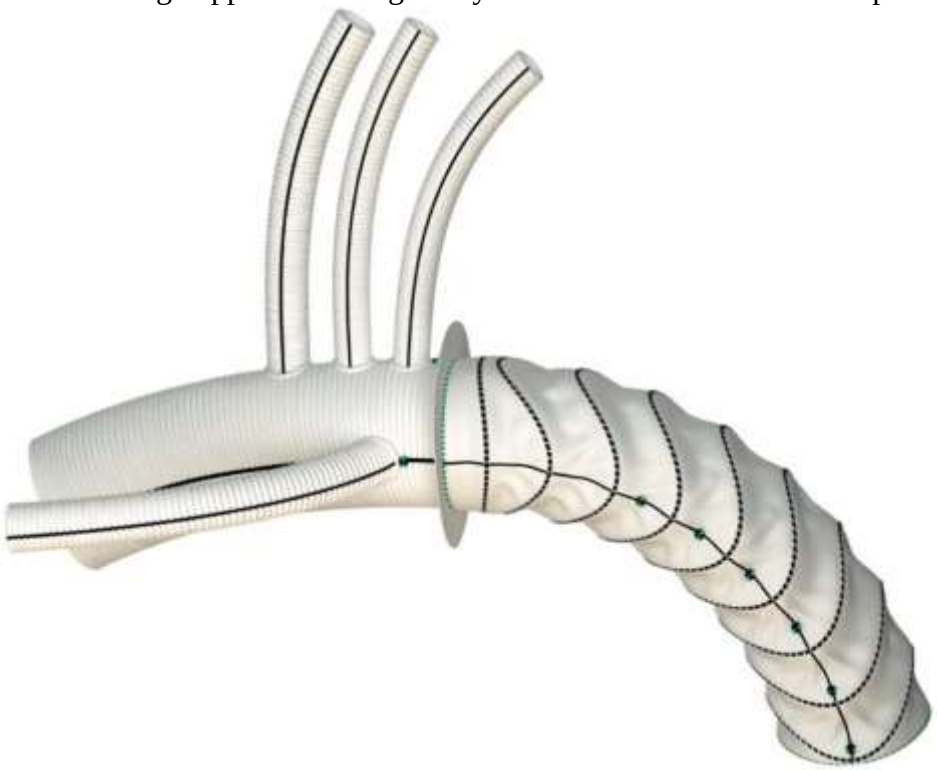
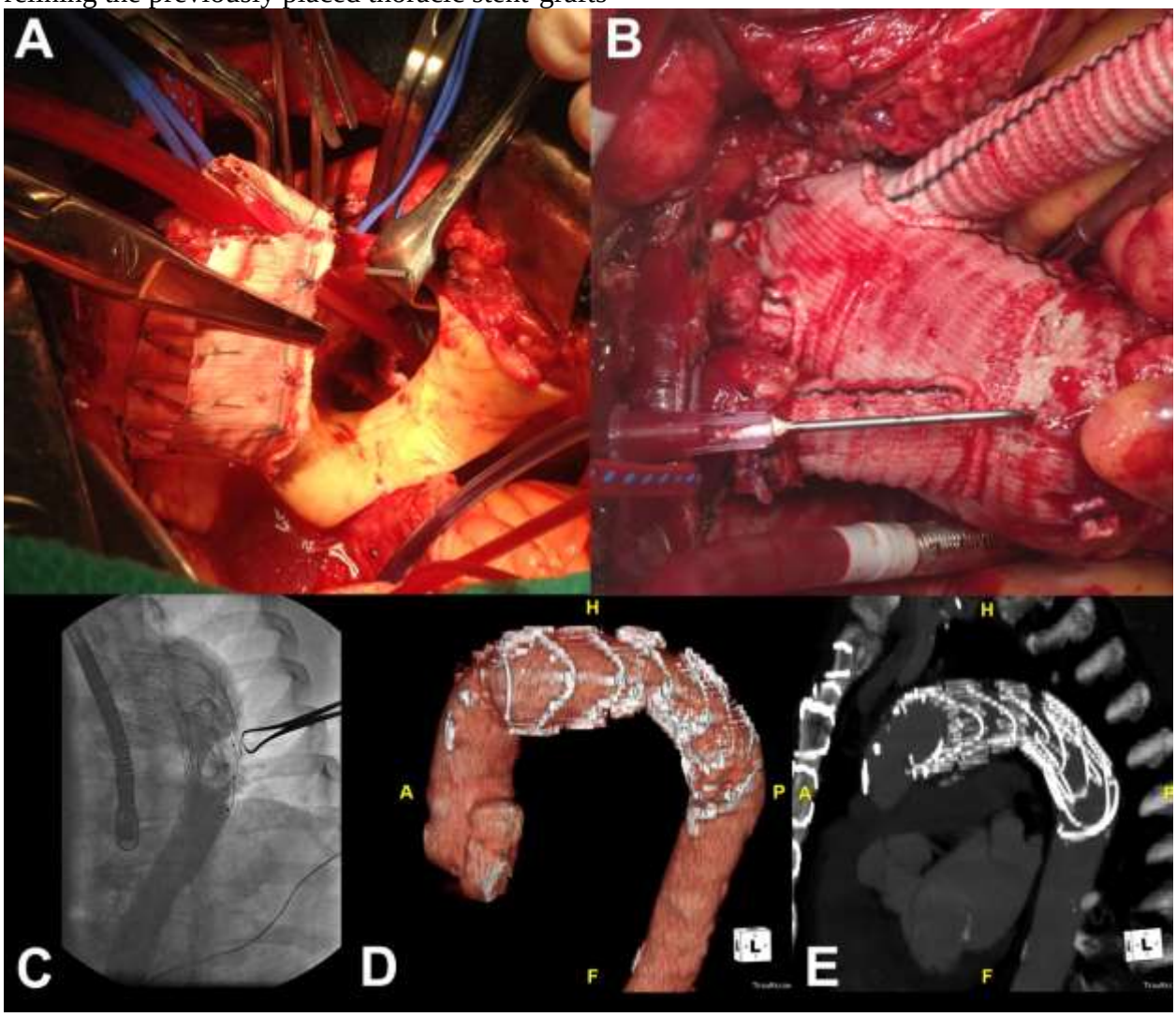


Figure 2 – Thoraflex repair of enlarging thoracic aortic aneurysm secondary to persistent type 1a endoleak after initial endovascular repair. A – Resection of proximal endovascular stent-graft. B – Proximal Dacron arch reconstruction. C – Intraoperative fluoroscopy showing deployment of the stent-graft component through the remnants of the previous TEVAR stent-graft. D – 3D CT scan reconstruction of the aortic arch demonstrating the ring stents of the thoraflex stent graft component. E – Sagittal CT scan demonstrating the thoraflex stent-graft relining the previously placed thoracic stent-grafts



Venous Arterialization for Non-Reconstructible Lower Extremity Arterial Disease - A Multi-Centre Case Series

Kyle A. Arsenault[a], Leonard W. Tse[b], Joel Gagnon[a], David Kelton[b], Keith Baxter[a], Jerry Chen[a], William Johnson[d], Varun Kapila[b], [a]Division of Vascular Surgery, University of British Columbia, Vancouver, BC, Canada, [b]Division of Vascular Surgery, William Osler Health System, Brampton, ON, Canada, [c]Division of Interventional Radiology, William Osler Health System, Brampton, ON, Canada, [d]Division of Vascular Surgery, Trillium Health Partners, Mississauga, ON, Canada

Background: Approximately 15% of patients with critical limb ischemia are not candidates for revascularization due to lack of target outflow vessels. The prognosis for these patients is grim, with major amputation being the only option for pain control or wound healing. A potential alternative for these patients is venous arterialization of the foot, which may provide reverse flow to the capillary beds and increase collaterals.
Methods: Between January 2016 and February 2017, we performed fourteen venous arterialization procedures on thirteen patents for critical limb ischemia at three Canadian vascular surgery centres. We present a case series of our initial experience with this procedure, including indications, techniques, and patient outcomes.
Results: Patients undergoing a venous arterialization procedure were between 51 and 87 years old (median 73.5). Patients had significant comorbidities with diabetes mellitus in nine (69%), dialysis-dependence in three (23%), and contralateral amputations in three (23%). All patients had critical limb ischemia, with Rutherford classification of 4 in two limbs, 5 in ten limbs and 6 in two limbs. All patients had undergone previous attempts at revascularization, including either surgical bypass, tibio-pedal angioplasty, or catheter-directed thrombolysis for a thrombosed popliteal aneurysm. Patients underwent pre- or intraoperative ultrasound mapping of the distal greater saphenous vein (GSV) and the superficial venous system in the foot. A bypass was performed using the remaining ipsilateral GSV or harvested arm vein from the most distal suitable artery to the GSV, which was left in-situ. Through a venotomy at the ankle, valves proximally and distally were lysed. All patients had intraoperative completion angiograms. Three patients underwent concomitant digital amputations. Technical success was 93%. One patient died perioperatively. Primary patency at 30 days was 82%. Six patients had relief of their rest pain and wound healing. Four patients went on to have a major amputation and two have been offered amputation.
Conclusions: Venous arterialization may provide symptom relief and tissue healing in patients with otherwise non-reconstructible lower extremity arterial disease. Our early experience is encouraging, but further followup and development of post-procedure strategies are required to assist with the long term limb-salvage benefits of this procedure.

Topical Oxygen Therapy Closes Chronic Diabetic Foot Ulcers
Paul Hayes, MD FRCS on behalf of the UK Topical Oxygen in Diabetic Foot Ulceration study group

Objective: Many diabetic foot ulcers exhibit a degree of hypoxia and this impairs the healing process because processes such as cell division, angiogenesis, fighting infection and collagen production do not occur efficiently in low oxygen environments.
Methods: The aim of this registry study was to evaluate the use a continuous oxygen ambulatory therapy device to deliver continuous moist oxygen directly to chronic diabetic wound foot wounds and assess improvement in healing. This was undertaken in across 2 formal, ethics board approved UK studies, TODFU-1 and TODFU-2.
In total 52 patients (10 in TODFU-1, and 42 in TODFU-2), with a non-healing foot ulcer for greater than 6 months' duration, were recruited from 18 specialist, hospital diabetic foot practices in the UK. All had a full diabetic/arterial assessment. Standardised digital images were collected to assess change in wound size.
Results: The DFU were truly chronic with a median duration of 12 months prior to the trial. The median age of the study patients was 64, and 40% of the patients continued to smoke. The median ulcer size decreased from 1.8cm^2 at the start of the study to only 0.15cm^2 at the end of the study. At week 8, the median ulcer size had decreased by 48%. By week 24, 42% had healed completely, with another 14% exhibiting greater than 80% re-epithelialisation. Although not all wounds closed this represented a significant benefit in closing recalcitrant DFU under long term specialist treatment.
Conclusion: The continuous ambulatory oxygen therapy device had a significant beneficial effect on wound healing in this difficult to treat patient group. Analysis of the economic significance of this finding is ongoing.

Saturday, September 16th, 2017
PAPER SESSION V: COMPUTATIONAL AND BENCH WORK

Performance Assessment of a Radiofrequency Powered Guidewire for Crossing Peripheral Arterial Occlusions Based on Lesion Morphology

Mohammad A. Tavallaei, James J. Zhou, Trisha Roy, Andrew D. Dueck, Graham A. Wright
Sunnybrook Research Institute, University of Toronto, Toronto, Canada

Objective: The goal of this study was to assess and compare the performance of a conventional guidewire to a radiofrequency (RF) powered guidewire for crossing various types of peripheral chronic total occlusions as characterized by Magnetic Resonance Imaging (MRI).
Methods: In this study, 27 samples of peripheral arterial plaques were excised from 2 amputation patients. To characterize the lesion morphology, each sample was imaged with 7 Tesla MRI using ultrashort echo time (UTE), and T2-weighted (T2W) sequences ($97\times97\times97\mu m^3$ voxels), and imaged with micro-CT ($50\times50\times50\ \mu m^3$ voxels). The lesions were categorized as "soft" (fat, thrombus, microchannels or loose fibrous tissue – bright on T2W images) or "hard" (dense fibrous tissue/collagen and segmented calcium – grey on UTE and dark on T2W images)[1–3] as shown in Fig. 1. Using a custom catheter test station, the load cell advanced the guidewires at a constant velocity of 0.05mm/s while recording the exerted forces. The performance of a 0.035" conventional hydrophilic guidewire was compared to a 0.035" RF guidewire with RF power (ON) (50W maximum at 468kHz) and without RF (OFF).
Results: For "hard" lesions, the conventional guidewire failed to penetrate (n=6) while the RF guidewire successfully punctured (n=3) with forces of 1.34N ± 0.36 when OFF and significantly lower forces of 0.54N ± 0.12 when ON (n=3) (one-tailed t-test, $p<0.03$) (Fig. 2). For "soft" lesions, the conventional guidewire penetrated the samples (n=5) with puncture forces of 0.25N ± 0.20, while the RF guidewire experienced forces of 0.62N ± 0.28 when OFF (n=5) and 0.04N ± 0.03 when ON (n=5) (one-way ANOVA, $F(2,12)$, $p<0.002$).
Conclusion: These results indicate that using RF power significantly reduces the required amount of force to puncture "hard" lesions; and, where the conventional guidewire fails, the RF guidewire succeeds. Future work will analyze the safety aspect of using RF in-vivo.

References

1. Roy T, Liu G, Qi X, Dueck A, Wright GA. MRI characterization of peripheral arterial chronic total occlusions at 7 Tesla with microCT and histologic validation. *J Cardiovasc Magn Reson*. 2015;17(Suppl 1):P404. doi:10.1186/1532-429X-17-S1-P404.
2. Roy T, Liu G, Shaikh N, Dueck AD, Wright GA. Magnetic Resonance Imaging as a Predictor of Forces Required to Cross Peripheral Arterial Lesions With a Guidewire. *J Vasc Surg*. 2016;64(5):1542. doi:10.1016/j.jvs.2016.08.031.
3. Roy T, Liu G, Shaikh N, Dueck AD, Wright GA. Puncturing Plaques. *J Endovasc Ther*. 2017;24(1):35-46. doi:10.1177/1526602816671135.

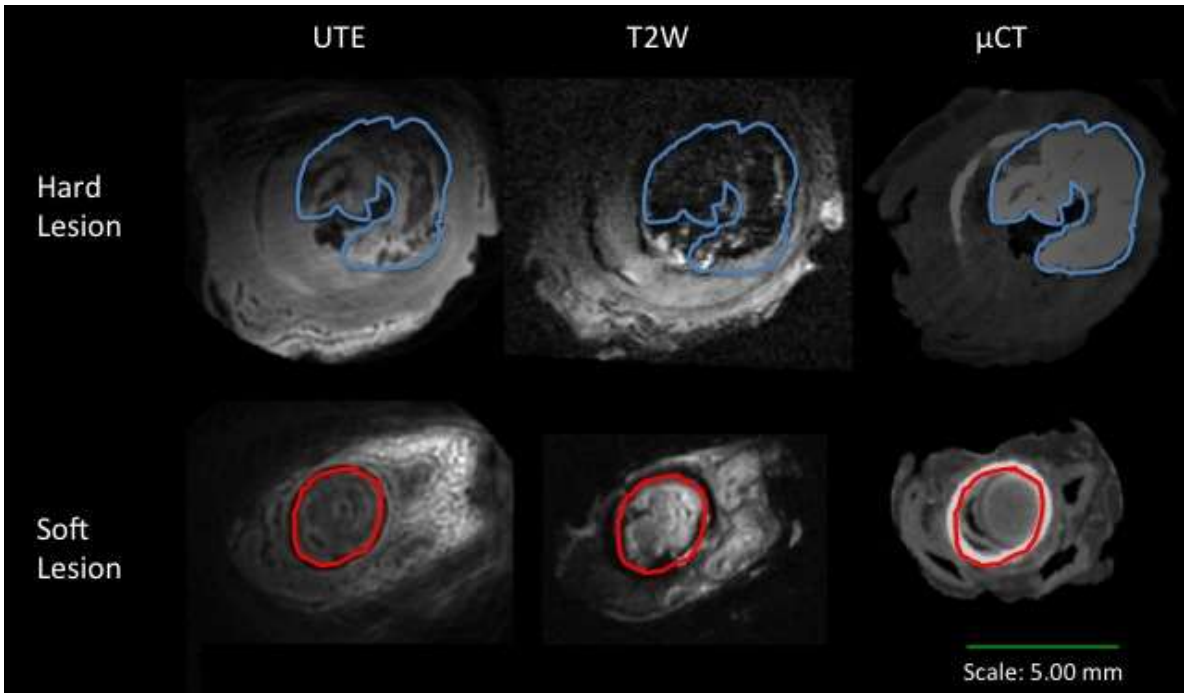


Figure 1: UTE, T2W and µCT images of a "hard" and "soft" sample. The blue outline surrounds the hard tissue, segmented calcium and collagen I matrix targeted by the guidewires; the red outline surrounds the soft tissue targeted by the guidewires.

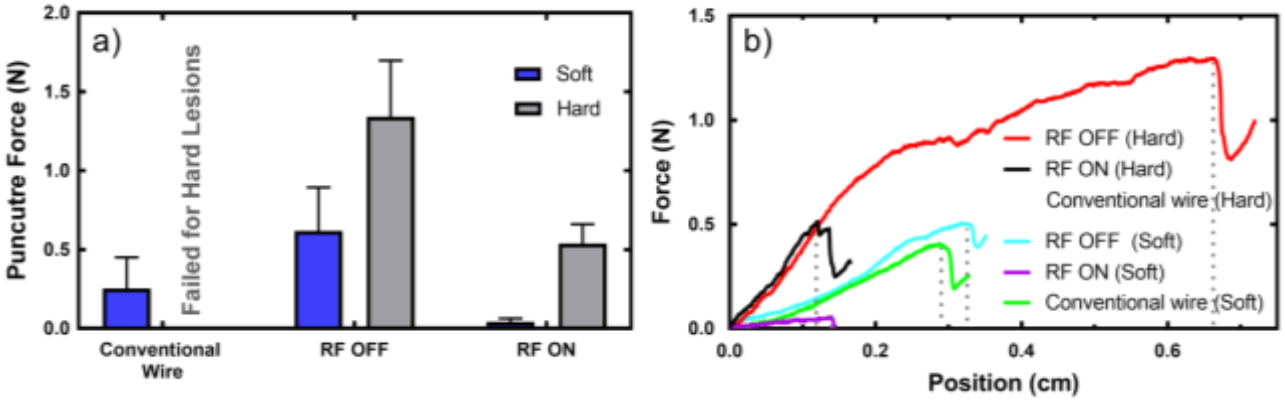


Figure 2: a) Average puncture forces for the "soft" and "hard" lesions with each guidewire. b) Force-displacement plots for representative cases of each category; the dotted lines indicate the puncture forces. The conventional wire failed to penetrate all hard lesions.

Air Bubbles Released from Thoracic Aortic Endograft Deployment: Analysis and Quantification

Joel Gagnon[1,2] MD FRCSC, Jacques Tittley MD FRCSC[3], Jonathan Misskey[1]† MD, [1]Division of Vascular Surgery, University of British Columbia, Canada, [2]Division of Vascular Surgery, Vancouver General Hospital, Vancouver, British Columbia, Canada, [3]Division of Vascular Surgery, McMaster University, Hamilton, Ontario, † Corresponding author

Introduction: Although the prevalence of stroke following TEVAR is well documented, the proportion of both clinically significant and silent air emboli during TEVAR remains undetermined. Although widely suspected, the presence and amount of retained air bubbles released on deployment of fully flushed and prepared thoracic endografts has never been independently verified. The goal of this study was to determine the volume of air and the size of any macrobubbles released (diameter > 1mm) during standard thoracic aortic endograft deployment in an *in-vitro* model.
Methods: A total of 11 thoracic endografts (8 Cook, 2 Gore, 1 Medtronic) were deployed within a custom-designed, sealed and pressurized (120cm H_2O) viewing chamber. Deployments were recorded using a high definition video camera, with considerations to avoid parallax effect. All Endograft devices were flushed, prepared, and deployed according to product specific Instructions for Use (IFU). Released air was measured using an air catch container and bubble diameter was estimated using dedicated image processing software.
Results: All deployed thoracic endografts, regardless of brand, demonstrated release of air bubbles on deployment. Mean collected volume of air from endografts was 0.18 mL per endograft deployment (Range 0.125 – 0.225 mL). Macrobubbles > 1 mm in diameter were observed in all grafts, with a mean bubble size of 2.59 mm (Range 1.07 – 5.21 mm). Macrobubbles were present in all Cook and Medtronic devices at the distal end of the delivery system, whereas they were only found at the proximal end of the delivery system with Gore devices. Mean number of macrobubbles released per graft was 2.1 (Range 1-5).
Conclusions: Air bubbles were release from all thoracic endografts deployed in our experimental in-vitro model, regardless of brand, and despite strict adherence to IFU instructions in preparation. The importance of this released air remains unclear but should be considered in explaining the cause of strokes in the management of thoracic arch pathologies with endograft modalities. Additional study to determine the in-vivo behavior of these bubbles is required to elucidate their potential for embolic events.

Correlation Between Matrix Metalloproteinase-9 Activity, Intraluminal Thrombus Deposition, and Computational Pulsatile Hemodynamics in Human Abdominal Aortic Aneurysms
Anne A Ducas[1], Richard J Lozowy[2], David CS Kuhn[2], and April J Boyd[1], [1]Department of Vascular Surgery, Health Sciences Centre, University of Manitoba, [2]Department of Mechanical Engineering, University of Manitoba, Winnipeg, Canada.

Objective: We have previously demonstrated that AAA rupture occurs in zones of low wall shear stress (WSS) where flow recirculation and intraluminal thrombus (ILT) deposition was increased. Matrix metalloproteinase-9 (MMP-9) is the most important metalloproteinase involved in pathogenesis of AAA. The purpose of this study was to examine regional differences in MMP-9 tissue levels, ILT deposition, and predicted pulsatile flow dynamics in human AAA.
Methods: Full-thickness aortic tissue samples were harvested in 25 patients undergoing open AAA repair. Aortic tissue, ILT and plasma were assessed for MMP-9 levels using a cytokine array assay (*Eve Technologies*). All tissues were harvested with ethics approval. Three-dimensional AAA geometry was generated from CTA images using *Mimics* software. Computational fluid dynamics was used to predict pulsatile aortic blood flow.
Results: Twenty-three patients were included in the analysis. The first case was a pilot study to assess the safety of tissue harvest and the data are not included. Another patient was excluded when hemodynamics could not be assessed due to the lack of contrast imaging. When ILT was present (21/23 cases), there was a significant positive correlation between location and thickness ILT with predicted low WSS and flow recirculation. There was a significant regional heterogeneity in MMP-9 levels within individual AAA. MMP-9 tissue levels were significantly elevated and positively-correlated with regions of ILT deposition.
Conclusions: This study was the first to correlate predicted pulsatile aortic blood flow with tissue levels of MMP-9 and ILT deposition in human AAA. There were significant regional differences in MMP-9 levels that generally

correlated with ILT deposition, flow recirculation and low WSS. The fact that ILT showed the highest levels of MMP-9, and that aortic wall adjacent to ILT showed the higher levels of MMP-9, suggests that ILT may promote AAA wall degeneration due to increased proteolytic activity.

Iliac Artery Torsion and Calcification Predict Endovascular Device Rotation and Severe Perioperative Complications in Advanced EVAR

Sean A. Crawford[1,3], Ryan M. Sanford[2], Matthew G. Doyle[2,3], Naomi Eisenberg[3], Mark Wheatcroft[4], Cristina H Amon[1,2], Thomas L Forbes[3], [1]Institute of Biomaterials and Biomedical Engineering, University of Toronto, [2]Department of Mechanical and Industrial Engineering, University of Toronto, [3]Division of Vascular Surgery, University Health Network, University of Toronto, [4]Division of Vascular Surgery, St. Michael's Hospital, University of Toronto, Toronto, ON, Canada

Objective: The objective of this study was A) to quantify the short-term clinical outcomes in patients with stent graft rotation and B) to identify anatomical markers that can predict stent graft rotation.
Methods: A prospective study evaluating all patients undergoing advanced EVAR was conducted at two university affiliated hospitals between November 2015 and December 2016. Stent graft rotation (defined as $\geq 10°$) was measured on intraoperative fluoroscopic video of the deployment sequence. Standard pre-operative CTA imaging was used to calculate the geometric properties of the arterial anatomy. Any in-hospital/30-day complications were prospectively documented and a composite outcome of any end-organ ischemia and/or death was used as the primary endpoint.
Results: Thirty-seven patients undergoing advanced EVAR were enrolled in the study with a mean age of 75 [64-89] and a mean aneurysm diameter of 63 mm [42-90 mm]. The incidence of stent graft rotation was 39% (n=14) with a mean rotation of 25.4° [10.2-51°]. The total net torsion and the total volume of calcific plaque was higher in patients with stent graft rotation, 8.9 ± 0.84 mm^{-1} vs 4.1 ± 0.53 mm^{-1} ($P<0.0001$; Figure 1A) and 1054 ± 143 mm^3 vs 537 ± 89 mm^3 ($P<0.01$; Figure 1D) respectively. The composite outcome of any end-organ ischemia and/or death was also substantially higher in patients with stent graft rotation, 43% vs 4.5% ($P<0.01$; Table 1). Additionally, patients with stent graft rotation had significantly higher combined rates of type 1 and type 3 endoleaks 36% vs 9% ($p<0.05$).
Conclusions: Patients with intraoperative stent graft rotation have a significantly higher rate of severe postoperative complications and this is strongly associated with higher levels of iliac artery torsion and calcification. These findings suggest that pre-operative quantitative analysis of iliac artery torsion and calcification is essential for patient risk stratification prior to advanced EVAR.

Table 1. Intraoperative fluoroscopy time, volume of contrast, total radiation dose and the in-hospital/30-day perioperative complication profile.

	Control (n=22)	Rotation (n=14)	Overall (n=36)	P-Value
Mean Rotation (°)	4.3 ± 0.6	25.4 ± 3.0	12.5 ± 2.1	< 0.0001
Mean Fluoroscopy Time (min)	95 ± 8.4	117 ± 9.6	104 ± 5.7	0.1
Mean Contrast Volume (mL)	157 ± 15	159 ± 16	158 ± 10	> 0.5
Radiation Entrance Dose (µSv)	4792 ± 710	7347 ± 1266	5699 ± 613	0.06
Hospital Length of Stay (days)	5.4 ± 1.3	7.7 ± 1.8	6.2 ± 0.9	0.3
No. of Re-interventions	3 (8%)	4 (27%)	7 (19%)	0.4
Branch Stent Occlusion	0 (0%)	2 (14%)	2 (6%)	0.14
30-day Complications				
Atrial fibrillation	1 (5%)	0 (0%)	1 (3%)	> 0.5
Paraplegia	0 (0%)	2 (14%)	2 (6%)	0.14
Myocardial infarction	1 (5%)	1 (7%)	2 (6%)	> 0.5
Ischemic Colitis	0 (0%)	1 (7%)	1 (3%)	0.4
Pancreatitis	0 (0%)	1 (7%)	1 (3%)	0.4
Death	0 (0%)	2 (14%)	2 (6%)	0.14
No. of Endoleaks				
Type 1c	0 (0%)	2 (18%)	2 (6%)	0.14
Type 2	7 (23%)	3 (27%)	10 (28%)	> 0.5
Type 3	2 (8%)	4 (27%)	6 (17%)	0.18
End-organ Ischemia and/or Death	1 (0%)	6 (43%)	7 (19%)	0.008

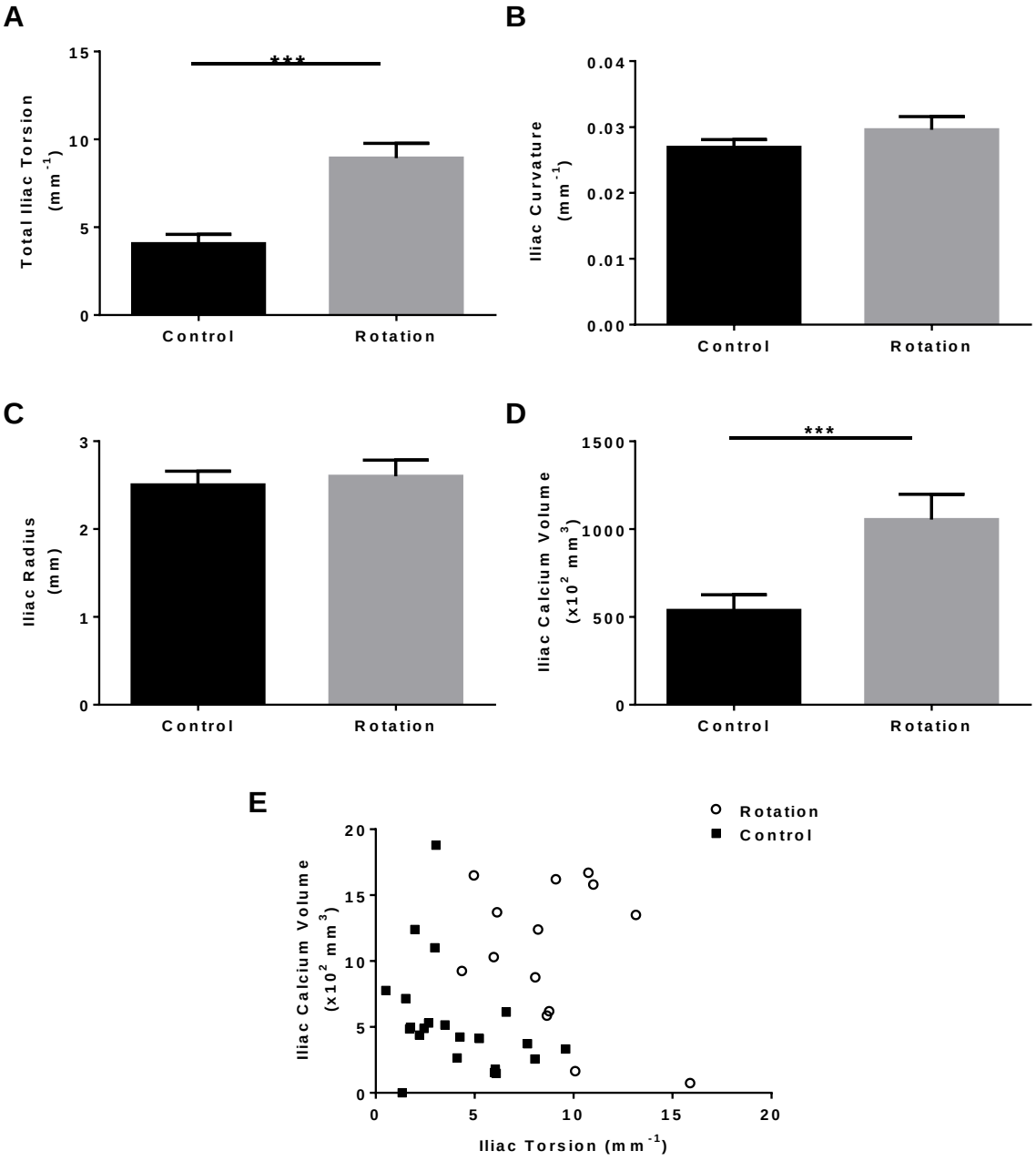


Figure 1. **(A)** Total iliac torsion **(B)** Mean Iliac Curvature **(C)** Mean minimum iliac radius **(D)** Iliac calcium volume in patients with stent graft rotation or without (control). Mean ± SEM. **(E)** Scatter plot of total iliac calcium volume relative to total iliac torsion in patients with stent graft rotation (white) or without (black).

MRI Characteristics of Peripheral Arterial Lesions Relate to the Difficulty of Endovascular Procedures

Trisha L. Roy BASc MD[1,2], Andrew D. Dueck MD MSc[1,2] and Graham A. Wright PhD[1,3]
[1]Schulich Heart Program and the Sunnybrook Research Institute, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada, [2]Division of Vascular Surgery, Department of Surgery, University of Toronto, Toronto, Ontario, Canada, [3]Department of Medical Biophysics, University of Toronto, Toronto, Ontario, Canada

Objective: Percutaneous vascular interventions (PVI) are associated with high technical failure and re-intervention rates. Limitations with current peripheral arterial imaging modalities make patient selection for PVI difficult. In this study we use MRI to characterize peripheral arterial lesions to predict whether lesions are difficult to cross with a guidewire.
Methods: A clinical 3T MRI scanner was used to image 8 peripheral arterial disease patients prior to their PVI. A steady state free precession (SSFP) flow-independent MR angiogram was used to precisely locate lesions and a prototype ultrashort echo time (UTE) was used to further characterize hard lesion components including calcium and dense collagen. Lesions were characterized as "hard" if >50% of the lumen was occluded with calcium or collagen in the hardest cross-section within the lesion. The time to cross a guidewire through the lesion was measured. The requirement for stenting a lesion was also evaluated.
Results: 7/8 procedures were immediately technically successful. 5/7 lesions were defined as "hard" based on their MRI signatures and 2/7 were "soft". Hard lesions took significantly longer to cross than soft lesions (average 13 min vs. 3 min 55 sec, p=0.047). Hard lesions also required stenting more often than soft lesions (5/5 vs. 0/2, p=0.005). In addition, MRI detected non-calcified hard lesion components and intermittent patencies in occlusive arteries that could not be visualized with X-ray angiography (Figures 1 and 2).
Conclusion: Clinical 3T MRI scanners using SSFP and UTE subtraction imaging can be used to determine which lesions are more difficult to cross with a guidewire. This technique also visualized important features of peripheral arterial lesions that could not be seen with x-ray angiography (the current gold standard). Future work will determine if MRI characterization of lesions can predict long-term endovascular outcomes and aid procedure planning.

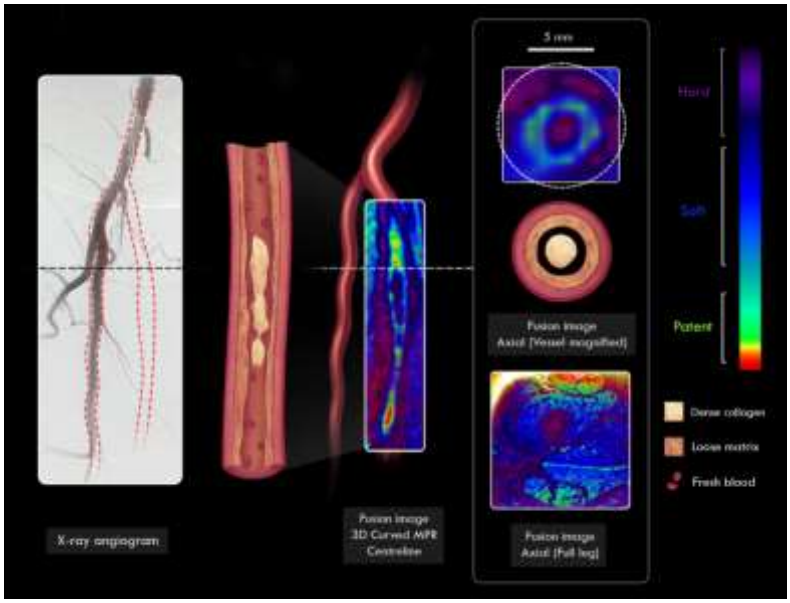


Figure 1: Non-calcified hard lesion in the superficial femoral artery (SFA). MR images identify a hard occlusive plug in the centre of the vessel (purple) that cannot be visualized with x-ray angiography indicating that it is minimally or non-calcified. There are small channels of patency that cannot be visualized with x-ray angiography

because of a more proximal occlusion that does not allow contrast to fill the SFA distally.

Figure 2: The same hard, non-calcified SFA lesion as Figure 1. MRI identified this lesion as hard (purple) even though it is not calcified. This finding was confirmed intraprocedurally because the lesion was very challenging to cross with a guidewire (indicated by wire buckling) or balloon open (indicated by waisting at the hardest cross-section of the vessel).

Saturday, September 16th, 2017
PAPER SESSION VI: QUALITY AND POPULATION CARE

Higher Surgeon Annual Volume, But Not Years of Experience, Leads to Reduced Rates of Perioperative Complications and Reoperations Following Open AAA Repair.

Dubois L[1,2], Shariff SZ[1], Allen B[1], Bray-Jenkyn K[1], Power A[2], DeRose G[2], Forbes T[3], Duncan A[2], [1]Institute for Clinical and Evaluative Sciences, London, Ontario, Canada, [2]Division of Vascular Surgery, Western University, London, Ontario, Canada, [3]Division of Vascular Surgery, University of Toronto, Toronto, Ontario, Canada

Objectives: Volume-outcome relationships for open AAA repair have been rarely studied in publically funded health systems. We sought to determine the effects of surgeon volume, surgeon years of experience, and composite volume on outcomes following all elective open AAA repairs performed in Ontario, Canada.
Methods: Using a population-based health administrative database, all elective open AAA repairs occurring in the province of Ontario from 2005-2014 were identified. Surgeon annual volume was classified by quintiles with the highest annual volume acting as the reference category. Multivariable logistic regression modeling was used, adjusting for patient factors (age, sex, comorbidities, year of procedure, income), surgeon years of experience and clustering amongst institutions, to investigate the relationship between surgeon annual volume and 30-day mortality, 30-day complications (MI, stroke, hemorrhage, infection, pneumonia, DVT/PE, acute renal failure), 30-day reoperations (related to index procedure), 1-year mortality, and 1-year reoperations.
Results: A total of 7 211 elective open AAA repairs performed by 101 surgeons were included. Median number of procedures in the low quintile group was 3 repairs/year while the very high quintile group performed 54 repairs/year. Overall 30-day mortality was 3%, with no effect of surgeon volume when comparing lowest volume to highest volume quintiles (P=.21). The lowest volume group exhibited a higher 30-day complication rate (28.0% vs 20.4%; OR 1.54; 95% CI 1.15-2.06) and 30-day reoperation rate (10.53% vs 6.73%; OR 1.63; 95% CI 1.18-2.26) when compared to the highest volume group. No effect of surgeon volume on 1-year mortality, or 1-year

reoperation was observed. Similarly, composite volume and surgeon years of experience did not significantly impact postoperative mortality.
Conclusions: Higher surgeon annual volume resulted in lower postoperative complication and reoperation rates, while having no effect on postoperative mortality. Surgeon years of experience did not influence outcomes suggesting that annual volume is more important than surgeon seniority in dictating outcomes after elective open AAA repair.

Evaluating Quality Metrics and Cost After Discharge: A Population-Based Study of Value in Health Care Following Major Vascular Surgery in Ontario

Charles de Mestral[a], Konrad Salata[a], Mohamad A. Hussain[a], Ahmed Kayssi[b], Mohammed Al-Omran[a], Nitharsana Manoharan[c], Graham Roche-Nagle[d], [a]St. Michael's Hospital, Toronto, Ontario, [b]Sunnybrook Health Sciences Centre, Toronto, Ontario, [c]Institute for Evaluative Clinical Sciences, Toronto, Ontario, [d]University Health Network, Toronto, Ontario.

Objective: While a common target of quality improvement initiatives**,** early readmission to hospital after major surgery fails to capture the quality-of-life and economic burden associated with outpatient health-related resource use. Within a large, single-payer regional healthcare system, we characterized the 30-day costs and risk of an emergency department (ED) visit, readmission or death following major vascular surgery.
Methods: We designed a population-based retrospective cohort study of patients who underwent elective major vascular surgery (Carotid endarterectomy, EVAR, Open AAA repair, Lower extremity bypass) in Ontario, Canada, between 2004 and 2015. The outcomes of interest were ED visit, readmission, death and costs to the Ministry of Health (acute inpatient, ED, rehab, physician billing claims, homecare) within 30 days of discharge. Multivariable regression analyses identified pre-discharge variables associated with an increased 30-day risk of ED visit, readmission or death and with increased 30-day cost.
Results: A total of 28,014 patients were identified - 9,639 carotid endarterectomies, 5,403 EVARs, 7,348 open AAA repairs, 5,779 lower extremity bypasses. Within 30-days of discharge, 2,159 (7.7%) were readmitted to hospital and 11 patients died (0.4%). Nearly the same number, a total of 1,894 (6.8%) patients, had visited an ED without requiring admission. Median time to ED visit or readmission was 7 days (interquartile range 3-14 days). Cost within 30 days of discharge was positively skewed (median $519, interquartile range $174-$1,438, maximum $160,938). Approximately two thirds of the average 30-day cost is attributable to readmission. Older age, female sex, greater comorbidity level and a longer index admission length of stay were associated with increased 30-day cost.
Conclusions: A focus on hospital readmission significantly underestimates 30-day health-related resource use and costs after major vascular surgery.

Increasing Mortality Trends for Open Infrarenal and Thoracoabdominal Aneurysm Eepairs in the Endovascular Era

Brendan M. Levac[1], S. Nagpal[1], George Hajjar[1], Andrew Hill[1], Dalibor Kubelik[1], Tim Brandys[1], Prasad Jetty[1], [1] Division of Vascular and Endovascular Surgery, Ottawa Hospital and the University of Ottawa, Ottawa, Ontario, Canada.

Introduction: Rapid adoption of EVAR has been driven by improving trends in perioperative morbidity and mortality compared to open repair. Current perioperative outcomes in the current era of anatomically more complex population of open repairs remains undetermined.
Purpose: The purpose of this study was to investigate trends for elective and ruptured aneurysm repairs, and in-hospital mortality for these patients at a high-volume tertiary care, university teaching hospital.

Methods: This study used an institutional, prospectively maintained database that derives all data from electronic hospital records, billing data and patient charts to capture patients receiving either EVAR or open repair for AAAs and TAAAs over an 11-year period between Jan 2004 and Jan 2015.
Results: 2753 aneurysm repairs were performed throughout the study period. 1673 (60.1%) were open repairs, while 1080 (39.2%) were EVAR. In 2004, 29 EVARs were performed (14.9% of total aneurysm repairs), increasing to 110 repairs in 2014 (46.8%; Fig 1). Linear regression demonstrated an 11-year average increase in EVAR of 10.5 cases per year ($R^2 = 0.68$), while open repair decreased by 5.2 cases per year ($R^2 = 0.73$). Percentage of RAAA repairs decreased from 11.3% in 2004 to 6.0% in 2014 with an increasing proportion performed by EVAR (9.1% in 2004, and 35.7% in 2014). Mortality for EVAR decreased from 6.9% in 2004 to 0.9% in 2014, while open repair mortality increased from 2.4% in 2004 to 6.4 % in 2014 (Fig 2). Respectively, average mortality for elective EVAR and open repair was 3.5% and 2.7% from 2004-2007, 0.9% and 1.8% from 2008-2011, and 1.6% and 5.6% from 2012-2014.
Conclusion: There is an ongoing transition favouring EVAR over open repair in the management of AAAs and TAAAs, albeit a slower rate of adoption at our center. Notably, there is an evident trend towards increasing mortality amongst patients receiving open repair. We postulate increasing patient complexity, and possibly decreased institutional memory (factors related to surgeon, anesthesia, and ICU experience) in the era of increasing endovascular and diminishing open repairs.

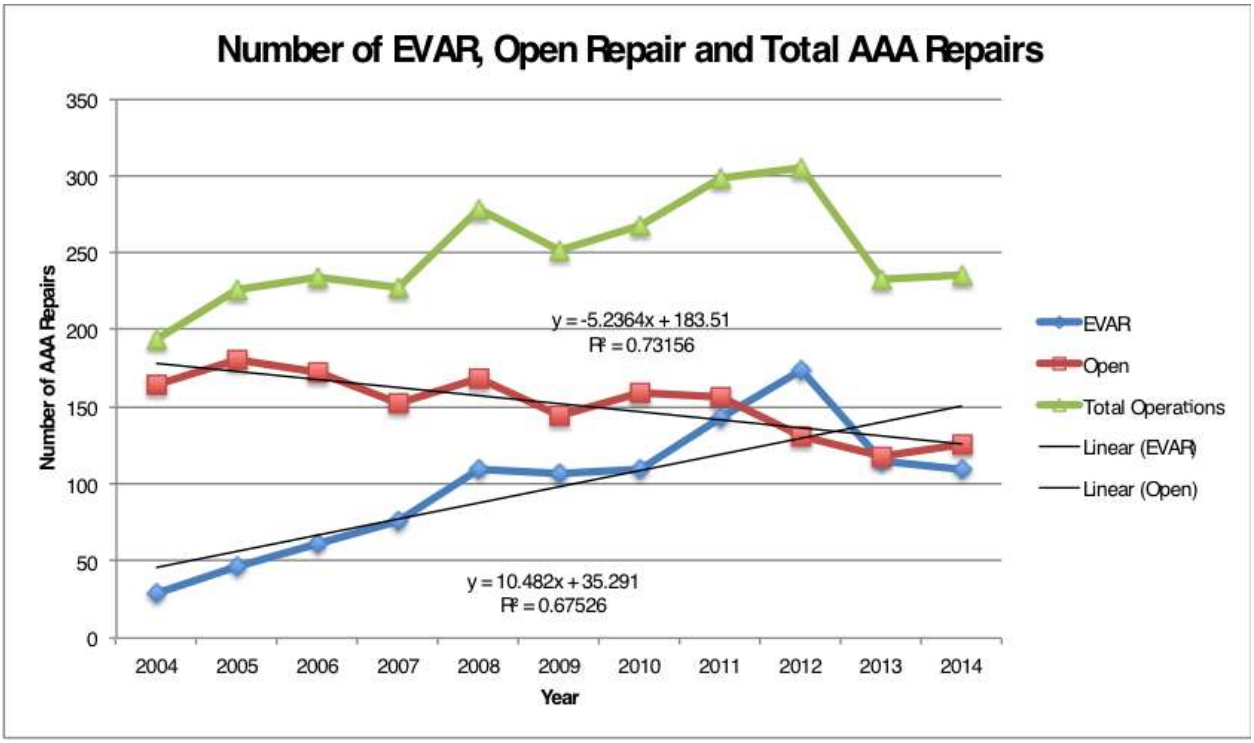


Figure 1: Trends in abdominal aortic aneurysm repairs by procedure type and total operations over the 11-year study period.

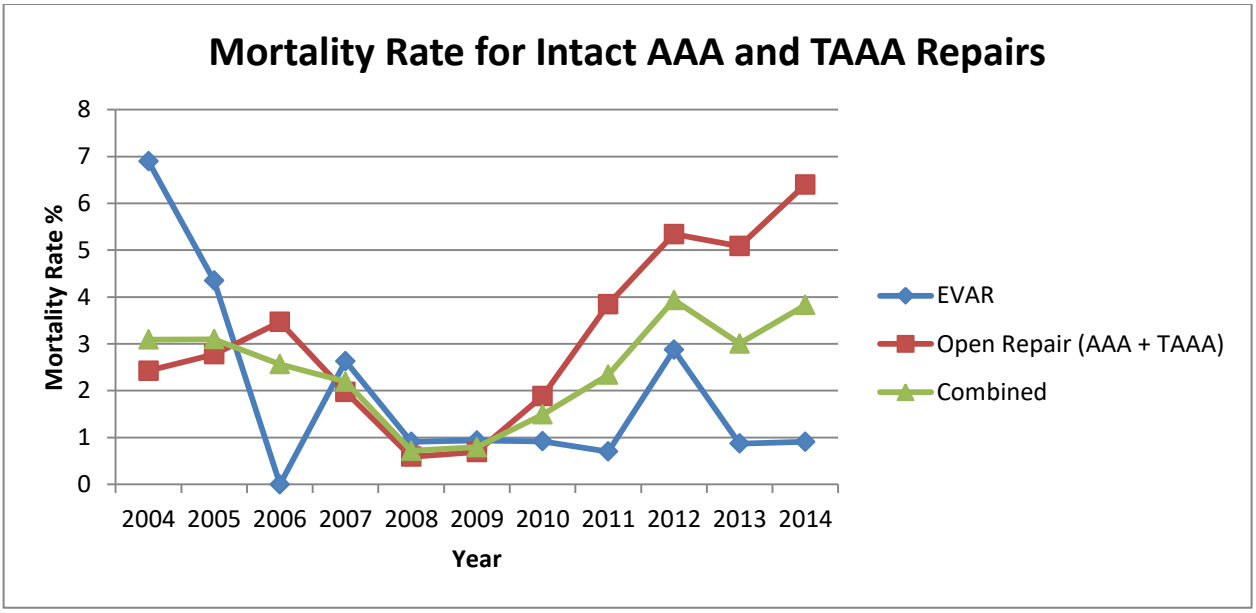


Figure 2: Mortality rate for intact AAAs by procedure type and overall combined mortality

Device-Specific Variability in Aneurysm Sac Regression Following Endovascular Aneurysm Repair Based on a Comprehensive Registry of Patients in Eastern Ontario

Prasad Jetty[1], Don Husereau[2], Vinay Kansal[1], Tinghua Zhang[3], Sudhir Nagpal[1]
[1]Division of Vascular Surgery, The Ottawa Hospital, University of Ottawa, Ottawa, Canada
[2]School of Epidemiology, Public Health and Preventive Medicine, University of Ottawa, Ottawa, Canada, [3]Methods Centre, Ottawa Hospital Research institute

Introduction: The objective of this study is to determine the rate of overall long-term sac regression following EVAR and the influence of specific endograft devices used at our centre.
Methods: This retrospective cohort study included all EVARs performed for intact and ruptured abdominal aortic aneurysms (AAAs) at a university teaching hospital. Pre-operative, operative and follow-up data were collected using clinical and radiological institutional databases. Pre-operative and post-EVAR sac diameters were determined by a blinded observer in accordance with Society for Vascular Surgery guidelines. Absolute and relative sac regression was determined at the following intervals: 0-6 months, 6-12 months, 12-18 months, 18 months-2 years, 2-5 years, 5-10 years, and greater than 10 years.
Results: From 1999 to 2015, 1060 patients underwent EVAR for an AAA at the Ottawa Hospital. Procedures were performed using a total of 9 unique endograft devices, with 5 devices (Cook Zenith®, n=398; Medtronic Endurant®, n=375; Medtronic Talent®, n=183; Cook Zenith LP®, n=52; and Terumo Anaconda®, n=23) used in 97% of procedures. The mean preoperative AAA diameter was 61.2 mm, with no detectable differences between endograft devices with respect to age, preoperative AAA diameter or rupture diagnosis. Overall mean sac regression increased from -1.3 mm at 6 months, to -14.9 mm beyond 10 years. The majority of sac regression (88.7%) was achieved within 2 years. Only 90/1060 patients (8.5%) experienced sac expansion >5mm at some point during their follow-up period. Kaplan-Meier analysis revealed that Zenith®, Zenith LP® and Endurant® endografts demonstrated the shortest time to >5mm sac regression among devices used in >10 patients (Fig.1.). In patients who never had a type 1
endoleak in follow-up, the Zenith® endograft demonstrated the most statistically significant sac regression at all intervals (Fig.2). Cox proportional hazard modelling demonstrated that age <75 years (HR1.4, p=0.001), female gender (HR1.4, p=0.003), absence of type 1 endoleak (HR 4.6, p<0.0001), AAA >70mm (HR3.7, p<0.0001) and

both the Zenith ® (HR2.0, p<0.0001) and Endurant® (HR1.7, p=0.001) devices were associated with shorter time to >5mm sac regression.
Conclusion: This study demonstrated a pattern of sac diameter change following EVAR, with the majority of sac regression occurring within the first 2 years. Variability in sac regression was most influenced by age, gender, original AAA diameter, absence of endoleak, and endograft device. The relationship between specific endograft design and materials, and sac regression is yet to be determined.

Saturday, September 16th, 2017
PAPER SESSION VII: CAROTID AND GENERAL TOPICS

Carotid-Artery Revascularization: Does Surgeon or Interventionalist Specialty Matter?
Mohamad A. Hussain[1,2], Muhammad Mamdani[3], Jack V. Tu[4], Gustavo Saposnik[3,5], Konrad Salata[1,2], Deepak L. Bhatt[6], Subodh Verma[1,3,7], Mohammed Al-Omran[1,2,3], [1]Department of Surgery, University of Toronto, Toronto, Ontario, Canada; [2]Division of Vascular Surgery, St. Michael's Hospital, Toronto, Ontario, Canada; [3]Li Ka Shing Knowledge Institute, St. Michael's Hospital, Toronto, Ontario, Canada; [4]Division of Cardiology, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [5]Division of Neurology, St. Michael's Hospital, Toronto, Ontario, Canada; [6]Harvard Medical School, Boston, Massachusetts, United States of America; [7]Division of Cardiac Surgery, St. Michael's Hospital, Toronto, Ontario, Canada

Objective: To examine the effect of operator specialty on 30-day outcomes among patients undergoing carotid endarterectomy and carotid-artery stenting.
Methods: We conducted a population-based, observational cohort study of all individuals who underwent carotid endarterectomy or stenting in Ontario, Canada (2002-2015) using administrative claims databases. We stratified endarterectomy and stenting patients according to operator specialty, and followed them for 30 days after the procedure. We built multilevel multivariable logistic regression models adjusted for patient demographics, comorbidities, carotid-artery symptom status, and annual institutional and operator volume to examine rates of 30-day stroke or death.
Results: A total of 16,544 patients were studied (n=14,301 endarterectomy and n=2,243 stenting). Vascular surgeons performed the majority (55.7%) of endarterectomy procedures, followed by neurosurgeons (21.0%), general surgeons (15.3%), and cardiac surgeons (7.9%). Radiologists (82.5%) and neurosurgeons (17.5%) performed carotid-artery stenting. In the endarterectomy group, the risk of stroke or death was higher among patients treated by non-vascular surgeons (4.0%) compared with vascular surgeons (2.9%) (adjusted odds ratio [OR], 1.32; 95% confidence interval [CI], 1.08-1.62; P=.008) (Fig. 1). With respect to specific non-vascular surgery specialties, the rate of 30-day stroke or death was higher in endarterectomy patients treated by neurosurgeons (4.1%; adjusted OR, 1.27; 95% CI, 1.00-1.61) and cardiac surgeons (4.4%; adjusted OR, 1.54; 95% CI, 1.04-2.30) compared with vascular surgeons (2.9%). Patients who underwent carotid-artery stenting by radiologists versus neurosurgeons experienced 30-day stroke or death at similar rates (8.0% vs. 7.9%, respectively; adjusted OR, 1.07; 95% CI, 0.66-1.74; P=.79) (Fig. 2).
Conclusions: The risk for stroke or death was significantly higher among carotid endarterectomy patients treated by non-vascular surgeons (neurosurgeons and cardiac surgeons) compared with vascular surgeons. Operator specialty did not appear to have a significant effect on outcomes among patients who underwent carotid-artery stenting. These results can have implications for physician referral practices and local policies.

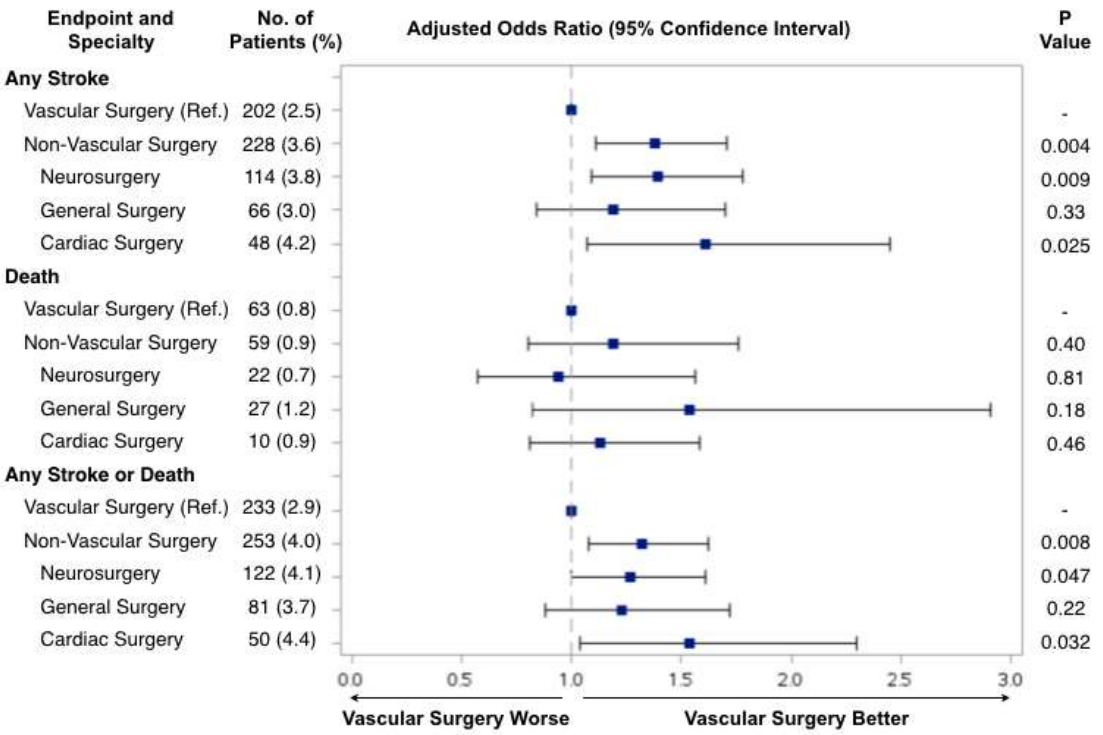


Fig 1. Risks of 30-day events after carotid endarterectomy based on operator specialty.

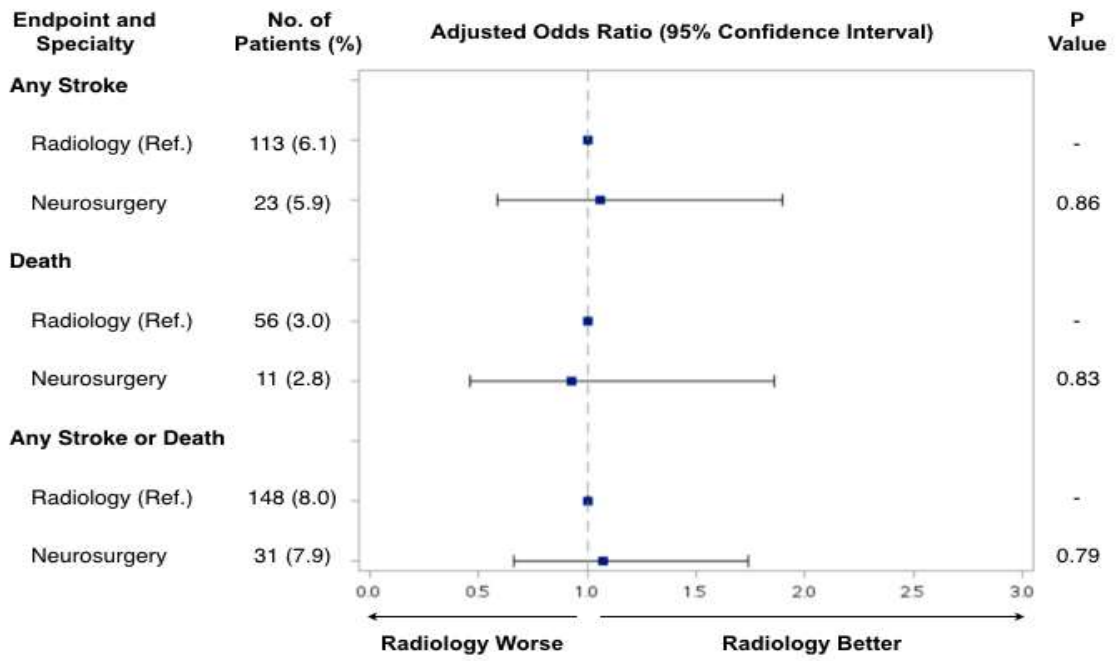


Fig 2. Risks of 30-day events after carotid-artery stenting based on operator specialty.

Risk of Intracranial Hemorrhage Following Carotid Endarterectomy Versus Stenting

Mohamad A. Hussain[1,2], Aziz S. Alali[1], Muhammad Mamdani[3], Jack V. Tu[4], Gustavo Saposnik[3,5], Konrad Salata[1,2], Charles de Mestral[1,2], Subodh Verma[1,3,6], Mohammed Al-Omran[1,2,3], [1]Department of Surgery, University of Toronto, Toronto, Ontario, Canada; [2]Division of Vascular Surgery, St. Michael's Hospital, Toronto, Ontario, Canada; [3]Li Ka Shing Knowledge Institute, St. Michael's Hospital, Toronto, Ontario, Canada; [4]Division of Cardiology, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [5]Division of Neurology, St. Michael's Hospital, Toronto, Ontario, Canada; [6]Division of Cardiac Surgery, St. Michael's Hospital, Toronto, Ontario, Canada

Objective: Intracranial hemorrhage (ICH) associated with cerebral hyperperfusion syndrome is a rare but major complication of carotid artery revascularization. The objective of this study was to compare the rates of ICH following carotid-artery stenting (CAS) versus endarterectomy (CEA).
Methods: This was a retrospective population-based cohort study of patients who underwent carotid revascularization in Ontario between 2002 and 2015. Our primary outcome was 90-day ICH among patients who underwent CAS versus CEA. We used inverse-probability-of-treatment-weighting using propensity scores to adjust for selection bias. In sensitivity analyses, we excluded patients who had post-procedure ischemic stroke, and examined a subgroup of patients ≥66 years old to account for baseline medication use.
Results: A total of 16,688 patients underwent carotid revascularization (14% CAS; 86% CEA). Patients with more comorbid illnesses, symptomatic carotid stenosis, cardiac disease, and on antiplatelets or warfarin preoperatively were more likely to undergo CAS. Among the overall cohort, 80 (0.48%) patients developed ICH within 90 days. The 180-day mortality after ICH was 42.5%, which was considerably higher than the 180-day mortality rate of the overall cohort (2.7%). In the adjusted analysis, CAS patients were more likely to have ICH compared to CEA (adjusted odds ratio [OR], 1.77; 95% confidence interval [CI], 1.32-2.36; P<0.001). These results were consistent after excluding patients who developed post-procedure ischemic strokes (adjusted OR, 1.90; 95% CI, 1.41-2.56);

among the subgroup of patients ≥66 years old (adjusted OR, 1.53; 95% CI, 1.05-2.24); and among symptomatic (adjusted OR, 1.74; 95% CI, 1.16-2.63) and asymptomatic (adjusted OR, 1.75; 95% CI, 1.16-2.63) carotid stenosis patients.
Conclusions: CAS is associated with rare but higher risk of ICH relative to CEA. Future research is needed to devise strategies that minimize the risk of this serious complication following CAS.

Level of Clinical Evidence Presented at the Canadian Society for Vascular Surgery Annual Meeting over a 5-year period (2012-2016)

Faysal Naji*[1, 2], Arshia Pedram Javidan*[2], Varun Srivatsav[2], Shawn Khan[2], John Harlock[1,2]
*Shared first authorship, [1]Hamilton Health Sciences, Hamilton, Ontario, [2]McMaster University, Hamilton, Ontario

Objectives: The Canadian Society for Vascular Surgery Annual Meeting (AM) informs vascular surgeons of the latest research and clinical practices in the field. Over the past decades, there has been increasing emphasis on the use of high quality evidence to inform clinical decision-making. The purpose of our study was to assess trends in the level of evidence (LOE) of abstracts presented at the AM over 2012-2016.
Methods: Abstracts of all 2012-2016 AM submissions were obtained through the Canadian Society for Vascular Surgery website. Two reviewers independently screened abstracts for eligibility, excluding research with a non-clinical focus. Data extracted from eligible abstracts included study type (therapeutic, prognostic, diagnostic), and sample size. Abstracts were assigned a LOE using the 2011 Oxford Centre for Evidence-Based Medicine classification scheme based on study design.
Results: Of 230 abstracts screened, 156 were included. Therapeutic studies were the most common study type (45%), followed by prognostic studies (39%), then diagnostic studies (15%). Overall, 1.9% of the abstracts were level I evidence, 5.1% level II, 34.0% level III, 58.3% level IV, and 0.6% level V (Table 1). The average LOE per year fluctuated between 3.59 to 3.39 with a mean of 3.51 (Table 2). A chi-squared test between LOE and year yielded P = 0.74, indicating a non-significant change in LOE between 2012-2016.
Conclusion: Overall, average LOE remained relatively consistent between 2012-2016, with most abstracts classified as level III or IV evidence. There was a gradual, albeit minor, increase in the average level of evidence in 2016, potentially indicating the increasing commitment to producing and disseminating high level research in vascular surgery. Furthermore, a lack of a classification tool specific to vascular surgery research occasionally presented a challenge in assigning LOE, perhaps indicating a need for such a tool in this specialty.

Table 1: Collated distribution of level I-V studies per study type (Therapeutic, Prognostic, Diagnostic) per year (2012-2016) in the Canadian Society for Vascular Surgery Annual Meeting

	Level I			Level II			Level III			Level IV			Level V			
	T	P	D	T	P	D	T	P	D	T	P	D	T	P	D	Total
2012	2	0	0	1	0	1	1	3	2	10	7	1	1	0	0	29
2013	1	0	0	2	0	0	2	2	0	9	6	5	0	0	0	27
2014	0	0	0	0	0	0	8	4	2	10	4	2	0	0	0	30
2015	0	0	0	1	0	0	1	10	2	7	10	3	0	0	0	34
2016	0	0	0	2	0	1	4	9	3	9	6	2	0	0	0	36
Total	3	0	0	6	0	2	16	28	9	45	33	13	1	0	0	156

Table B: Collated distribution of level I-V studies stratified by level of evidence per year (2012-2016) in the Canadian Society for Vascular Surgery Annual Meeting

	Level I	Level II	Level III	Level IV	Level V	Total	Average Level of Evidence
2012	2	2	6	18	1	29	3.48
2013	1	2	4	20	0	27	3.59
2014	0	0	14	16	0	30	3.53
2015	0	1	13	20	0	34	3.56
2016	0	3	16	17	0	36	3.39
Total	3 (1.9%)	8 (5.1%)	53 (34.0%)	91 (58.3%)	1 (0.6%)	156	3.40

Break Out of the Classroom: The Use of Escape Rooms as an Alternative Learning Strategy for Surgical Education

Anna Kinio M.Sc.,[1] Laurence Dufresne MD,[2] Tim Brandys MD FRCSC[1,2], Prasad Jetty MD FRCSC[1,2], [1] Faculty of Medicine, University of Ottawa, Ottawa, Canada, [2] Division of Vascular and Endovascular Surgery, The Ottawa Hospital, Ottawa, Canada

Escape Rooms are immersive games in which participants are locked into a room and required to solve a series of riddles to escape. We postulate that Escape Rooms can be used as a learning tool to transform medical learners from passive spectators to active participants.
Objective: To implement and assess the impact of a Vascular Escape Room on medical student motivation, satisfaction and engagement in CanMEDS roles.
Methods: We designed an Escape Room combining Vascular Surgery objectives, knowledge-based problems and technical skills into Vascular Surgery-themed stations. Groups of 3-4 medical students participated in the activity and were given preparatory reading material. Data collected included: time to escape, CanMEDS roles covered, debriefing interview session and satisfaction survey.
Results: Thirteen medical students divided into four groups participated in the activity. Only one participant had previous exposure to Vascular Surgery and 92% reported an increased level of interest in Vascular Surgery following the experience. Two teams used a collaborative strategy to complete the activity and successfully "escaped" with an average time of 53.6 minutes, while only one of the two teams completing the experience in an individualistic manner successfully escaped. Following the experience, 83% stated that the experience motivated them to prepare beforehand and 83% believed that the experience consolidated the knowledge they read. All the participants also reported that the experience encouraged the use of the CanMEDs communicator and collaborator roles. As well, 76.9% of students mentioned that they enjoyed the practical exercises incorporated into the experience and 53.8 % stated that they would like to see the Escape Room format included in the medical curriculum.
Conclusion: By combining knowledge-based problems, key learning objectives, technical skills and CanMEDS themes into an Escape Room, we have developed a learning platform that may be more enjoyable and provide an adjunct to traditional didactic lectures.

Knowledge, Impressions, and use of Government-Funded Physical Disability Support Programs in Vascular Surgery: A Survey of Canadian Physicians
Matthew V. Ingves, Adam Forster, Luc Dubois, Audra Duncan, Guy DeRose, Adam H. Power
Division of Vascular Surgery, Western University, London, ON.

Objective: Many medical conditions can qualify for government disability support programs (DSPs), including cardiovascular conditions; however, research investigating the role of DSPs in vascular claudication and surgeon practices are lacking.
Methods: We invited 146 practicing vascular surgeons in Canada to complete a questionnaire regarding their knowledge, impressions, and use of provincial government DSPs.
Results: Out of the 43 that responded (85% male), only 27% of surgeons submit DSP applications for their patients, and most (61%) are not familiar with their provincial DSP, including program restrictions and available program information. Ninety-five percent of respondents consider vascular claudication a disability; 37% agree and 17% strongly agree that patients requiring DSP funding for vascular claudication should be offered surgery, but funding support should be re-evaluated regularly. Factors considered important for DSP qualification include smoking status, failure of non-surgical treatment, degree of walking impairment, and impact on employment. Other medical comorbidities were also either important (41%) or very important (20%). Most (83%) were not familiar with physician remuneration for submitting DSP applications and 74% do not charge a fee. Although private businesses solicit patient DSP applications, 93% of surgeons are unaware these existed and opinions favoring or opposing private solicitation were split.
Conclusion: This national survey of vascular surgeons identifies that most consider vascular claudication a disability and 54% feel patients receiving DSP funding should be offered surgery for claudication. There is, however, a lack of surgeon knowledge of DSPs and limited DSP utilization. Other patient and medical factors

should be considered when evaluating patients with vascular claudication for DSP funding. Increased surgeon knowledge of DSPs may benefit future patient disability support and socioeconomics, while important ethical and surgical questions require further study.

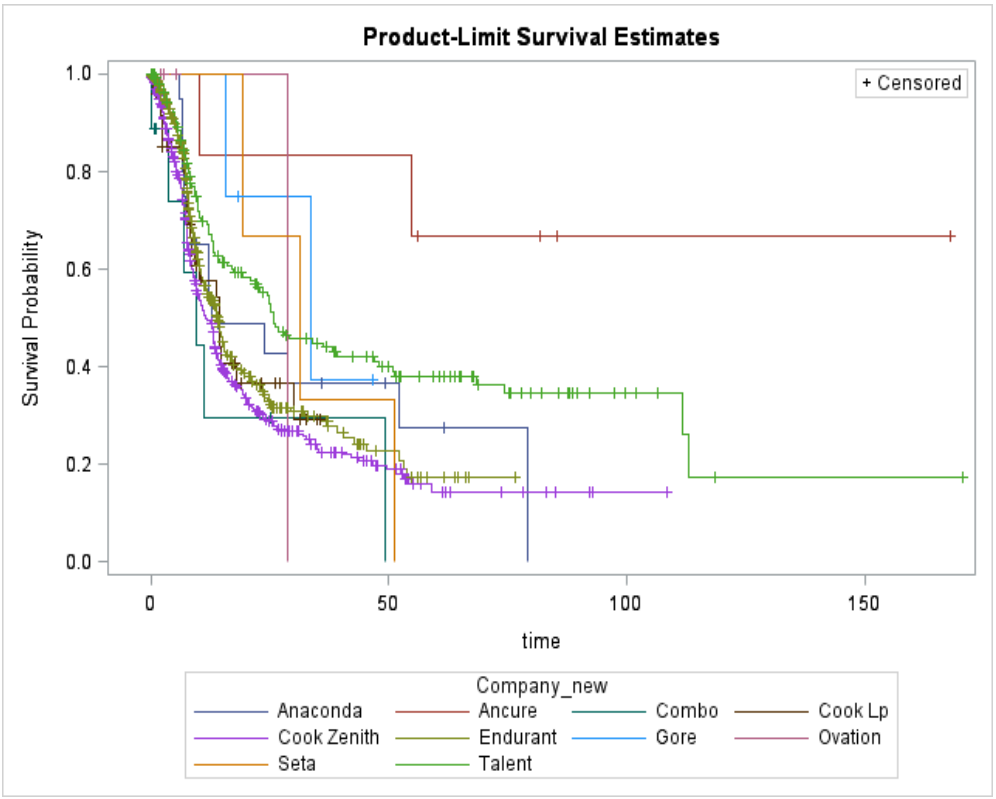
Is Patient Satisfaction Improved by Showing Patients their CT and Angiographic Images Prior to Undergoing Vascular Surgery?

Dominic LeBlanc[1], Adam Power[1], Guy DeRose[1], Audra Duncan[1], Luc Dubois[1,2]. , [1]Division of Vascular Surgery, Western University, London, Ontario, Canada, [2]Department of Epidemiology and Biostatistics, Western University, London, Ontario, Canada.

Objectives: Patient-based decision aids and other multimedia tools have been developed to help enrich the preoperative discussion between surgeon and patient. Use of these tools, however, can be time consuming and logistically challenging. We investigated whether simply showing patients their images from preoperative CTs or angiograms would improve patient satisfaction with the preoperative discussion. We also examined whether this improved patient knowledge, patient trust, and whether it contributed to increased preoperative anxiety.
Methods: Consecutive patients undergoing either elective AAA repair or lower limb revascularization were randomly assigned to either standard perioperative discussion or perioperative discussion and review of images (CT or Angiogram). Randomization was concealed and stratified by surgeon. Primary outcome was patient satisfaction with the preoperative discussion as measure by a validated 7-item scale (score 0-28), with higher scores indicating improved satisfaction. Secondary outcomes included: patient understanding, patient anxiety, patient trust, and length of preoperative discussion. Scores were compared using t-test.
Results: Overall 51 patients were randomized, 25 to the intervention arm (discussion + imaging) and 26 to the control arm. Most patients were male (69%) and average age was 70 years. Patient satisfaction with the discussion was generally high with no added improvement when preoperative images were reviewed (mean score 24.9 ±3.02 vs 24.8±2.93, *P*=.88). Similarly, there was no difference in patient anxiety, level of trust, or knowledge when the imaging review was compared to standard discussion. There was a trend towards longer preoperative discussions in the group that underwent imaging review (8.18 vs 6.35 mins, *P*=.07).

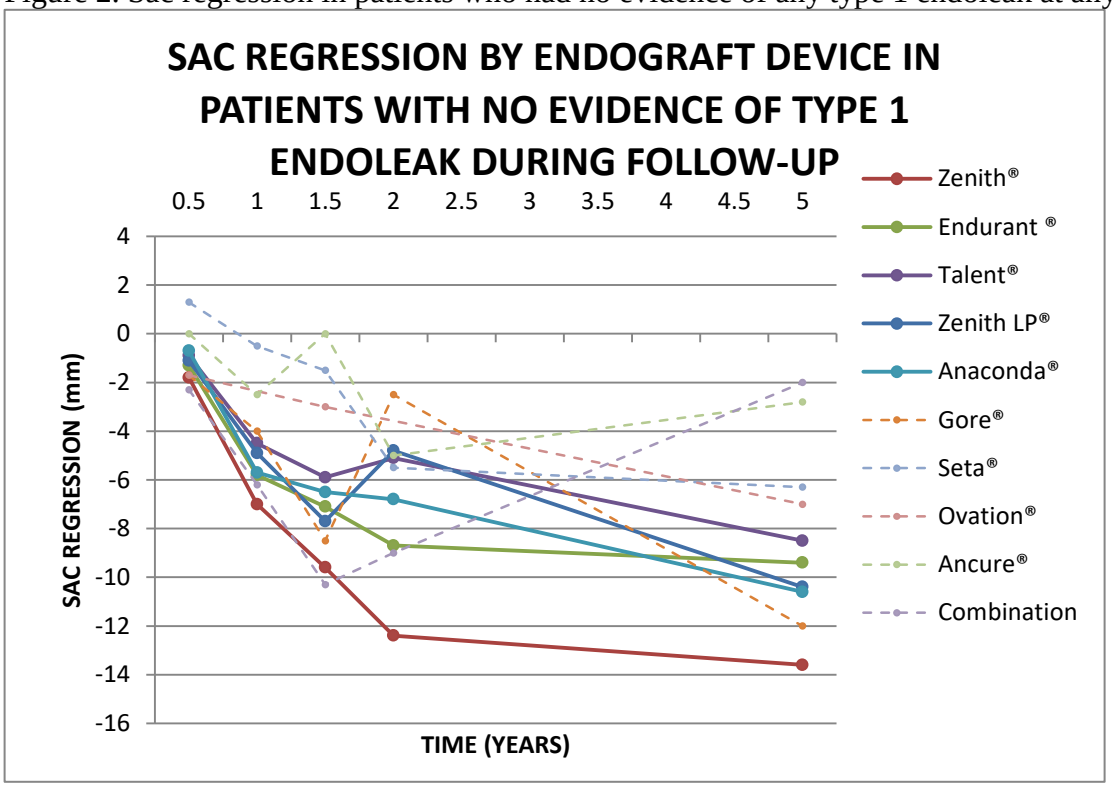
Conclusions: Showing patients their CT or angiographic images during the preoperative discussion does not improve patient satisfaction. Similarly, there was no effect on patient trust, knowledge, or anxiety level. Unless patients specifically request imaging review, we would suggest against doing this routinely as it may lengthen the preoperative discussion unnecessarily.

Figure 1. Kaplan-Meier Plot demonstrating time to sac regression >5mm (in months), stratified by endograft device



Significant p-values are listed after Sidak adjustment for multiple comparisons using the Logrank Test: Endurant® vs Talent® (p=0.0461), Zenith ® vs Zenith LP® (p=0.006), Zenith® vs Anaconda® (p=0.0021), Zenith® vs Talent (p<.0001), Zenith LP® vs Talent (p=0.0002), Anaconda® vs Talent® (p=0.0002)

Figure 2. Sac regression in patients who had no evidence of any type 1 endoleak at any point during their follow-up



Statistically significant differences using ANOVA and Tukey's adjustment for multiple comparisons were detected for sac regression by endograft device in the setting of no type 1 endoleak (Zenith® vs Talent® endografts at 12 months, p<0.012, at 18 months, p=0.004, 2 years, p<0.0001, 0.0007, 5 years, p=0.0004]). A further difference was detected between Zenith® and Endurant® endografts at 5 years, p=0.0007. Dashed lines represent endografts placed in less than 10 patients and thus not included in statistical comparisons.

Do Vascular Surgery Patients Investigated with an *Angiogram First* Approach Receive Faster Treatment in Saskatchewan vs. those Investigated with CTA?

Joel Herback[1], David Kopriva[2], Kylie Kvinlaug[3], [1] University of Saskatchewan, Department of General Surgery, [2]Regina Qu'Appelle Health Region, Division of Vascular Surgery, [3]Saskatoon Health Region, Division of Vascular Surgery

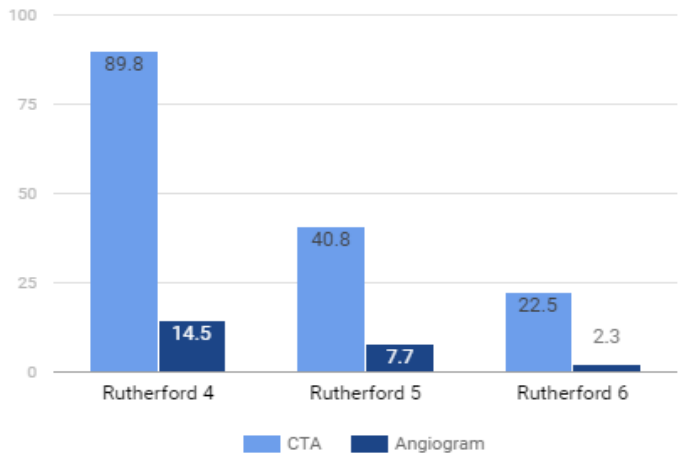
Objectives: To investigate if patients presenting to Regina or Saskatoon vascular surgeons with infrainguinal arterial occlusive disease receive more timely surgical intervention if they are first investigated with conventional angiogram vs. CT angiography.

Methods: A provincial prospective registry was created by Saskatchewan's Vascular Surgeons in 2013 for quality assurance purposes in an attempt to address practice variation. Patients presenting to clinic or emergency department with infrainguinal PAD were consented and enrolled. Patient demographics, investigations, treatment, and follow-up details were collected and a database was created by the Saskatchewan Health Quality Council. From this database, those with critical limb ischemia who underwent treatment were reviewed based on Rutherford classification. Time from initial clinical review to either CTA or angiogram was measured, as was time to eventual open or endovascular treatment. Mean time to treatment with standard deviation were compared using t-tests.

Results: 276 patients were registered in the database. First limb revascularized critical limb ischemia patients who underwent either CTA or angiogram first were selected (74 patients). Mean time to treatment for Rutherford 4 patients (30) with CTA first (18) was 89.8 days (SD 85.1) compared to angiogram first (12) in 14.5 days (SD 14.3) **(p-value < 0.05)**. Similarly, of Rutherford 5 patients (37), 15 had CTA initially (mean 40.8 days, SD 35.6), and 22 patients had angiogram before treatment (mean 7.7 days, SD 7.0) **(p-value < 0.05)**. For Rutherford 6 patients (7), 3 had CTA prior to treatment (mean 22.5 days, SD 27.1) and 4 had angiogram initially (mean 2.3 days, SD 3.9) **(p = 0.188)**. See Table 1.

Conclusions: The available data demonstrates that patients investigated with an *angiogram first* approach for critical limb ischemia experience significantly shorter wait times for definitive intervention.

Table 1 - Time to Intervention, in days



Friday, September 16th, 2016
POSTER SESSION

IFU Violation and Anatomic Factors are Strongest Predictors of Clinically Significant Type II Endoleaks
Kevin Lee[1], Sajjid Hossain[1], Matthew Ingves[1], Christine Herman[2], Phillip Charbonneau[2], Kiattisak Hongku[2], Oren Steinmetz[2], Luc Dubois[1] , [1]Division of Vascular Surgery, Western University, Hamilton ON, [2] Division of Vascular Surgery, McGill University, Montreal, QC

Objective: Although some anatomic factors such as number of aortic branches and use of anticoagulants have been linked to type II endoleaks following EVAR; few studies have examined the potential role of IFU violations and tenuous endograft sealing resulting in transmitted endotension which may act as a promoter of persistent and clinically significant type II endoleaks. We examined the role of anatomic factors, clinical factors and IFU violations in predicting the presence of clinically significant type II endoleaks.
Methods: This multicenter study included patients undergoing elective EVAR from 2005 to 2014. Preoperative CT scans were reviewed using a standardized anatomic scoring system, and IFU violations were tabulated on a device specific basis. Demographic, anatomic, and follow-up data was collected and predictors of clinically significant type II endoleaks were determined. Type II endoleaks were considered significant if they persisted beyond one year and were associated with sac expansion, reintervention, or persistence of aortic sac diameter. Factors associated with clinically significant type II endoleaks were analyzed using Chi-squared test or T-test where appropriate.
Results: Complete follow-up data was available for 429 patients, with a mean follow-up of 2 years. Type II endoleaks occurred in 21% (n=90) of patients, with 44% (n=40) of type II endoleaks considered significant. Predictors of clinically significant type II endoleaks included number of patent aortic sac branches (mean 6.2 vs 4.7; *P= 0.001)*, and less circumferential aortic thrombus in the aortic sac (*P = 0.012)*. Patients with significant type II endoleaks were more likely to have a graft placed in violation of IFU (60.0% vs 40.9%; *P = 0.02*). Clinical parameters, anticoagulant use, and antiplatelet use were not associated with type II endoleaks.
Conclusion: IFU violation appears to be associated with the occurrence of significant type II endoleaks, perhaps through tenuous graft sealing and transmitted pressure that promotes persistence of the endoleak and pressurization of the aortic sac. Patients who have grafts implanted outside the IFU and have greater than 5 patent aortic sac branches and minimal aortic thrombus may benefit from preoperative embolization of aortic sac branches.

Surgically Positioned Paravertebral Catheter for analgesia post Retroperitoneal Aortic Aneurysm Repair
Samuel Jessula[1], Min S. Lee[2], Patrick Casey[2], Kwesi Kwofie[3], Christine Herman[2,4]
[1]Division of General Surgery, Department of Surgery, Dalhousie University, Halifax, NS, Canada, [2]Division of Vascular Surgery, Department of Surgery, Dalhousie University, Halifax, NS, Canada, [3]Department of Anesthesiology, Pain management & Perioperative Medicine, Dalhousie University, Halifax, NS, Canada, [4]Division of Cardiac Surgery, Department of Surgery, Dalhousie University, Halifax, NS, Canada

Objective: To report the feasibility and efficacy of surgically positioned paravertebral catheters for post-operative analgesia following retroperitoneal abdominal aortic aneurysm (AAA) repair.
Methods: We completed a retrospective case series of all patients undergoing retroperitoneal AAA at a tertiary referral centre by two surgeons between 2010 and 2016 inclusive. Patient demographics, co-morbidities, analgesic and hospital outcomes as well as adverse events were recorded.
Results: A total of 59 consecutive records were reviewed. The patient cohort consisted of 76.8% male with a median age of 73. The frequency of hypertension, dyslipidemia, diabetes and COPD were respectively 71.2%, 55.9%, 15.3% and 22.4%. Twelve patients (20.3%) were symptomatic at time of operation. Paravertebral catheter

insertion was attempted in all patients, successful in 56 (94.9%) and median removal time was on post-operative day 3. Table 1 summarizes analgesic outcomes. Median cumulative oral morphine equivalents (MEQ) on post-operative day 1, 2 and 3 were 137.1mg, 45mg and 30mg. Median maximal pain scores (ranging from 0-10) on post-operative day 1, 2 and 3 were 3, 3.5, 0 at rest and 5, 6, 2 with coughing respectively. Median time to extubation was 1.5 hours, median length of stay was 1 day in ICU and 7 days in hospital, summarized in Table 2. Five patients (8.5%) required repeat operations, all on POD0 and none related to the paravertebral catheter. Adverse event rates were 21.4% for nausea, 3.6% for vomiting, 1.6% for confusion with 64.2% rate of anti-emetic use. The results are summarized in Table 1 and 2.
Conclusion: Retroperitoneal AAA repair provides unique access to the paravertebral space. Surgically positioned paravertebral catheters are feasible and an effective post-operative analgesic adjunct with minimal adverse effects.

Table 1: Analgesic intake and pain scores on post-operative day 1, to 3

	Median	IQR
POD1 MEQ (mg)	137.1	42.45-617.1
POD2 MEQ (mg)	45	15-105
POD3 MEQ (mg)	30	0-60
POD1 pain score at rest (/10)	3	0-6
POD1 pain score with coughing (/10)	5	2-8
POD2 pain score at rest (/10)	3.5	0-5
POD2 pain score with coughing (/10)	6	4-8
POD3 pain score at rest (/10)	0	0-3.5
POD3 pain score with coughing (/10)	2	0-5

MEQ= oral morphine equivalent. POD= post-operative day.

Table 2: Hospital outcomes

	Median	IQR
Time to extubation (hours)	1.5	0-15.5
Time in ICU (days)	1	0-1
Time on ward (days)	7	6-9

ICU= Intensive care unit

Point of Care Ultrasound (POCUS) Use as Adjunct to Physical Exam and its Impact on Arteriovenous Fistula Maturation

Sajjid Hossain MD[1], Amit Sharma[1], Luc Dubois MD[1], Audra Duncan MD[1], Guy DeRose MD[1], Adam Power MD[1], [1]Western University, London, Ontario

Objective: Point of Care Ultrasound as a preoperative assessment tool in clinic may help identify anatomical factors predictive of fistula maturation, decrease costs to the health care system and decrease time to access creation as compared to formal vein mapping. We sought to determine the impact of POCUS as an adjunct to physical exam on arteriovenous fistula maturation.
Methods: All consecutive patients undergoing first time dialysis access creation over a 7-year period were retrospectively reviewed. Surgeons that routinely use POCUS to assess preoperative maximal vein diameter and quality were compared to surgeons that only relied on physical exam. All access and patency definitions were in

accordance with the Society for Vascular Surgery reporting standards. The effect of POCUS on fistula maturation rate and fistula abandonment was analyzed using logistic regression, controlling for patient comorbidities, anticoagulant use, and location of fistula.
Results: A total of 316 patients were included in the study. 250 patients were assessed with physical exam only and 66 patients underwent POCUS. There was no significant difference in mean age or comorbidities between the groups. The primary failure rate in the ultrasound group was 17% as compared to 47% ($p<0.001$) in the group of patients who did not undergo ultrasound examination. In patients without preoperative ultrasound there were higher rates of requiring new access creation (31% vs 9% $p<0.001$) and fistula abandonment (66% vs 39% $p<0.001$). Multivariable analysis showed absence of preoperative US was associated with a 3.65 greater risk of failure (95% CI 1.72-7.78, P=0.001) when compared to physical exam alone.
Conclusions: POCUS as an adjunct to physical exam for dialysis access patients leads to decreased rates of primary failure, new access creation and fistula abandonment as compared to patients who only undergo physical examination. Further studies are required to compare POCUS with formal preoperative vein mapping.

Outcomes of Minor Amputations in Patients with Peripheral Vascular Disease at a Tertiary Care Institution
Amy SW Chan[1], Janice Montbriand[2], Naomi Eisenberg[1], Graham Roche-Nagle[1] , [1]Division of Vascular Surgery, Toronto General Hospital, Peter Munk Cardiac Centre, [2]Department of Anesthesia and Pain Management, Pain Research Unit, University Health Network, University of Toronto. Toronto, Ontario, Canada.

Objective: We investigated the rates and predictors of healing and major reamputation after non-traumatic minor amputations in vasculopaths at our institution.
Methods: Consecutive minor amputations between January 1, 2005 and December 31, 2015 were identified. Patient demographic, pre-surgical, surgical and post-surgical variables were collected and analyzed for their relationship to (a) major reamputation and (b) healing through univariate tests followed by logistic regression and Kaplan-Meier analysis.
Results: 220 patients (69.5% male, 67.6 ± 11.2 years) underwent 296 primary minor amputations in 244 lower extremities (Figure 1). Within our cohort, 80.5% were diabetic, 25% had chronic kidney disease, and 60.9% were current or ex-smokers (Table 1).
Rates of progression to major amputation were 7.4% (18 of 244 limbs) and 21.7% (53 of 244 limbs) at 30 days and 1 year respectively. Low pre-operative posterior tibial (PT) waveform was an independent predictor of limb loss [odds ratio (OR) 3.03, 95% confidence interval (CI) 1.49 to 5.88]. Patients undergoing ray amputation had decreased duration of limb survival compared to partial or toe ($P < 0.05$). Interestingly, diabetes did not predict limb loss ($P = 0.68$).
Wound healing was achieved in 18.2% (54 of 296 amputations) at 3 months and 48.0% (142 of 296 amputations) at the final visit. While COPD predicted healing only at 3 months [OR 6.55, 95% CI 1.17 to 25.0] and post-operative infection predicted non-healing only at the final visit [OR 0.30, 95% CI 0.13 to 0.77], admission by emergency department and low pre-operative PT waveform predicted poor healing at both time points (Figure 2).
Conclusion: Although minor amputations are a means of limb salvage, limb loss and chronic wounds complicate recovery. Low pre-operative PT waveform and admission by emergency department were consistent predictors of poor outcomes. Early intervention and aggressive perfusion management are key in improving chances of limb salvage.

Figure 1. Primary minor amputation by level

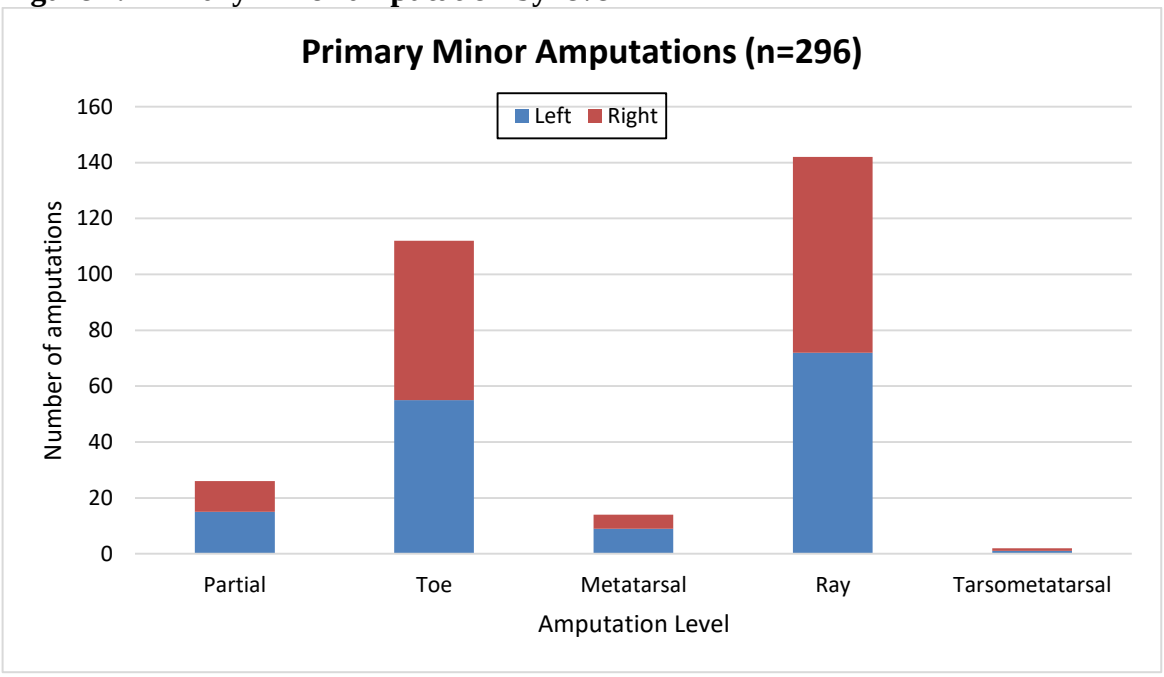
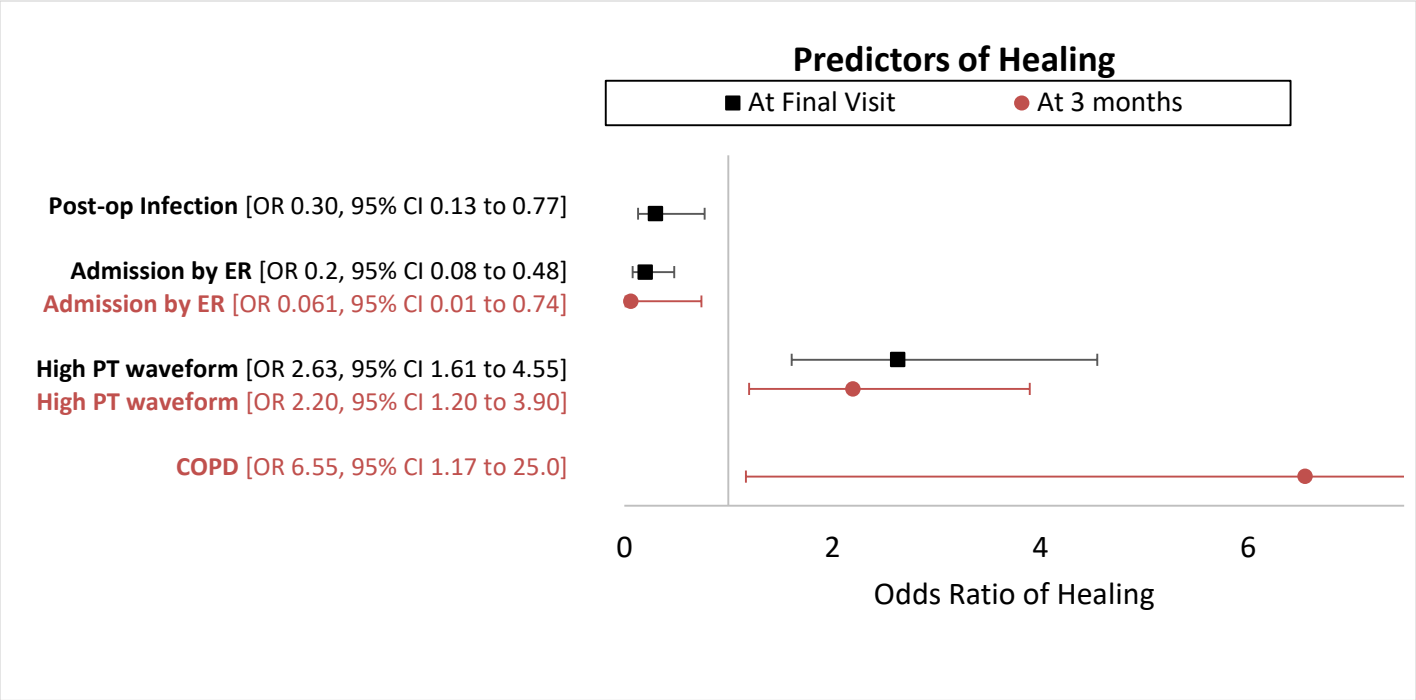


Table 1. Patient Demographics

	Mean ± SD	Range
Age (years)	67.7 ± 11.2	39-93
Follow Up Length (days)	579.5	4-3155
	No. of Patients	**Percentage**
Sex		
Male	153	69.5%
Female	67	30.5%
Comorbidities		
Hypertension	199	90.5%
Diabetes Mellitus	177	80.5%
Renal insufficiency (GFR<60)	147	66.8%
Hyperlipidemia	132	60.0%
Coronary Artery Disease	123	55.9%
Myocardial Infarction	78	35.4%
Cerebrovascular Event	57	25.9%
End-stage Renal Disease	55	25.0%
Congestive Heart Failure	39	17.7%

COPD	33	15.0%
Smoker		
Ex-smoker	92	41.8%
Current Smoker	42	19.1%
Never	24	10.9%
Medications		
Antiplatelet	173	78.6%
Statin	165	75.0%
ACE inhibitor/ARB	151	68.6%
Anticoagulant	77	35.0%

Figure 2. Predictors of healing at 3 months and at the final visit

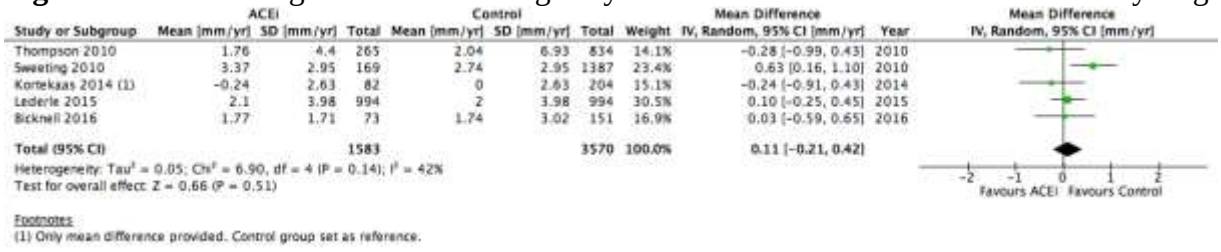


The Effect of Renin-Angiotensin System Blockade on Abdominal Aortic Aneurysm Growth, Rupture and Perioperative Outcomes: A Systematic Review and Meta-Analysis

Konrad Salata[1,4], MD; Rachel Eikelboom[2], BArtSc; Muzammil Syed[3]; Mohamad Hussain[1,4], MD; Norah Alsaif[4], MD; Subodh Verma[1,5], MD, PhD, FRCSC, FAHA; Mohammed Al-Omran[1,4], MD, MSc, FRCSC.
[1]Department of Surgery, University of Toronto, Toronto, Canada; [2]Faculty of Medicine, University of Toronto, Toronto, Canada; [3]Faculty of Science, McMaster University, Hamilton, Canada; [4]Division of Vascular Surgery, St. Michael's Hospital, Toronto, Canada; [5]Division of Cardiac Surgery, St. Michael's Hospital, Toronto, Canada.

Purpose: To summarize the literature regarding the effects of ACEi and ARBs on human AAA growth, rupture, and peri-operative mortality.
Methods: We conducted a systematic review in accordance with PRISMA guidelines. Our review protocol was registered at the International Prospective Register of Systematic Reviews (PROSPERO 2016: CRD42016054082). We searched MEDLINE, EMBASE, and The Cochrane CENTRAL databases from inception to 2017 for studies examining the effects of ACEi or ARB treatment on AAA growth, rupture or peri-operative mortality. Review, abstraction, and quality assessment were conducted in duplicate, and a third author resolved discrepancies. We assessed study quality using the Cochrane, and Newcastle-Ottawa scales. We used random effects models to calculate pooled mean differences and odds ratios (OR) with 95% confidence intervals. Heterogeneity was quantified using the I^2 statistic.
Results: Our search yielded 525 articles. One randomized and 8 observational studies involving 35,565 patients were included. Inter-rater agreement was excellent (κ=0.78), and risk of bias was low to moderate. All studies investigated ACEi; three studies investigated ARBs; and two studies included a composite ACEi or ARB group. Four studies assessed rupture and 30-day mortality, and 5 studies assessed AAA growth. There was no difference in AAA growth rate between ACEi vs control (mean difference 0.11 mm/yr, 95% CI -0.21, 0.42, p=0.51, I^2=42%) (Figure 1) or ARB vs control (mean difference -0.57, 95% CI -1.33, 0.18, p=0.14, I^2=0%). No protective effect of ACEi was demonstrated for AAA rupture (OR 0.90, 95% CI 0.73, 1.12, p=0.36, I^2=85%) (Figure 2).
Conclusion: Angiotensin converting enzyme inhibitors do not affect AAA growth or rupture rates. The small number of retrospective studies, and limited long-term follow-up precludes the dismissal of ACEi or ARBs as pharmacotherapy for AAA. More prospective, long-term research is needed to determine the effect of renin-angiotensin system blockade on AAA growth, rupture and peri-operative mortality.

Figure 1: Effect of angiotensin converting enzyme inhibitors on abdominal aortic aneurysm growth rate



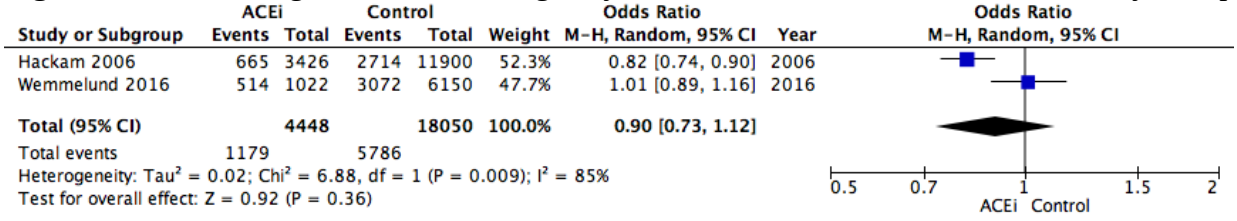
Study or Subgroup	ACEi Mean [mm/yr]	ACEi SD [mm/yr]	ACEi Total	Control Mean [mm/yr]	Control SD [mm/yr]	Control Total	Weight	Mean Difference IV, Random, 95% CI [mm/yr]	Year
Thompson 2010	1.76	4.4	265	2.04	6.93	834	14.1%	-0.28 [-0.99, 0.43]	2010
Sweeting 2010	3.37	2.95	169	2.74	2.95	1387	23.4%	0.63 [0.16, 1.10]	2010
Kontekaas 2014 (1)	-0.24	2.63	82	0	2.63	204	15.1%	-0.24 [-0.91, 0.43]	2014
Lederle 2015	2.1	3.98	994	2	3.98	994	30.5%	0.10 [-0.25, 0.45]	2015
Bicknell 2016	1.77	1.71	73	1.74	3.02	151	16.9%	0.03 [-0.59, 0.65]	2016
Total (95% CI)			1583			3570	100.0%	0.11 [-0.21, 0.42]	

Heterogeneity: Tau² = 0.05; Chi² = 6.90, df = 4 (P = 0.14); I² = 42%
Test for overall effect: Z = 0.66 (P = 0.51)

Footnotes
(1) Only mean difference provided. Control group set as reference.

Mean Difference IV, Random, 95% CI [mm/yr]
-2 -1 0 1 2
Favours ACEi Favours Control

Figure 2: Effect of angiotensin converting enzyme inhibitors on abdominal aortic aneurysm rupture rate



Study or Subgroup	ACEi Events	ACEi Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Hackam 2006	665	3426	2714	11900	52.3%	0.82 [0.74, 0.90]	2006
Wemmelund 2016	514	1022	3072	6150	47.7%	1.01 [0.89, 1.16]	2016
Total (95% CI)		**4448**		**18050**	**100.0%**	**0.90 [0.73, 1.12]**	
Total events	1179		5786				

Heterogeneity: Tau² = 0.02; Chi² = 6.88, df = 1 (P = 0.009); I² = 85%
Test for overall effect: Z = 0.92 (P = 0.36)

Odds Ratio M-H, Random, 95% CI
0.5 0.7 1 1.5 2
ACEi Control

Hospital Readmission and Emergency Department Visits After Vascular Surgery: A Prospective Cohort Study

Mohamad A. Hussain[1,2], Zeyad Khoshhal[2], Konrad Salata[1,2], Baidaa Altuwaijri[2], Norah Alsaif[2], Subodh Verma[1,3,4], Mohammed Al-Omran[1,2,4], [1]Department of Surgery, University of Toronto, Toronto, Ontario, Canada; [2]Division of Vascular Surgery, St. Michael's Hospital, Toronto, Ontario, Canada; [3]Division of Cardiac Surgery, St. Michael's Hospital, Toronto, Ontario, Canada; [4]Li Ka Shing Knowledge Institute, St. Michael's Hospital, Toronto, Ontario

Objective: Establish the rates and causes of hospital readmission and emergency department (ED) visits after vascular surgery, and understand how these patients are managed.
Methods: We conducted a prospective observational cohort study at a single tertiary center in Toronto, Ontario. We enrolled all inpatients that underwent a vascular surgery procedure between September 2015 and June 2016, and followed them up at 30 days post-discharge using telephone interviews. We established baseline patient characteristics, and gathered follow-up data on readmissions and ED visits.
Results: A total of 133 patients were enrolled. Mean age (SD) was 65.3 (13.1) years; 29% were women. The most common index admission diagnoses were peripheral arterial disease (50%), abdominal aortic aneurysm (25%), and carotid stenosis (9%). Of the 128 patients that were discharged home and were alive at 30-day follow-up, 19 (15%) had been readmitted or had visited the ED. Rates of readmission or ED visit varied based on the index procedure (Fig. 1), urgency of the procedure (Fig. 2A), and residing distance from the treating hospital (Fig. 2B), although these differences did not reach statistical significance. Patients were readmitted after a mean of 17 days following discharge (n=10); surgical site infection was the most common cause of readmission (30%); the primary treatment was antimicrobial therapy or surgical in 40% and 30% of the cases, respectively; and the mean length of stay after readmission was 14 days. With respect to ED visits (n=9), patients presented after a mean of 11 days following discharge; they most commonly reported a wound issue (67%) or lower extremity edema (22%); and they were managed with either oral antibiotics (67%) or reassurance (33%).
Conclusion: Early readmission or ED visit after vascular surgery is common, often due to surgical site infection or wound-related issues. Hospital-based and outpatient quality initiatives may help reduce these events.

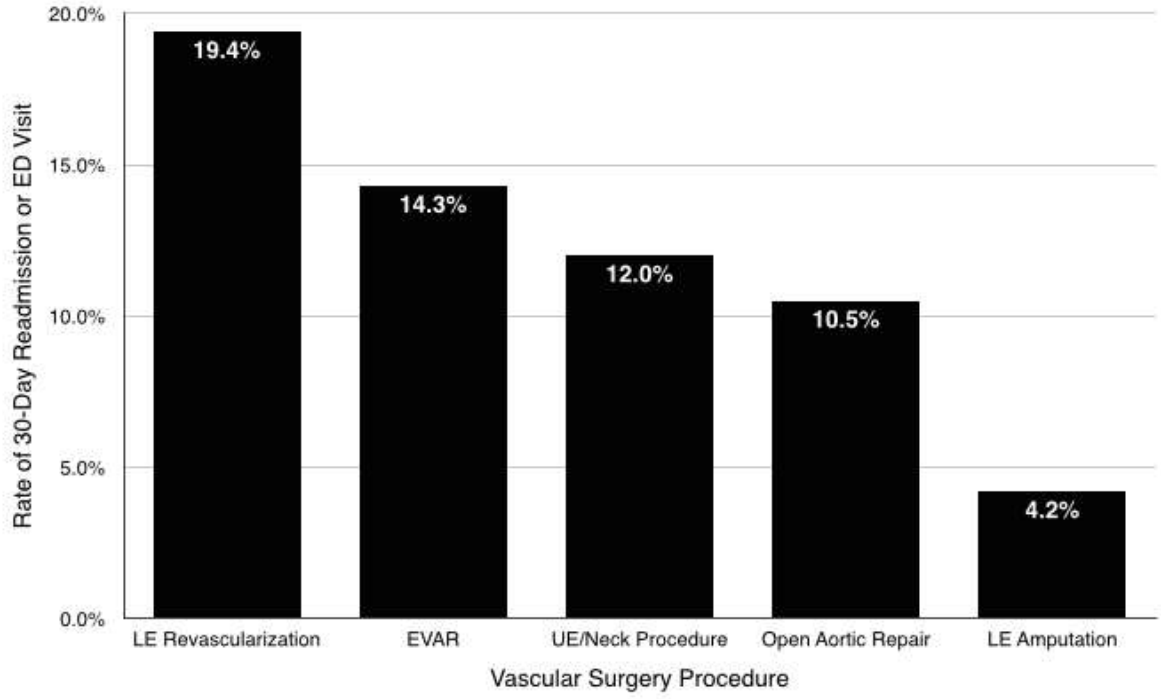


Fig 1. Rate of readmission or ED visit by index procedure. Abbreviations: LE = lower extremity; EVAR = endovascular aortic repair; UE = upper extremity; ED = emergency department.

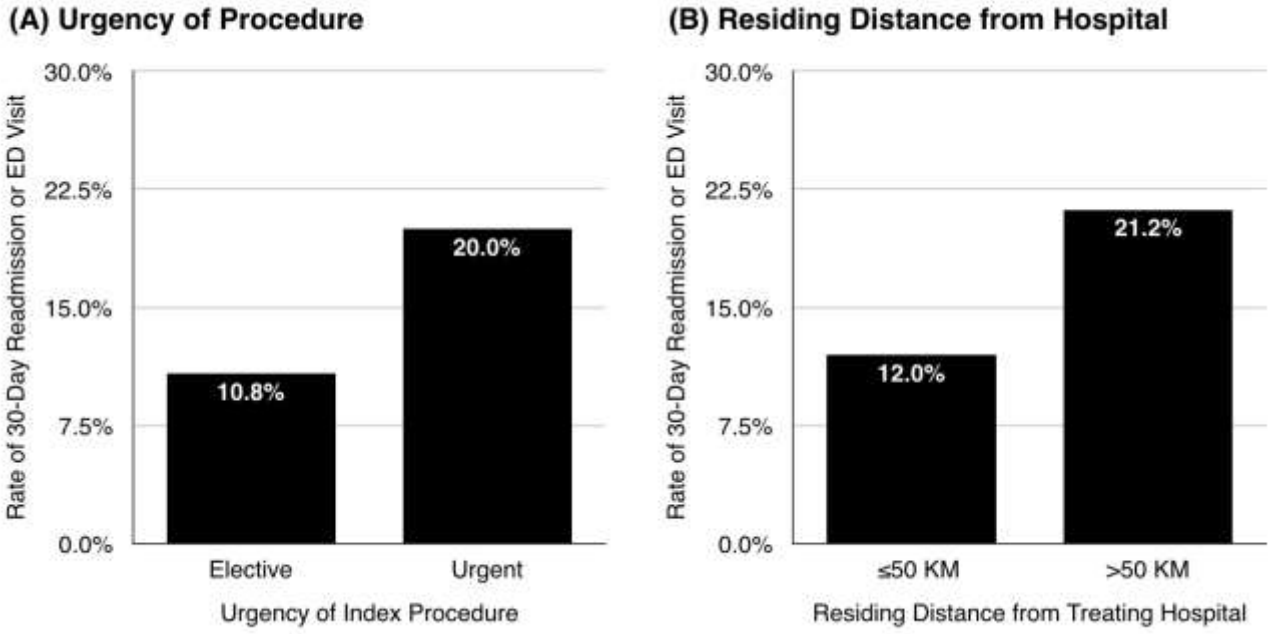


Fig 2. Rate of readmission or ED visit by urgency of procedure (A) and patient residing distance from the treating hospital (B).

Assessing Patient Preferences for and Ranking of Outcomes Presented in Randomized Trials of Endovascular Aortic Surgery (APPROPRIATE)

Danielle Dion[1], Adam Power[1], Guy DeRose[1], Audra Duncan[1], Thomas Forbes[2], Luc Dubois[1], [1]Division of Vascular Surgery, Western University, London, Ontario, Canada, [2]Division of Vascular Surgery, University of Toronto, Ontario, Canada

Introduction: We surveyed both AAA patients undergoing surveillance and vascular surgeons to assess their preference for and ranking of both traditional and functional outcomes following AAA repair.
Methods: Patients with AAA between 3.0-5.0 cm who were undergoing surveillance were surveyed during clinic visits; while an internet based survey was sent to all members of the CSVS. We asked each respondent to rate the importance of 19 unique outcomes following AAA surgery. Each response was coded using a 5-point Likert scale with 1 = "not important", to 5= "most important". We compared responses using t-test.
Results: One hundred patients (mean age 68) and 66 surgeons (mean age 48) completed the questionnaires. Both surgeons and patients scored avoiding early postoperative mortality, ability to return home and function independently, and avoiding postoperative complications as the most important outcomes following AAA repair. Patients placed more importance on avoiding an aortic reintervention than surgeons did, with 63% of patients indicating it was either "very important" or "most important", while only 31% of surgeons felt it was as important (P<.01) (Figure 1). Similarly, patients placed more importance on 2-year mortality (P<.01), time to ambulation (P<.01), impact on cognition (P<.01), changes in energy level (P<.01), problems with urination (P<.01), problems with bowel function (P<.01), and pain/numbness in the legs (P<.01), than surgeons did. Both hospital length of stay and size of incision were deemed less important (Table 1).
Conclusions. Although agreement exists in the importance of avoiding early postoperative mortality and complications; patients placed more importance on avoiding an aortic reintervention, functional and cognitive outcomes, and 2-year mortality than surgeons did. Given this discordance, patient engagement into the selection of outcomes is important when evaluating different methods of AAA repair. Certain outcomes rated highly by both groups (recovery, cognition, independence) are poorly studied and should be the focus of further evaluations of AAA repair.

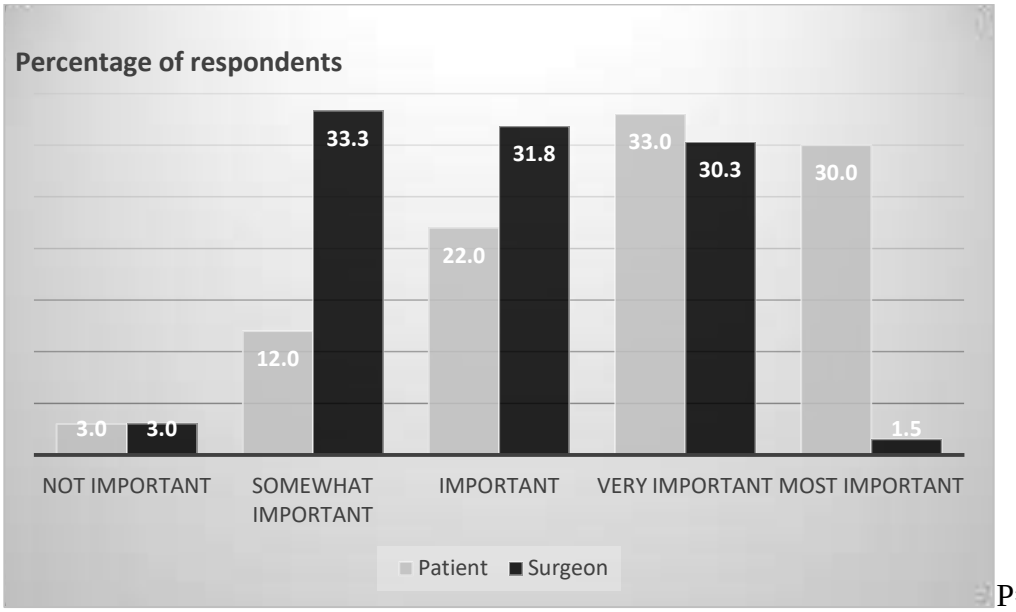
Table 1. Comparison of the relative importance of different outcomes following open AAA repair or EVAR as assessed by both patients and surgeons. (Likert scale; 1=not important to 5=most important).

Outcome	**Patient**		**Surgeon**		P-value
	Average*	% very or most important**	Average	% very or most important	
Chance of dying during or immediately after surgery	4.08	72	4.20	83	0.52
Ability to return home and live independently	4.22	77	4.15	89	0.59
Avoiding postoperative complications	4.03	74	3.74	71	0.02
Avoiding the need for a second procedure to treat the aneurysm	**3.75**	**63**	**2.94**	**31**	**<0.01**
Length of hospital stay	2.62	22	2.55	17	0.67
Chance of dying two years following the procedure	**3.96**	**67**	**3.10**	**44**	**<0.01**
Chance of being impotent after surgery	2.14	18	2.64	21	0.01
Amount of time needed to fully recover from surgery	3.24	37	2.98	33	0.13
Changes in energy level after surgery	**3.27**	**36**	**2.77**	**19**	**<0.01**
Amount of pain following surgery	3.02	27	2.76	23	0.10
Amount of time needed to resume walking normally	**3.32**	**43**	**2.71**	**21**	**<0.01**
Loss of appetite following surgery	2.37	13	2.11	8	0.09
Chance of problems passing urine after surgery	**3.53**	**50**	**2.05**	**6**	**<0.01**
Chance of problems with passing stool after surgery	**3.32**	**44**	**1.92**	**6**	**<0.01**
Chance of having pain or numbness in your legs after surgery	**3.64**	**51**	**2.45**	**12**	**<0.01**
Weight loss following surgery	**2.13**	**14**	**1.70**	**3**	**<0.01**
Impact of surgery on your ability to think and make decisions	**3.96**	**74**	**3.18**	**45**	**<0.01**
Impact of surgery on your caregivers	3.27	42	3.23	48	0.81
Location/size of incisions	1.85	6	2.11	14	0.10

* Higher score indicates more importance

** Percentage of respondents who indicated the outcome was either “very important” or “most important”

Figure 1. Relative importance of avoiding an aortic reintervention as rated by both surgeons and patients. (Likert scale 1= not important, 2= somewhat important, 3= important, 4 = very important, 5 = most important)



P=<0.001

Establishing the Publication Rate of Abstracts Submitted between 2012 to 2016 to the Canadian Society for Vascular Surgery Annual Meeting

Faysal Naji*[1, 2], Arshia Pedram Javidan*[2], Khatija Pinky Ali[2], John Harlock[1, 2]
*Shared first authorship, [1]Hamilton Health Sciences, Hamilton, Ontario, [2]McMaster University, Hamilton, Ontario

Objectives: The purpose of this study was to establish the publication rate of abstracts submitted from 2012 to 2016 to the Canadian Society for Vascular Surgery (CSVS) annual meetings, and examine factors related to likelihood of publication.
Methods: Abstracts of all 2012-2016 CSVS annual meetings were obtained through the CSVS website. Two reviewers independently extracted data from abstracts. Data extracted using Pubmed, Ovid and EMBASE, included status, date, journal of publication, and status of findings of the abstract (positive findings, negative findings, or N/A if abstract was descriptive). A level of evidence (LOE) was assigned using the 2011 Oxford Centre for Evidence-Based Medicine classification scheme based on study design.
Results: Overall, (52/230, 23%) of the abstracts had a corresponding full-text publication in the literature. The majority of abstracts (24/52, 46%) had corresponding publications in the *Journal of Vascular Surgery*, followed by *Vascular & Endovascular Surgery* (3/52, 6%) and *Vascular* (3/52, 6%). The average time to publication was 13.8 months (95% CI: 10.1 months - 17.4 months). There was a statistically significant correlation ($P < 0.001$) between the status of publication and the status of the finding of the outcome (Table 1). Abstracts with positive findings were most likely to be published (35/89, 39%), followed by descriptive findings (16/123, 13%), and least likely were negative findings (1/17, 6%). There was no correlation between LOE and publication status ($P = 0.187$, Table 2).
Conclusion: Nearly one-quarter of all abstracts presented at CSVS from 2012-2016 had corresponding full-text publications. Abstracts with positive findings were most likely to be published; this contributes to publication bias in vascular surgery. Emphasis should be placed on publication of non-positive findings, and of abstracts that have a higher place on the hierarchy of evidence.

Table 1: Distribution of abstracts stratified by publication status (published/not published) and status of outcome (positive finding, negative finding, or N/A for descriptive research)

Status of Outcome	Positive	Negative	N/A (Descriptive)	Total
Published	35 (39%)	1 (6%)	16 (13%)	52 (23%)
Not published	54 (61%)	17 (94%)	107 (87%)	178 (77%)
Total	89	18	123	230

Chi-squared test: P < 0.001

Table 2: Distribution of abstracts stratified by publication status (published/not published) and level of evidence (1-5 or N/A)

Level of Evidence	1	2	3	4	5	N/A	Total
Published	2 (67%)	3 (38%)	16 (29%)	19 (26%)	0 (0%)	12 (20%)	52
Not published	1 (33%)	5 (63%)	39 (71%)	73 (79%)	1 (100%)	59 (83%)	178
Total	3	8	55	92	1	71	230

Chi-squared test: P = 0.187

Computational Simulations to Predict Fenestrated Stent Graft Rotation upon Deployment

Ryan M. Sanford[1], Sean A. Crawford[2, 3], Matthew G. Doyle[1, 2], Cristina H. Amon[1, 3], Thomas L. Forbes[2], [1]Department of Mechanical and Industrial Engineering, University of Toronto, [2]Division of Vascular Surgery, Department of Surgery, University of Toronto
[3]Institute of Biomaterials and Biomedical Engineering, University of Toronto

Objective: The objective of this study was to use finite element simulations of fenestrated endovascular aneurysm repair (FEVAR) to predict whether the stent graft would rotate upon deployment leading to fenestration misalignment and related complications, such as end-organ ischemia.
Methods: Following institutional research ethics approval, preoperative CT scans and stent graft plans were collected for 3 patients who had undergone FEVAR. The aortoiliac geometries were segmented from the common femoral artery to above the visceral vessels and vessel centerlines were calculated. Geometries of the stent graft, based on the plans, as well as the guidewire, and the delivery sheath were created. Realistic material properties, including frictional effects, were assigned for all materials, with the vessel wall properties being those of an elderly male taken from the literature. Using the finite element software LS-DYNA, vessel deformation in response to the guidewire was simulated by displacing the guidewire to follow the vessel centerline path, and then removing this displacement, forcing the guidewire to try to straighten, until the deformations of the guidewire and the vessel wall reached equilibrium. The stent graft model was then compressed into a sheath which was delivered into position in the aorta by following the guidewire path. Once the device was in position, the sheath was removed, allowing the stent graft to expand and potentially rotate.
Results: Stent graft rotation was calculated as the angle between the position of the graft before and after unsheathing. These calculated angles showed excellent agreement with the rotation measured clinically from the intraoperative imaging (7°, 2°, and 12° computationally vs. 5°, 2°, and 16° clinically).
Conclusions: A finite element model of stent graft delivery and deployment was developed to predict the amount of stent graft rotation that may occur clinically. Preliminary results show excellent agreement with the clinical data.

Current Practices in Venous Disease – A Survey of Canadian Vascular Surgeons

Gary K Yang, Ramin Hamidizadeh, Jerry Chen, Division of Vascular Surgery, University of British Columbia, Vancouver, BC

Objective: To evaluate the practice patterns of vascular surgeons in Canada in the treatment of superficial venous disease.
Methods: A web-based survey was sent to 155 active members of the Canadian Society for Vascular Surgery (CSVS). The survey included 19 questions investigating the venous practices of vascular surgeons. Questions assessed training background, practice site, venous treatments offered and obstacles to therapy. Open-ended questions were also included as options for additional comments.
Results: A total of 63 responses (41%) were acquired over February and March 2017. Respondents were roughly equal from academic (54%) and community (46%) sites with an even distribution of years in practice. Only 62% offered sclerotherapy while 49% offered endovenous ablation procedures on their practice. The majority of surgeons felt that their residency and fellowship did not prepared them for an active venous practice (68%). Seventy-five percent of surgeons are interested in attending a hands-on course in venous therapy. The main challenges faced with venous therapy include lack of time due to overwhelming arterial pathologies (67%), equipment cost/office space limitations (52%) and lack of knowledge or skills in contemporary procedures (27%). Sixty percent of the respondents perceived barriers in getting venous ultrasound imaging for their patients. Fifty-seven percent of surgeons believe there are gaps between published guidelines on the care of venous disease in their practices. However, 92% of respondents believe that vascular surgeons should be leaders in delivering care for venous disease.
Conclusion: The treatment of superficial venous disease has advanced over the last few decades but significant obstacles exist for Canadian surgeons to deliver venous therapy in accordance with current guidelines.

Temporal Trends of Aortic Custom Medical Device Usage in Canada

Sean A. Crawford[1], Mohamad A. Hussain[2], Mohammed Al-Omran[2], Thomas L. Forbes[1], Graham Roche-Nagle[1], [1]Division of Vascular Surgery, University Health Network, University of Toronto, [2]Division of Vascular Surgery, St. Michael's Hospital, University of Toronto, Toronto, ON, Canada

Objective: The objective of this study was to evaluate the utilization of custom medical devices (CMDs) in advanced endovascular aneurysm repair (EVAR) across Canada.
Methods: A time-series analysis was performed using exponential smoothing models for all CMDs sold by Cook Medical from 2010 to 2016. This dataset includes thoracoabdominal devices, but does not include iliac devices. The primary analysis examined the temporal changes in rates of CMDs sold during this period, with subset analyses of the rates of fenestrated and branched devices. Secondary analyses examined the population normalized rates of CMDs with respect to province and the number of institutions performing this procedure.
Results: A total of 1127 thoracoabdominal grafts (613 branched and 514 fenestrated) were included in the analysis. The number of CMDs purchased per year increased 50% from 0.38 per 100 000 individuals in 2010 to 0.58 per 100 000 individuals in 2016 ($P<0.01$; Figure 1). The number of branched and fenestrated CMDs purchased per year increased by 110% ($P<0.001$) and 50% ($P<0.001$) respectively. The population normalized rates of CMD utilization by province varied significantly ranging from 0.25 per 100 000 in Saskatchewan to 1.09 per 100 000 in Manitoba ($P<0.001$: Figure 2). Thirty-one different institutions purchased CMDs with the absolute number of devices purchased per institution ranging from 3 to 194.
Conclusions: The overall rates of both fenestrated and branched thoracoabdominal stent grafts have significantly increased between 2010 and 2016. While this dataset is limited to one manufacturer, it provides an important snapshot into the utilization of custom medical devices in advanced aortic repair in Canada.

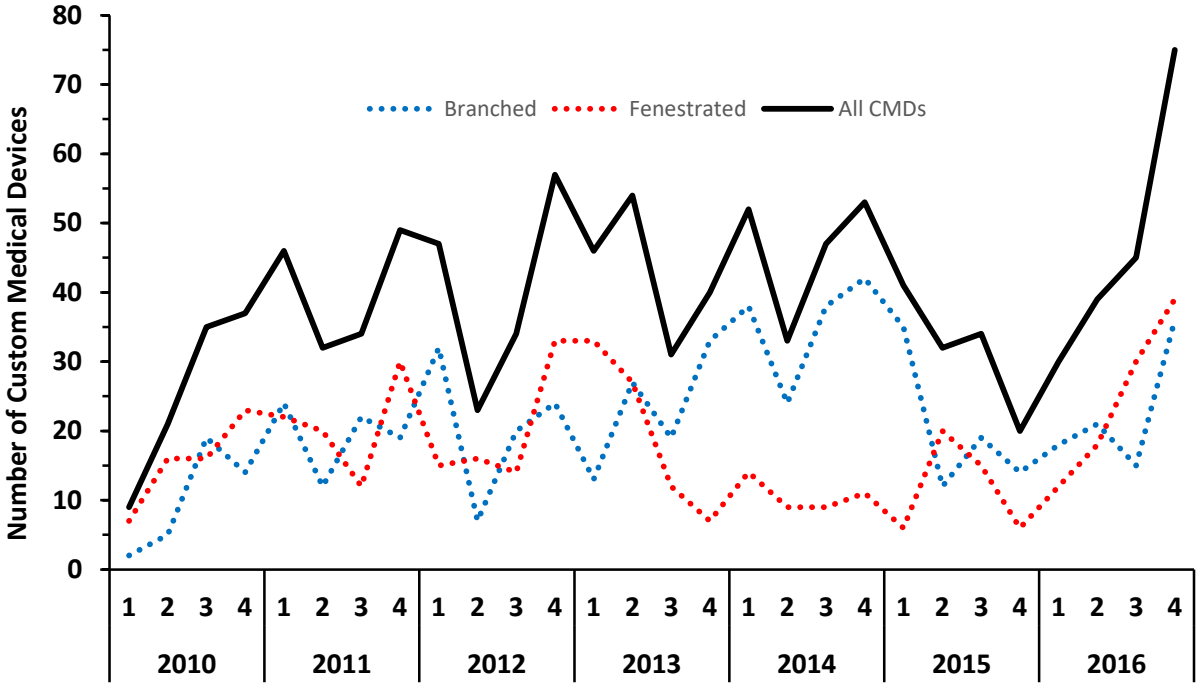


Figure 1. Temporal distribution of custom medical devices purchased at Canadian institutions by quarter

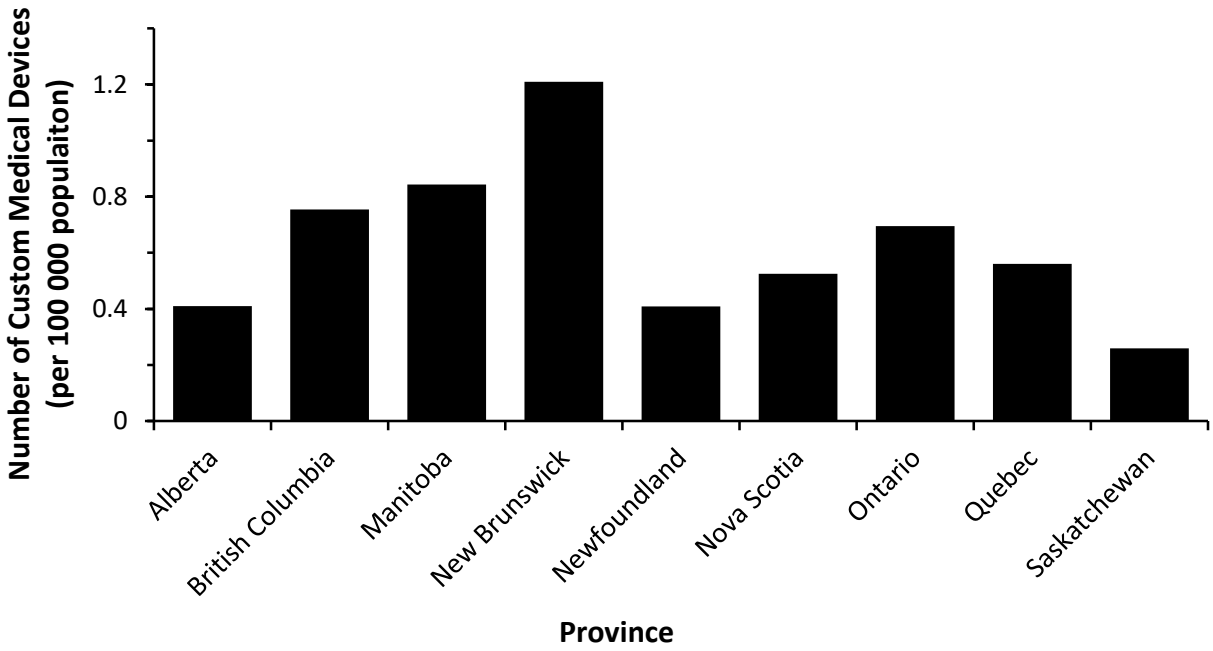


Figure 2. Number of custom medical devices purchased per province normalized to 2016 provincial population estimates

Development of a Semi-Automated FEVAR Planning Technique

Helen Genis[1], Sean A Crawford[1,2], Matthew G Doyle[1,3], Thomas F Lindsay[1], Cristina H Amon[2,3], and Thomas L Forbes[1], [1]Division of Vascular Surgery, University Health Network, University of Toronto, [2]Institute of Biomaterials and Biomedical Engineering, University of Toronto, [3]Department of Mechanical and Industrial Engineering, University of Toronto, Toronto, ON, Canada

Objective: The objective of this study is to develop a semi-automated method for the generation of fenestrated stent graft plans to minimize the intra-operator variability seen in manual CTA measurements.
Methods: Preoperative CTAs from a prospectively maintained advanced EVAR database were used to validate the proposed method. The aortic lumen and visceral arteries were segmented using a custom MATLAB interface. The horizontal vessel position was calculated as the angle between the vessel's origin and the anterior-posterior line that intersects the aortic centerline. The vertical vessel position was calculated using two metrics: the axial distance and the aortic centerline distance. Generated stent graft plans were then compared to the physician generated plans.
Results: Thirty-one patients were included in the study. The generated stent graft plans had excellent agreement with the physician based plans for horizontal fenestration alignment, with mean differences of 2±2°, 1±2°, 6±3°, and 2±2° for the celiac, SMA, left renal, and right renal arteries. In aortas with non-angulated visceral segments (n=17), both the axial and centerline based approaches to vertical alignment had good agreement with mean differences of 2.5±0.4mm and 2.8±0.4mm for the left and right renal arteries. For those with angulated visceral segments (n=14), the difference between methods was significant with mean differences of 7.1±1.1mm and 5.0±0.9mm for the left and right renal arteries.
Conclusions: This FEVAR planning technique demonstrated excellent agreement with the horizontal alignment of the fenestrations, but the vertical position was highly dependent on the planning physician's measuring technique. This is potentially a significant source of fenestration misalignment and future studies will employ computational simulations to predict the degree of aortic straightening observed intraoperatively.

A Novel Iliac Morphology Score Predicts Procedural Mortality and Major Vascular Complication in Transfemoral Aortic Valve Replacement

Christine Ou, DO; Juliet Blakeslee-Carter, BS; David Dexter, MD; Brandon Cain, MD; Jean Panneton, MD, Eastern Virginia Medical School Division of Vascular Surgery and Sentara Cardiology. Norfolk, VA

Objectives: Vascular complications remain a challenge for transfemoral approach to TAVR (Transcatheter Aortic Valve Replacement). This study was to develop a preoperative tool for prediction of major vascular complications of TAVR.
Methods: A retrospective review was performed of patients who underwent transfemoral TAVR from 2011-2015 (N =280). Iliofemoral arterial measurements were obtained with CTA 3D reconstructions and Iliac Morphology Score (IMS) was created from these measurements. Vascular complications were defined by Valve Academic Research Consortium (VARC-2).
Results: Vascular complications were seen in 42 patients (15%). Major and minor vascular complication rates were 3.6% (n=10) and 11.4% (n=32) respectively. Fifty-three patients (19%) required vascular surgery consultation with 31 (11%) requiring vascular interventions. IMS was calculated by CTA analysis of iliac segments in 198 patients. Gender, iliac diameter and calcification, and access type were identified as predictors of major complications. IMS was composed of ipsilateral minimum iliac diameter and iliac calcifications based on AUROC analysis ($p<.05$, AUROC =.82). Arterial size and calcification were classified from 0-3 based on severity. Multivariate analysis identified gender and IMS as independent predictors of major complications. High (IMS≥5, n=55) and low risk (IMS<5, n=139) groups were based on inflection point for specificity (73%) and sensitivity (83%). High-risk group had smaller iliac diameters, areas, and luminal volumes, and a higher rate of major vascular complications. Mortality rate in the high score group was 10% and 1.4% in low score group. Patient risk score (PRS) was created to evaluate morphologic and patient factors that predict major complications. The PRS identified 59 patients as high risk (PRS≥7).
Conclusion: IMS of ipsilateral minimum iliac diameter plus iliac calcification is a predictor of major vascular complications and mortality. Alternative access in patients with high IMS may reduce major vascular complications and procedural mortality.

Posterior Approach to Popliteal Artery Aneurysm Repair; an Underutilized Technique?

Jason Patapas, Trinh Mai, Prasad Jetty, Tim Brandys, Sudhir Nagpal, Dalibor Kubelik, Andrew Hill, George Hajjar, The Division of Vascular and Endovascular Surgery, The Ottawa Hospital – Civic Campus**,**1053 Carling Avenue**,** Ottawa, Ontario, Canada

Objective: The objective of this study was to analyze long-term results of popliteal artery aneurysm repair via a posterior approach.
Methods: We performed a retrospective analysis of all patients who underwent popliteal aneurysm repair via a posterior approach from November 2004 until January 2017.
Results: Forty-two popliteal artery aneurysms (mean maximum diameter of 3.35 cm) were repaired via an open posterior approach in 35 patients. Ninety-four percent were men with an average age 66 years-old. Most patients had hypertension (57%), dyslipidemia (60%) and were smokers or ex-smokers (71%). Clinically most patients presented electively (76%) with symptomatic aneurysms (54%) versus those found incidentally. Fifty-two percent were right-sided and 63% had normal 3-vessel runoff. Synthetic (PTFE) grafts were more commonly used as conduit (62.5%) than harvested veins. The average post-operative hospital stay was 4.2 days, with 19% having early post-operative complications (wound infection or dehiscence). Regarding long-term complications (over 30 days), only 7.2% of patients suffered minor transient nerve injury, while 4.7% of patients had persistent wound infections. The 5-year primary patency was 83.3% overall and 91.8% in elective cases.
Conclusion: Open repair of popliteal artery aneurysms through a posterior approach represents an excellent option, with few complications and good long-term primary patency, especially in elective patients.

Reliability and Measurement Error of Digital Planimetry for the Measurement of Chronic Venous Leg Ulcers

Michael Stacey1,3, Steven Phillips1, Forough Farrokhyar1,2, Jillian M. Swaine3,4
1 Department of Surgery, McMaster University, 237 Barton St. East, Hamilton, ON, L8L 2X2 Canada, 2 Department of Health, Evidence, Impact, McMaster University, 39 Charlton Avenue East, Hamilton, Ontario, L8N 1Y3, Canada, 3 School of Surgery, University of Western Australia, 35 Stirling Hwy, Crawley, 6009, Western Australia, 4 Institute of Health Research, University of Notre Dame Australia, 19 Mouat St., Fremantle 6160, Western Australia

Objectives: To determine the within rater reliability, between rater reliability, and standard error of measurement of a digital planimetry device used to measure the surface area of chronic leg ulcers.
Methods: Wound area in 42 patients was measured weekly for 12 weeks by two different raters, with each rater measuring the wound 10 times per visit. Intraclass correlation coefficients (ICC 1,k) and standard error of measurement were calculated for both within and between raters using 10 and the first 3 repeated measures to determine if using less measurements was as reliable. The true change in wound area was calculated by dividing standard error of measurements by mean wound areas.
Results: Within rater reliability for raters 1 and 2 were 0.995 and 0.992 for 10 measurements, and 0.996 and 0.992 for 3 measurements per time point. Between rater reliability was 0.979 for 10 measurements and 0.996 for 3 measurements per time point. The within rater standard error of measurement for raters 1 and 2 was 0.98 cm2 and 1.28 cm2 for 10 measurements and 0.895 cm2 and 1.29 cm2 for 3 measurements at each time point. The standard error of measurement for between raters was 2.07 cm2 for 10 measurements and 2.25 cm2 for 3 measurements per time point. The true change in wound size varied from 6.4% for within one rater to 15.7% for across different raters.
Conclusions: This study found that both within and between rater reliability of the digital planimetry device was very high for 3 measurements per time point, and that there is some degree of uncertainty whether performing a single measurement is as reliable as performing 3. When using multiple assessors, change in wound size that could be considered to be real and not within the range of measurement error was 15.7% or greater.

Physicians' Peripheral Arterial Disease Knowledge Gap Starts in Medical School

Musaad AlHamzah1, Rachel Eikelboom2, Muzammil Syed3, Konrad Salata1, Mohamad A. Hussain1, Mohammed Al-Omran1,4, 1Department of Surgery, University of Toronto, Toronto, Canada; 2University of Toronto Faculty of Medicine, Toronto, Canada; 3Faculty of Science, McMaster University, Hamilton, Canada; 4Division of Vascular Surgery, St. Michael's Hospital, Toronto, Canada

Objective: Previous data indicate physicians have suboptimal knowledge about peripheral arterial disease (PAD). The aim of our study was to evaluate PAD knowledge among Canadian medical school graduates to understand if this knowledge gap exists early in medical training.
Methods: We conducted a descriptive, cross-sectional, interview-based study of graduating medical students at the University of Toronto (class size, n=259). Participants were blinded to the content of the research study prior to participation. We administered a validated questionnaire utilizing open-ended questions to evaluate students' knowledge of PAD and coronary artery disease (CAD) in the following domains: clinical presentation, risk factors, preventative measures, treatment, and complications. The maximum total score for each disease was 28 based on the number of correct responses. We calculated mean (SD) scores for each PAD and CAD knowledge domain, and examined for differences in PAD versus CAD scores using paired t-tests.
Results: An interim analysis was done in March 2017 after interviewing a quarter of the graduating medical school class, with a view to complete data collection by April 2017. Of the participants, 65% were female; and nearly all had been exposed to PAD (100%) and CAD (95%) through their medical school curriculum. Overall, medical students scored better in identifying CAD characteristics (mean [SD] score, 16.0 [2.9]) compared to PAD (mean [SD] score, 14.2 [2.8]) (P=0.027). This difference was driven by inferior performance of students in identifying risk factors and complications of PAD compared to CAD (Table 1).
Conclusions: Our results demonstrate suboptimal medical graduates' knowledge of PAD relative to CAD. Although PAD and CAD share common atherosclerotic risk factors and cardiovascular complications, medical students were less likely to associate these with PAD versus CAD. We recommend a comprehensive module that incorporates all presentations of atherosclerotic disorders to enhance students' understanding of these pathologies in medical schools.

Table 1: Participants' mean scores of each domain in both diseases. **PAD:** peripheral arterial disease; **CAD:** coronary artery disease; **SD:** standard deviation.

Knowledge domain	Maximum score	Medical student score for PAD (mean, SD)	Medical student score for CAD (mean, SD)	p-Value
Symptoms	7	2.7 (1.3)	2.9 (1.2)	0.54
Risk factors	7	4.0 (0.9)	4.8 (1.0)	0.004
Preventive measures	7	4.5 (1.1)	4.6 (1.1)	0.88
Treatment	3	2.1 (0.7)	1.9 (0.6)	0.38
Complications	4	1.1 (0.6)	1.9 (0.6)	0.0002
Total	**28**	**14.2 (2.8)**	**16.0 (2.9)**	**0.027**

Endovascular Repair of Abdominal Aortic Aneurysm (EVAR) in Octogenarians: A Report on Clinical Outcomes

Raju Sneha[1], Eisenberg Naomi[2], Montbriand Janice[2], Roche-Nagle Graham[2], [1]Faculty of Medicine, University of Toronto, [2]Division of Vascular Surgery, Toronto General Hospital, University Health Network, University of Toronto, Toronto, Ontario, Canada.

Objectives: To investigate outcomes and predictors of EVAR complications in octogenarians.
Methods: A retrospective chart review of consecutive patients ≥80 years of age who received an EVAR between August 2010 to January 2017. After appropriate univariate comparisons, logistic

regression was completed to determine predictors of complications, and Kaplan Meir was used to explore survival times.

Results: One hundred and fifty-four octogenarians underwent an EVAR during this period for an infrarenal aneurysm with an average size of 63.77 mm (SD= 12.73). The average age was 84.1 and the majority were males (81%). Eighteen patients presented as ruptured AAA. Intraoperative endoleak was documented in 64 (42%) cases with Type II lumbar being the most common (n=38). On follow-up, there were 12 retreatments for these. Forty-three patients sustained a postoperative complications with myocardial ischemia (n=24) and dysrhythmias (n=10) being the highest contributors. Diabetes (B = 1.45, OR = 4.27, 95% C.I. = 1.09- 16.74, p = 0.037) was found to be multivariate predictor of all complications.

Most patients (88%) continued follow-up to an average of 20 months (range 0-72.5 months). An average patient attended three follow-up visits with CT or ultrasound imaging.

Overall mortality was 13% (n=21), with 43% (n=9) occurring during index admission. Of those that died during index admission, all 9 were ruptured AAA (χ^2=37.3, p = 0.0005). Patients who sustained a postoperative complications were found have significantly lower survival times (Figure 1; KM Log rank χ^2= 6.55, p = 0.011). The average survival time post-EVAR was 58 months.

Conclusion: EVAR in octogenarians is a suitable form of therapy with acceptable short and long-term results in the elective setting. Diabetes was a predictor of complications in this population.

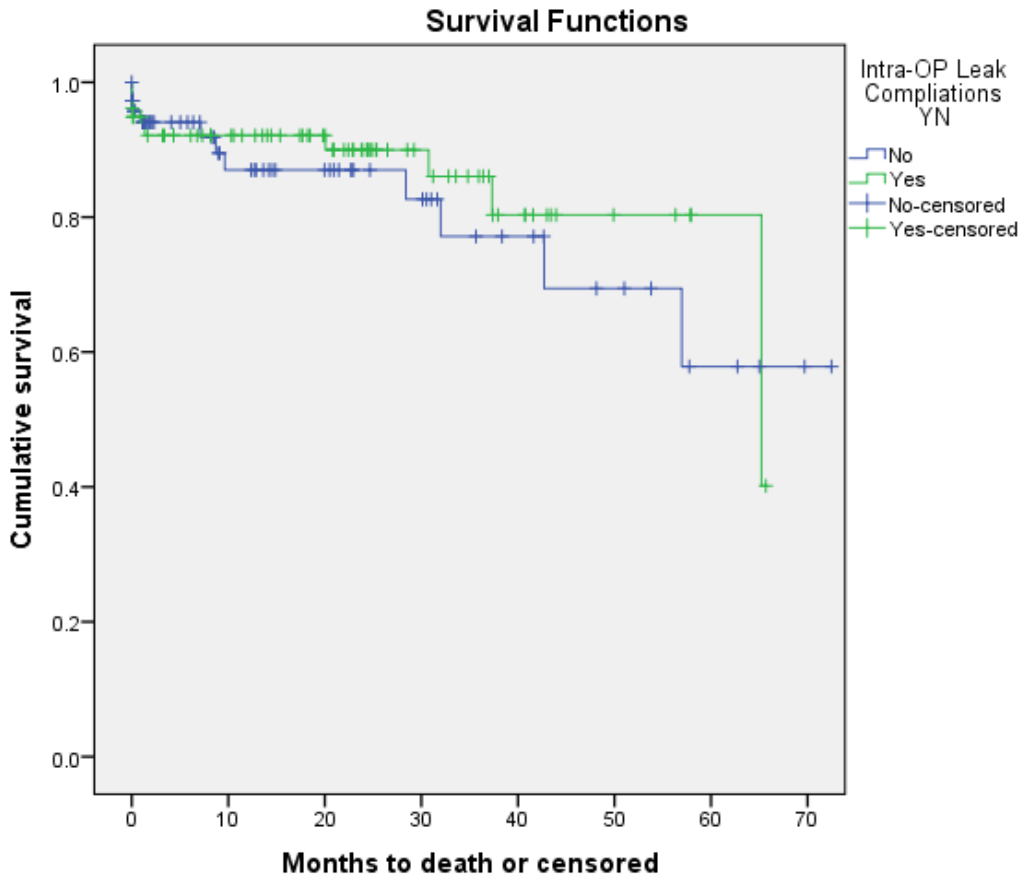


Figure 1: KM Analysis of Survival vs. Postoperative Complications

There were 106 cases with no complications (9 events) and 43 with complications (10 events). The average survival time for those without events was 61.5 months (SE=3.31, 95% CI = 55.02 to 67.99 months) and for those with complications was 49.89 months (SE=4.65, 95% CI = 40.77 to 59.02 months). There was a significant difference found between these survival times (Log rank χ^2= 6.55, p = 0.011).

SAVE THE DATE

CSVS Annual Meeting
September 28-29, 2018 Westin Montréal
Montréal, Québec

2018 is the "40th Anniversary" of the CSVS

Thank you to our 2017 sponsors