



Temerty Faculty of Medicine  
University of Toronto  
Division of Vascular Surgery

# VASCULAR SURGERY RESEARCH DAY

Friday May 13<sup>th</sup>, 2022



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## Chair's Welcome



It is with great pleasure that I welcome you to the Annual University of Toronto Vascular Surgery Research Day. The 2020 and 2021 Research Days were different to say the least as we shifted to a virtual-only format. The COVID-19 pandemic put the world on hold but we're finally ready to get back together (with a hybrid model) and celebrate another academic year, the successes and research productivity of our faculty, students, residents, fellows and research trainees.

The highlight of the day will be the 11<sup>th</sup> *Annual K. Wayne Johnston Visiting Lecture in Vascular Surgery*. We are privileged to have Dr. Michael Conte from UCSF as our guest. I'm sure his talk will be fascinating, informative and will inspire us to greater academic heights.

I'd like to extend specific thanks to the U of T Vascular Surgery Executive who made this day possible through their commitment to our academic mission. These surgeons include: Mohammed Al-Omran (Division Head, St. Michael's), Andrew Dueck (Division Head, Sunnybrook), Christiane Werneck (Division Head, Trillium), Kerry Graybiel (Division Head, Humber River), John You (Division Head, Scarborough), Elisa Greco (Residency Program Director), Mark Wheatcroft (Fellowship Program Director), Ivica Vucemilo (Director of Undergraduate Medical Education) and Graham Roche-Nagle (Quality & Best Practices).

Special thanks to Michelle Paiva, our Division's Administrative Assistant, without who this day would not have been possible.

Also, we appreciate the generosity and commitment of our sponsors who continue to support this day through unrestricted education grants.

Welcome and I hope you enjoy the University of Toronto Vascular Surgery Research Day.

Sincerely,

Thomas L. Forbes, MD, FRCSC, FACS, DFSVS  
*R. Fraser Elliott Chair & Head, Division of Vascular Surgery, UHN  
Sprott Department of Surgery, Peter Munk Cardiac Centre  
Professor & Chair, Division of Vascular Surgery, University of Toronto*



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## K. Wayne Johnston Visiting Lecturer in Vascular Surgery

In recognition of Dr. Johnston's unprecedented contributions to our specialty of Vascular Surgery and the University of Toronto an annual lecture began in his name. Dr. Johnston was a founding member and President of the Canadian Society for Vascular Surgery and later became President of the Society for Vascular Surgery. He is a pre-eminent academic surgeon who served as Editor-in-Chief of the Journal of Vascular Surgery and Co-Editor of two editions of Rutherford's Textbook of Vascular Surgery. No other Canadian, and few internationally, have contributed more to academic vascular surgery than Dr. Johnston. In 2009 he was honored with the Lifetime Achievement Award by the Society for Vascular Surgery. In 2018 Dr. Johnston was honored as a Member of the Order of Canada for his outstanding achievement, dedication to the community and service to the nation.

This lectureship was made possible through the generous donations of faculty, students and alumni.



## Previous K. Wayne Johnston Lecturers

2012	Joseph L. Mills	University of Arizona
2013	Lewis B. Schwartz	University of Chicago
2014	Philip P. Goodney	Dartmouth University
2015	Ronald L. Dalman	Stanford University
2016	Melina R. Kibbe	Northwestern University
2017	Marc Schermerhorn	BIDMC, Harvard University
2018	Julie Freischlag	Wake Forest Baptist Medical Center
2019	A. Ross Naylor	Leicester Vascular Institute
2020	Gilbert R. Upchurch, Jr	University of Florida
2021	Edith Tzeng	University of Pittsburgh



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## 2022 K. Wayne Johnston Visiting Lecturer in Vascular Surgery

### **Michael S. Conte, MD**

*Professor & Chief, Division of Vascular & Endovascular Surgery*

*Edwin J. Wylie, MD Chair in Vascular Surgery*

*Co-Director, UCSF Heart & Vascular Center, Co-Director, UCSF Center for Limb Preservation*

*Director, Vascular Surgery Integrated Residency Program*

*University of California, San Francisco*



Dr. Michael Conte received his medical degree in 1986 at Albert Einstein College of Medicine. He completed his surgical residency at New York Hospital-Cornell Medical Center in 1993, which included a two year research fellowship at Brigham and Women's Hospital (BWH) and Massachusetts Institute of Technology in Boston. He completed his vascular surgery training in 1994 as the John Homans Fellow at BWH and Harvard Medical School.

Dr. Conte was an Assistant Professor of Surgery at Yale University from 1994-1997, and a member of the Boyer Center for Molecular Medicine. He returned to BWH as Assistant Professor (1997-2001) and then Associate Professor (2001-2008 ) of Surgery at HMS. From 2002-2008, he was the Director of Vascular Surgical Research at BWH and from 2005-2008, he was Co-Director of the Clinical Trials Group at the Center for Surgery & Public Health.

In 2006, Dr. Conte received the Distinguished Achievement Award from the New York Weill Cornell Medical Center Alumni Council. He is on the Editorial Board for Vascular and Endovascular Surgery, Vascular Medicine, Journal of Vascular Surgery, and Vascular. He has served as an Associate Editor for Circulation.

Dr. Conte's clinical interests include diseases of the aorta and its major branches, aneurysms, carotid artery disease, and peripheral artery disease (PAD). He is particularly interested in diabetic vascular disease, and in complex revascularization to preserve limb function and prevent amputation in patients with advanced forms of PAD. He had led the largest multicenter clinical trial to date examining the outcomes of leg bypass surgery in patients with severe PAD and is nationally and internationally recognized for his leadership in this area.

Dr. Conte's research is focused on developing new molecular therapies to improve the long-term results of cardiovascular procedures. His translational research program includes basic laboratory investigations as well as prospective clinical trials to study the causes of failure of angioplasty and bypass surgery and develop new approaches to stratify patients at risk.



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## Objectives:

1. To obtain new knowledge regarding advances in basic science and clinical research in the field of vascular surgery.
2. For vascular surgery trainees, to have an opportunity to present their research work and to obtain feedback and questions from their peers.
3. To obtain new knowledge regarding the pathophysiology of vascular disease.
4. To understand the value of continuing quality assurance in surgical practice.
5. To have an opportunity to learn and collaborate with colleagues within and without the University of Toronto.

## Accreditation:

The 2022 University of Toronto Division of Vascular Surgery Annual Research Day is a self-approved group learning activity (Section 1) as defined by the Maintenance of Certification Program of the Royal College of Physicians and Surgeons of Canada





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## RESEARCH DAY AGENDA

### 0800 – 0815: Welcoming Remarks

Dr. James Rutka

*R.S. McLaughlin Professor & Chair, Department of Surgery, University of Toronto*

Dr. Thomas L. Forbes

*Professor & Chair, Division of Vascular Surgery, University of Toronto*

### 0815 - 0915: Session 1 – Peripheral Arterial Disease

*(10 minute presentations, 5 minutes questions)*

Moderator: Dr. Thomas Forbes (Division Head, University Health Network)

0815 – 0830:

#### **Urinary Fatty Acid Binding Protein 3 has diagnostic and prognostic value in peripheral artery disease**

Niousha Jahanpour, Ben Li, Abdelrahman Zamzam, Muzammil H. Syed, Shubha Jain, Rawand Abdin, Mohammad Qadura

0830 – 0845:

#### **The status of wound care research in Canada**

Michael Ho-Yan Lee, Anjali Chauhan, Natalie Kozlowski, Cindy Zhang, Thanasayan Dhivagaran, Leslie Summers deLuca, Hannah Brooks, Ahmed Kayssi

0845 – 0900:

#### **Low dose aspirin and rivaroxaban combination therapy to overcome aspirin non-sensitivity in patients with vascular disease**

Mariya Popkov, Hamzah Khan, Shubha Jain, Niousha Djahanpour, Muzammil H. Syed, Margaret L. Rand, John Eikleboom, David Mazer, Mohammed Al-Omran, Rawand Abdin, Mohammad Qadura

0900 – 0915:

#### **A pilot study of clinical risk prediction of 90-day reintervention following lower extremity angioplasty**

Kennedy Ayoo, Ben Li, Mohammed Al-Omran, Elisa Greco, Mohammad Qadura, Mark Wheatcroft, Muhammad Mamdani, Charles de Mestral



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0915 - 0920: **Rapid Fire Session – Cutting Edge Research**  
(5 minute presentation)

**Systematic Review of Perioperative Risk Models**

Lauren Gordon, G. Sampieri, R. Adams-McGavin, S. Birdi, S. Doshi,  
Mark Wheatcroft, Teodor Grantcharov

0920 - 1020: **Session 2 – Clinical Challenges in Vascular Surgery**  
(10 minute presentations, 5 minutes questions)

Moderator: Dr. Elisa Greco (Residency Program Director)

0920 - 0935: **A scoping review of the effect of prehabilitation on perioperative outcomes in surgical patients**

Monica Abdelmasih, Brianne Yarranton, Gar-Way Ma, Leslie Summers deLuca,  
Thomas L. Forbes, Ahmed Kayssi

0935 - 0950: **Vascular complications with Extracorporeal Membrane Oxygenation (ECMO)**

Miguel Ferrer, Amanda Spriel, Ruane Sale, Tanya Jain, Naomi Eisenberg,  
Eddy Fan, Phyllis Billia, Graham Roche-Nagle

0950 - 1005: **A systematic review and meta-analysis of the role of sealants for achieving anastomotic hemostasis in vascular surgery**

Gar-Way Ma, Andrew Kucey, Sam C Tyagi, Giuseppe Papia, Daryl S. Kucey,  
Ramon L. Varcoe, Thomas L. Forbes, Richard Neville, Andrew D. Dueck,  
Ahmed Kayssi

1005 - 1020: **Misplaced vascular access devices: case series of diagnosis and endovascular management**

Zeeshan Ahmed, Sultan Khoja, Graham Roche-Nagle, George Oreopoulos,  
Thomas L. Forbes

1020 - 1035: **Nutrition Break**



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1035 - 1120: 11<sup>th</sup> Annual K. Wayne Johnston Lecture

**Intimal hyperplasia and vascular inflammation: a surgical perspective**

Dr. Michael Conte

*University of California, San Francisco*

1120 - 1205: Session 3 - Surgeon-Scientist Training Program Forum

(10 minute presentations, 5 minutes questions)

Moderator: Dr. Paul Walker

1120 - 1135

**Endothelial cells secrete extracellular vesicles in a polarized fashion to participate in cell-cell communication: Implications for atherosclerotic plaque development**

Sneha Raju, Kamalben Prajapati, Tse Wing Winnie Ho, Mark Blaser, Crizza Ching, Natalie J Galant, Lindsey Fiddes, Steven R. Botts, Ruilin Wu, Jamie Stark, Shawn Veitch, Elena Aikawa, Warren Lee, Jason E. Fish, Kathryn L. Howe

1135 – 1150:

**Long-term outcomes of endovascular and open surgical revascularization for peripheral artery disease**

Jean Jacob-Brassard, Mohammed Al-Omran, Thérèse A Stukel, Muhammad Mamdani, Douglas S Lee, Charles de Mestral

1150 – 1205

**Adjunctive hyperbaric oxygen therapy for spinal cord ischemia after complex aortic repair**

Angela Lee, Rita Katznelson, Maral Ouzounian, Darren Au, Jennifer Chung, Thomas F. Lindsay

1205 - 1245: Lunch Break

1245 - 1250: Rapid Fire Session – Cutting Edge Research

(5 minute presentation)

**Real-world machine learning classification of Doppler audio**

Brandon Van Asseldonk, Leslie Summers deLuca, Ahmed Kayssi





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**1250 - 1350: Session 4 – Aneurysms**

(10 minute presentations, 5 minutes questions)

Moderator: Dr. Andrew Dueck (Division Head, Sunnybrook)

1250 – 1305: **Plasma Complement Protein C2 as a viable adjunct to prognostication of abdominal aortic aneurysm**  
Tiam Feridooni, Mariya Popkov, Abdel Rahman Zamzam, Mohammad Qadura

1305 – 1320: **Survival after elective total arch replacement is comparable to hemiarch replacement**  
Julia F. Chen, Maral Ouzounian, Mark D. Peterson, Francois Dagenais, Ali Hage, Michael W.A. Chu, Jennifer C.-Y. Chung

1320 – 1335: **Evaluating branch characteristics of off-the-shelf t-branch and custom-made stent grafts in endovascular repair of thoracoabdominal aortic aneurysms**  
Apoorva Bhandari, Daniyal N. Mahmood, Rodolfo Rocha MD, Samantha M. Forbes, Kong Teng Tan, Maral Ouzounian, Jennifer C-Y Chung MD, Thomas F. Lindsay

1335 – 1350: **Sex differences in outcomes following ruptured abdominal aortic aneurysm repair**  
Ben Li, Naomi Eisenberg, Miranda Witheford, Thomas F. Lindsay, Thomas L. Forbes, Graham Roche-Nagle

**1350 – 1355: Rapid Fire Session – Cutting Edge Research**

(5 minute presentation)

**Development of an artificial intelligence tool for intraoperative guidance during endovascular aneurysm**

Allen Li, Arshia P. Javidan, Babak Namazi, Amin Madani, Thomas L. Forbes



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1355 - 1410: Nutrition Break

1410 - 1525: Session 5 – Education & Diversity

(10 minute presentations, 5 minutes questions)

Moderator: Dr. Mark Wheatcroft (Acting Division Head, St. Michael's Hospital)

1410 - 1425: **Examining access to vascular care for Indigenous populations in North West Ontario**

Asha Behdinan, Mary MacDonald, Richard Foty, Ahmed Kayssi

1425 - 1440: **The refinement of the Diabetic Wound Assessment Learning Tool [DiWALT] for competence in diabetic wound assessment and management**

Konrad Salata, Omar Selim, Andrew Dueck

1440 - 1455: **Evaluation of the efficacy of an online learning module to increase wound care theoretical knowledge amongst medical students**

Cesar Cuen-Ojeda, Gar-Way Ma, Arshia Javidan, Leslie Summers DeLuca, Julien Bernatchez, Ahmed Kayssi

1455 – 1510: **Investigating the role of gender, ethnicity, and visible minority in cardiovascular residency training – an interim analysis**

Shaidah Deghan Manshadi, Sneha Raju, Jean Jacob-Brassard, Thomas L. Forbes, Elisa Greco

1510 – 1525: **Evaluating YouTube as a source of patient education for patients undergoing surgery**

Arshia Javidan, Allen Li, Yung Lee, Matthew Nelms, Ahmed Kayssi, Faysal Naji

1530: Adjournment



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### Awards Presentation (to be announced later)

Best Presentation by a Student

Best Presentation by a Junior Resident

Best Presentation by a Senior Resident or Fellow

Alumni Award for Best Presentation by a SSTP Resident

### Previous Research Day Award Winners

	Best Presentation by a Student	Best Presentation by a Junior Resident	Best Presentation by a Senior Resident or Fellow	Alumni Award for Best Presentation by a SSTP Resident
2015		Patrick McVeigh	Ahmed Kayssi	Mohamad Hussain
2016		Caleb Zavitz	Ahmed Kayssi	Trisha Roy
2017		Caleb Zavitz	Charles de Mestral	Konrad Salata
2018		Sneha Raju	Omer Abdulrahim	Sean Crawford
2019		Sneha Raju	Sean Crawford	Omar Selim
2020		Brandon Van Asseldonk	Konrad Salata	Monica Abdelmasih
2021	Steven Botts	Brandon Van Asseldonk	Julien Bernatchez	Sneha Raju

### Previous Teaching Award Winners

	Most Outstanding Teacher – Resident or Fellow (as voted by residents and fellows)	George Oreopoulos Teaching Award Most Outstanding Teacher – Faculty (as voted by residents and fellows)
2016	Ahmed Kayssi	Andrew Dueck
2017	Charles de Mestral	Mark Wheatcroft
2018	Miranda Witheford	Thomas Lindsay
2019	Husain Al-Mubarak	George Oreopoulos
2020	Caleb Zavitz	Graham Roche-Nagle
2021	Bader Alsuwailam	Mark Wheatcroft



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**Urinary Fatty Acid Binding Protein 3 has diagnostic and prognostic value in peripheral artery disease**

Niousha Jahanpour, Ben Li, Abdelrahman Zamzam, Muzammil H. Syed, Shubha Jain, Rawand Abdin, Mohammad Qadura

**Objective:** Despite its significant association with limb loss and death, peripheral artery disease (PAD) remains underdiagnosed and undertreated. The current accepted gold-standard for PAD screening, the ankle brachial index (ABI), is limited by operator dependence, erroneous interpretation, and unreliability in patients with diabetes. Fatty acid binding protein 3 (FABP3) is an intracellular protein that becomes released into circulation and excreted into urine following skeletal muscle injury. We examined the prognostic ability of urinary FABP3 (uFABP3) in predicting adverse PAD-related events.

**Methods:** In this prospective case-control study, urine samples were collected from patients with PAD (n=142) and without PAD (n=72). The cohort was followed for 2 years. uFABP3 was normalized to urinary creatinine (uCr) (uFABP3/uCr). The primary outcome was major adverse limb event (MALE; composite of vascular intervention [open or endovascular] or major limb amputation). The secondary outcome was worsening PAD status (drop in  $ABI \geq 0.15$ ). Cox regression analyses with multivariable adjustment for baseline demographic and clinical variables were performed to assess the prognostic value of uFABP3/uCr with regards to predicting MALE and worsening PAD status.

**Results:** Patients with PAD had significantly higher median [IQR] uFABP3/uCr levels (3.46 [2.45–6.90] vs. 2.61 [1.98–4.62],  $p=0.001$ ). MALE and worsening PAD status were observed in 21 (10%) and 28 (14%) patients, respectively. uFABP3/uCr predicted MALE and worsening PAD status with adjusted hazard ratios (HR) of 1.28 (1.11–1.48,  $p=0.001$ ) and 1.15 (1.02–1.29,  $p = 0.020$ ), respectively. Patients with high uFABP3/uCr had a lower 2-year freedom from MALE (86% vs. 96%,  $p=0.047$ ) and worsening PAD status (78% vs. 99%,  $p=0.001$ ). There was good discriminatory ability for uFABP3/uCr in predicting the primary outcome of MALE, with an area under the receiver operating characteristics curve (AUROC) of 0.78.

**Conclusion:** Measuring uFABP3/uCr levels in patients with PAD can help identify those at high risk of adverse PAD-related events. This study highlights the prognostic value of uFABP3 in risk-stratifying individuals for further diagnostic vascular evaluation or aggressive medical management.



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**Table 3: Hazard ratios for events per one unit increase in uFABP3/uCr.**

	<b>Unadjusted HR (95% CI)</b>	<b>P</b>	<b>Adjusted HR (95% CI)<sup>‡</sup></b>	<b>P</b>
<b>MALE</b>	1.24 (1.10 – 1.40)	<b>0.001</b>	1.28 (1.11 – 1.48)	<b>0.001</b>
<b>Vascular intervention</b>	1.15 (1.02 – 1.28)	<b>0.031</b>	1.13 (1.02 – 1.27)	<b>0.037</b>
<b>Major amputation</b>	1.19 (0.92 – 1.55)	0.19	1.27 (0.81 – 1.20)	0.29
<b>Worsening PAD (drop in ABI <math>\geq</math> 0.15)</b>	1.15 (1.04 – 1.27)	<b>0.009</b>	1.15 (1.02 – 1.29)	<b>0.020</b>

MALE (major adverse limb event: composite of vascular intervention and major amputation), PAD (peripheral artery disease), ABI (ankle brachial index)

<sup>‡</sup>Adjusted for age, sex, hypertension, dyslipidemia, diabetes, smoking, coronary artery disease, congestive heart failure and medications (statins, ACE-I/ARB, beta blocker, diuretic, ASA, antiplatelets other than ASA, and low-dose rivaroxaban).



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**The status of wound care research in Canada**

Michael Ho-Yan Lee, Anjali Chauhan, Natalie Kozlowski, Cindy Zhang, Thanasayan Dhivagaran, Leslie Summers deLuca, Hannah Brooks, Ahmed Kayssi

**Objective:** To identify the characteristics of Canadian research on wound healing and prevention through a systematic approach using a scoping review methodology.

**Methods:** We searched Medline, Embase, Cochrane Central, CINAHL and SCOPUS from inception to July 2021 for studies analysing wound care in the Canadian population by Canadian institution-affiliated authors. Interventional, observational cohort studies, pre-clinical or animal studies were also eligible. Study characteristics, outcomes and subcategories, and important findings were collected from each article and summarised. Thematic analysis was performed to identify wound care priorities.

**Results:** Five hundred and sixty-five articles were included in our study. Physicians co-authored 86.7% of studies (n=490) and nurses contributed to 32.4% of studies. The top five themes identified were: wound prevention, management and treatment (n=241, 43%); surgical site infections (n=105, 19%); vascular and wound healing biology (n=100, 18%); healing apparatus and devices software (n=84, 15%); and models of follow-up care (n=83, 15%) (Table 1). Differences were found between authorship themes. Nurses more likely to co-author articles exploring themes related to direct patient wound care prevention, management, and treatment (Physicians: 147/241 [61.0%] vs Nurses: 154/241 [63.9%]). Physician specialties were more likely to co-author publications on surgical site infections (Physicians: 91/105 [86.7%] vs Nurses: 5/105 [4.7%]), wound healing milieu (Physicians: 79/100 [79.0%] vs Nurses: 7/100 [7.0%]) and advancing technologies (Physicians: 52/85 [61.2%] vs Nurses: 37/84 [44.0%]).

**Conclusion:** We mapped the scope of wound care research in Canada. Surgical wounds, pressure-injuries, diabetic foot ulcers and burns were the most reported exposures. Wound prevention, management and treatment was the most common priority followed by surgical site infections management and vascular and wound healing biology. We have provided data that supports potential high-yield themes. Our results will inform a Delphi process for a national consensus of stakeholders on wound care research priorities to accelerate improved patient outcomes.



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**Table 1: Thematic Analysis of Current Canadian Wound Care Research Priorities**

Themes	Number of Articles Analysing the Theme	Percentage of Total Articles with Themes
Wound Prevention/Management/Treatment	241	43%
Surgical Site Infection	105	19%
Vascular and Wound Healing Biology	100	18%
Healing apparatus, Devices, Applications & AI	84	15%
Models of care to follow patients during therapy (e.g., nurse run clinic, surgeon follow up, home care, education)	83	15%
Assessment/diagnosis	80	14%
Pressure/Arterial/Venous Ulcer	67	12%
Time to Heal	66	12%
Wound Severity, Recurrence, Amputation Rate	64	11%
Patient risk factors (e.g., diabetes, elderly, smoker)	61	11%
Cost-analysis & Health Systems Policy	52	9%
Infection (General/Non-Surgical)	47	8%
Health-Related Quality of Life	40	7%
Surgical Wound Complications	38	7%
Technology (Diagnostic imaging/ Monitor therapy)	34	6%
Scarring	28	5%
Wound Type	11	2%
Surgical Wound Dehiscence	10	2%
Skin Tear	8	1%
Follow-up time	8	1%
Hematoma	2	0%
Seroma	1	0%



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**Low dose aspirin and rivaroxaban combination therapy to overcome aspirin non-sensitivity in patients with vascular disease**

Mariya Popkov, Hamzah Khan, Shubha Jain, Niousha Djahanpour, Muzammil H. Syed, Margaret L. Rand, John Eikleboom, David Mazer, Mohammed Al-Omran, Rawand Abdin, Mohammad Qadura

**Objective:** The purpose of this study was to investigate the potential for low dose rivaroxaban to overcome aspirin (ASA) non-sensitivity ex vivo in patients with Peripheral Arterial Disease (PAD).

**Methods:** In the discovery phase, 83 patients with PAD taking 81 mg ASA were recruited. Each patient was interviewed to obtain a full medical history, and the patient's blood was drawn into sodium citrate tubes. Platelet aggregation testing was started within 15 min of the blood draw and was conducted with the use of Light transmission aggregometry (LTA) analysis. Patients were considered ASA non-sensitive if they had a maximal platelet aggregation of  $\geq 20\%$  when activated with arachidonic acid.

**Results:** Out of the 83 patients, 19 (23%) were determined to be non-sensitive to ASA. After ex-vivo addition of 2.5 mg dosage equivalent of rivaroxaban, ASA non-sensitivity was overcome in 11 (58%) of these 19 patients. In a validation phase, 58 patients with cardiovascular risk factors who were not prescribed ASA were recruited to further explore our findings. In this group, ex-vivo addition of 2.5 mg dosage equivalent of rivaroxaban significantly reduced arachidonic acid-induced platelet aggregation in the presence of ASA. In the absence of ASA, rivaroxaban only tended to reduce aggregation, however this was non-significant.

**Conclusion:** In this pilot study, the value of low dose rivaroxaban and aspirin combination in overcoming aspirin non-sensitivity in patients with PAD was shown. Further large clinical studies are needed to evaluate and confirm these findings.





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**A pilot study of clinical risk prediction of 90-day reintervention following lower extremity angioplasty**

Kennedy Ayoo, Ben Li, Mohammed Al-Omran, Elisa Greco, Mohammad Qadura, Mark Wheatcroft, Muhammad Mamdani, Charles de Mestral

**Objective:** To develop a simple approach to clinical risk prediction of 90-day reintervention following lower extremity angioplasty

**Methods:** Data from the St. Michael's Hospital Vascular Quality Improvement Program were used to identify all patients who underwent a lower limb angioplasty +/- stenting from July 1, 2019 to June 30, 2021. Demographics, clinical presentation, and angiographic data were collected from medical records. The cohort was classified by likelihood of 90-day endovascular or surgical reintervention based on clinical presentation and angiographic result, as defined a priori: (i) *Definite*, when part of established treatment plan, (ii) *Unlikely*, when no limb-threatening ischemia and successful target lesion revascularization without iatrogenic complication, (iii) *Possible*, all other instances. The frequency and type of reintervention within 90 days were captured and considered across clinical risk prediction groups.

**Results:** A total of 145 patients were treated with lower limb angioplasty +/- stenting (Table 1) among whom 33 (22.8%) required reintervention within 90 days: 10 of 10 (100%) in the *definite* risk group, 20 of 87 (23.0%) in the *possible* risk group and 3 of 48 (6.2 %) in the *unlikely* risk group. Patients in the *definite* risk group underwent 8 minor amputations for infection control, 1 open surgical revascularization and 1 repeat endovascular revascularization. In the *possible* group, reinterventions included 4 major amputations, 8 minor amputations, 5 open revascularizations, 3 repeat endovascular revascularizations and 1 thrombin injection for a pseudoaneurysm. In contrast, there were no amputations in the *unlikely* group, with only 2 contralateral endovascular revascularizations for claudication and 1 patient undergoing thrombin injection to correct a pseudoaneurysm.

**Conclusion:** Simple risk stratification based on clinical presentation and angiographic result may provide reliable prediction of 90-day re-intervention risk following lower-extremity angioplasty. Further investigation is warranted to understand the added value to clinical practice from advanced risk prediction analytics such as machine learning algorithms.



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**Table 1. Cohort characteristics**

<b>Characteristic</b>	<b>Lower Extremity Endovascular Revascularization</b> N=145
Age – Mean (SD)	69.9 (9.9)
Male sex – N (%)	89 (57.1)
Diabetes – N (%)	91 (62.8)
Smoking – N (%)	46 (31.7)
Scheduled intervention – N (%)	111 (76.6)
Infection at index intervention – N (%)	31 (21.4)
Indication – N (%)	
Chronic Limb-Threatening Ischemia	89 (61.4)
Claudication	33 (22.8)
Bypass protection	15 (10.3)
Acute Limb Ischemia	6 (4.1)
In-stent stenosis	1 (0.7)
Decreased ABI pre-ankle surgery	1 (0.7)
Target Lesion(s) – N (%)	
Femoropopliteal	100 (70.0)
Aortoiliac	39 (26.9)
Tibial	17 (22.8)



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**Systematic Review of Perioperative Risk Models**

Lauren Gordon, G. Sampieri, R. Adams-McGavin, S. Birdi, S. Doshi, Mark Wheatcroft, Teodor Grantcharov

**Objective:** While a common part of the perioperative process, surgical outcome prediction rarely influences patient management. This study reviews developed multispecialty predictive models with the aim to evaluate their predictive ability and to assess whether actionable intraoperative predictors have been included.

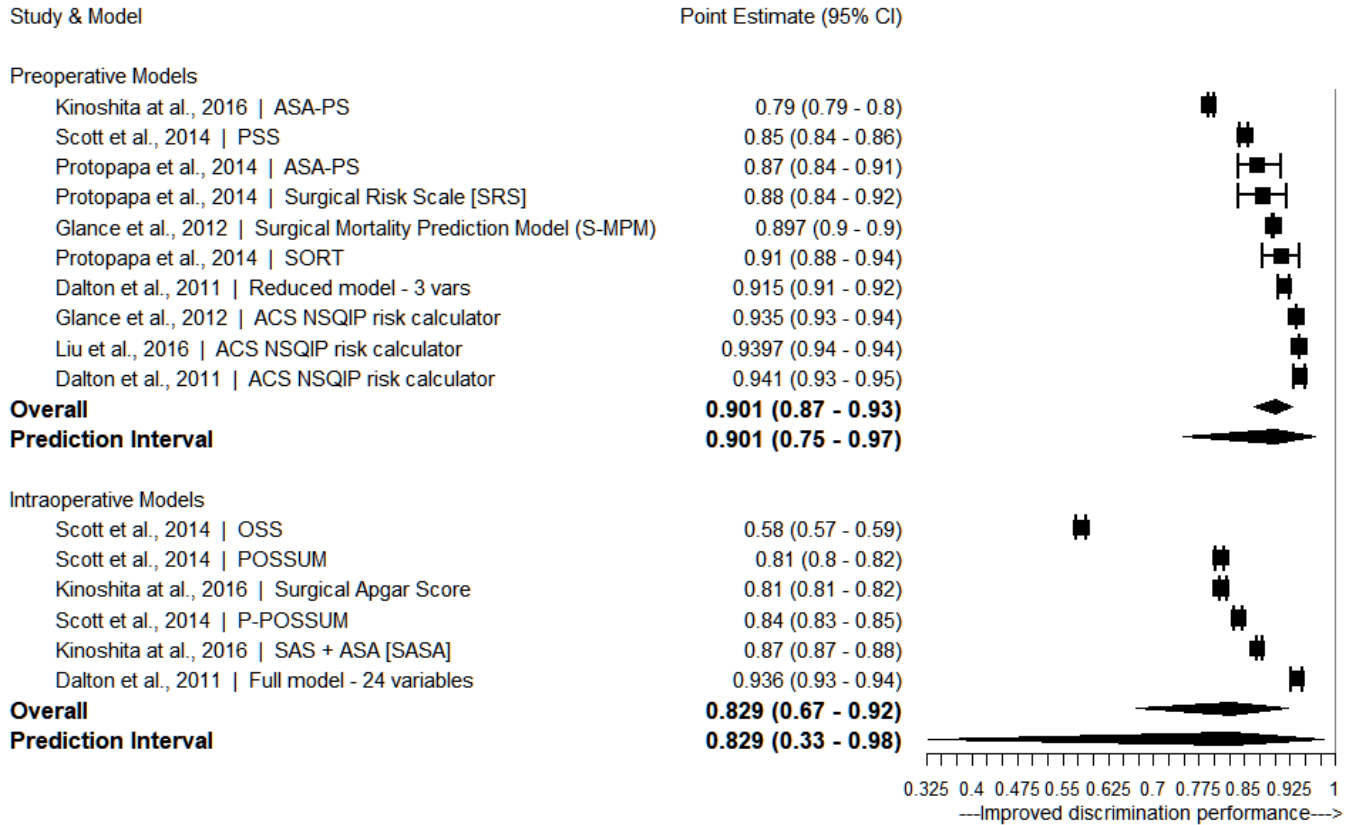
**Methods:** PubMed, Embase and Cochrane Library were systematically searched for studies either developing or validating prediction models for postoperative morbidity and/or mortality. Databases were searched for studies from 1997-2017. Screening and data extraction were conducted independently by pairs of reviewers. The Prediction Model Risk of Bias Assessment Tool (PROBAST) was used to assess study quality.

**Results:** 22,300 articles were retrieved, and 107 studies containing 324 eligible models were included in the systematic review. Intraoperative variables were included in 37.1% of mortality models and 38.9% of morbidity models. Risk of bias was generally high; mainly owing to analysis concerns. 17 models, from 6 studies, were eligible for meta-analysis of 30-day mortality. On metaanalysis, there was no difference in discriminative ability between models using only preoperative predictors and those including both preoperative and intraoperative predictors.

**Conclusion:** Many predictive models have been developed and validated for prediction of perioperative morbidity and mortality. Several, including the ACS NSQIP risk calculator and the P-POSSUM calculator, are appropriate for clinical use. The vast majority, however, are at high risk of bias. Those seeking to develop and validate predictive models should be cautious about their analysis, and thorough in reporting, to reduce risk of bias in the future. More work is needed to explore how actionable intraoperative predictors affect patient outcomes.



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**A scoping review of the effect of prehabilitation on perioperative outcomes in surgical patients**

Monica Abdelmasih, Brianne Yarranton, Gar-Way Ma, Leslie Summers deLuca, Thomas L. Forbes, Ahmed Kayssi

**Objective:** Prehabilitation is a multimodal strategy to improve patient health and wellbeing prior to surgery in order to optimize post-operative recovery. The broader scope of literature on the effect of prehabilitation prior to surgery has not yet been thoroughly explored. To explore the effect of prehabilitation on perioperative outcomes in different surgical populations and to identify any gaps in the current literature.

**Methods:** We performed a scoping review and searched four databases including MEDLINE, Embase, CINAHL, and Cochrane Central. Two independent reviewers screened each study based on the title and abstract then the full text to determine eligibility based on criteria that were specified a priori. Conflicts were resolved by a third reviewer. Key information was extracted from each article that was included in the final analysis.

**Results:** Our search strategy yielded 5915 articles and two additional articles were hand-selected. 3423 and 282 articles were screened during the title/abstract and full text stages, respectively, resulting in 154 articles in the final analysis. The majority of articles were published from 2017 onwards with patients undergoing hip or knee arthroplasty, colorectal resection, and surgery for lung cancer being the most frequently studied patient populations. Outcomes fell into general themes such as physical fitness or functional status, surgical, and patient-reported outcomes with most areas having mixed evidence regarding the effect of prehabilitation. Readmission and mortality appeared to be clearer, with almost all studies not finding an effect. Gaps in the current literature were identified related to evidence regarding whether duration, supervision, and prehabilitation components have an impact on efficacy, and thus the characteristics of an optimal prehabilitation program.

**Conclusion:** There is a high degree of heterogeneity in the literature regarding the effect of prehabilitation on perioperative outcomes and how prehabilitation is implemented, thereby making it challenging to propose a definitive assessment of its efficacy. The exception may be readmissions and mortality which do not appear to be affected. Further studies would be beneficial to determine optimal features of a prehabilitation program that may result in improvement in perioperative outcomes.



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**Vascular complications with Extracorporeal Membrane Oxygenation**

Miguel Ferrer, Amanda Spriel, Ruane Sale, Tanya Jain, Naomi Eisenberg, Eddy Fan, Phyllis Billia, Graham Roche-Nagle

**Objective:** To determine the frequency, nature and risk factors for vascular complications associated with peripheral venoarterial (VA) extracorporeal membrane oxygenation (ECMO) and the efficacy of the use of a distal perfusion cannula (DPC).

**Methods:** This is a retrospective review of patients who received peripheral VA ECMO at Toronto General Hospital between January 2012 and September 2019. Demographic variables were analyzed such as age, gender, BMI, peripheral vascular disease (PVD), hypertension (HTN), hyperlipidemia, diabetes, coronary artery disease (CAD), atrial fibrillation, asthma, chronic obstructive pulmonary disease (COPD), stroke or TIA, chronic kidney disease (CKD) or dialysis. Technical variables included cannulation site and side, location where the procedure was performed and cannula size, among others. Other variables that were analyzed included use of prophylactic DPC, duration of ECMO treatment, ICU and hospital stay and presence of vascular and non-vascular complications.

**Results:** During the study period, 170 patients received ECMO and 104 patients met the inclusion criteria, with a mean age of  $46.4 \pm 14.1$  years [19,75]. 67.3% (n=70) of them were male and mean BMI was 28.70 kg/m<sup>2</sup>. The distribution of risk factors is listed in Table 1. Most of the procedures were performed in the operating room (86%). Mean ICU stay was 25.68 days. Mean ECMO duration was 9.5 days [1,64], and it was not associated with any type of vascular complication. Non-vascular complications included surgical site infections (21.2%, n=22), stroke (4.8%, n=5) and AKI requiring temporary or permanent hemodialysis (38.5%, n=40). The mean size for the arterial cannula was 19.75 Fr [15,25]. No strong associations were found between any type of vascular complications or in-hospital mortality and arterial cannula size. 47 patients (45.2%) developed some sort of vascular complications. These included acute limb ischemia (68.1%, n=32), followed by vascular injuries resulting in expanding hematomas or pseudoaneurysms (31.9%, n=15). None of these patients was treated with a percutaneous intervention. All vascular injuries required an open surgical repair, whereas those hematomas which were managed conservatively with clinical surveillance were not computed as complications. The overall incidence of ALI was 30.8%. Regarding the 32 patients who developed ALI, only 4 (12.5%) were managed conservatively. The remaining 28 required either local repairs with or without patch plasty alone (9), embolectomy (3) or a combination of both (10). In addition to this, 12 patients required fasciotomies (37.5%), 6 of them along with revascularization, and 2 patients received major amputations (both males) despite receiving both revascularization and fasciotomy. All this lead to an amputation rate of 6.3% among patients with ALI and an overall amputation rate of 1.9%. ALI was more frequent in men (78.1%, n=25 vs 21.9%, n=7.  $p=0.1798$ ). There were no significant differences between males and females regarding incidence of complications or need for revascularization or fasciotomy. Mean ICU stay was longer for patients who developed ALI,



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being 29.25 days vs 24.09 for patients who did not develop that complication ( $p < 0.001$ ). Overall in-hospital mortality was 49% (n=51), being higher for patients with ALI (56.25%, n=18 vs 45.8%, n=33.  $p=0.44$ ). Both patients who underwent major amputations survived to discharge (1 male and 1 female).

An antegrade DPC was prophylactically used in 55 patients (52.9%), of which 19 were female (34.5%). The use of DPCs throughout the study period remarkably increased from 30% (2012-2013) to 71.4% (2018-2019). Incidence of ALI with DPC was lower, although it showed no statistical differences (27.3% vs 34.7%,  $p=0.5447$ ), and the same happened with the need for surgical revascularization (16.4% vs 28.6%,  $p=0.2074$ ). In-hospital mortality was lower as well in these patients, but again these differences were not significant (45.5%, n=25 vs 53.1%, n=26;  $p=0.5632$ ).

**Conclusion:** The incidence of vascular complications is frequent in peripheral VA ECMO patients and contributes to increased morbidity and ICU stay. Open surgical treatment is the cornerstone of their management. The use of DPC might contribute to reduce the incidence of ALI and in-hospital mortality.



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**Table 1.** Demographics

Characteristic	Patients (n=104)
Age (at time of intervention)	46.4 ± 14.1
Male	70 (67.3%)
BMI	28.70
Hypertension	38 (36.5%)
Hyperlipidemia	17 (16.3%)
Diabetes	22 (21.2%)
Past smoker	11 (10.6%)
Current smoker	12 (11.5%)
Atrial fibrillation	14 (13.5%)
Asthma or COPD	10 (9.6%)
Coronary Artery Disease (CAD)	23 (22.1%)
Peripheral Vascular Disease (PVD)	1 (1%)
Stroke or TIA	5 (4.8%)
Chronic Kidney Disease (CKD)	12 (11.5%)
Dialysis	6 (5.8%)





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**A systematic review and meta-analysis of the role of sealants for achieving anastomotic hemostasis in vascular surgery**

Gar-Way Ma, Andrew Kucey, Sam C Tyagi, Giuseppe Papia, Daryl S. Kucey, Ramon L. Varcoe, Thomas L. Forbes, Richard Neville, Andrew D. Dueck, Ahmed Kayssi

**Objective:** This review evaluated sealant effectiveness in vascular surgery for achieving anastomotic hemostasis.

**Methods:** We searched Cochrane Vascular Specialised Register, Cochrane Central Register of Controlled Trials, MEDLINE (from January 1946), Embase (from January 1974), CINAHL (from January 1982), World Health Organization International Clinical Trials Registry Platform, and ClinicalTrials.gov to March 2022 for randomized controlled trials comparing fibrin/synthetic sealants with alternatives for achieving anastomotic hemostasis in vascular surgery. Primary outcomes were time to hemostasis, hemostatic intervention failure, and intraoperative blood loss. Secondary outcomes were operating time, death/postoperative bleeding/unplanned return to the operating room from bleeding in 30 days, quality of life, and adverse events. Meta-analyses used random-effects models.

**Results:** 28 studies with 2612 patients met inclusion criteria. Sealants significantly reduced time to hemostasis (standardized mean difference [SMD]-1.20, 95%CI -1.65 to -0.75,  $p < 0.00001$ ,  $I^2 = 85\%$ ), including when compared only to manual compression (SMD-1.98, 95%CI -2.46 to -1.50,  $p < 0.00001$ ,  $I^2 = 93\%$ ), oxidized cellulose (SMD-1.60, 95%CI -1.97 to -1.23,  $p < 0.00001$ ,  $I^2 = 95\%$ ), and gelatin sponge (SMD-0.91, 95%CI -1.14 to -0.68,  $p < 0.00001$ ,  $I^2 = 79\%$ ). Intervention failure (RR0.46, 95%CI 0.35-0.60,  $p < 0.00001$ ,  $I^2 = 62\%$ ) and operating time (-9.64 minutes, 95%CI -18.62 to -0.66,  $p = 0.04$ ,  $I^2 = 0\%$ ) were significantly less in sealants. Intraoperative blood loss, postoperative bleeding, and unplanned return to the operating room were not significantly different. No studies reported death from bleeding or quality of life.

**Conclusion:** Sealants significantly reduced time to hemostasis, intervention failure, and operating time, but not intraoperative blood loss, postoperative bleeding, or unplanned return to the operating room. Deaths and quality of life could not be analyzed. Limitations include the risk of bias in all studies.



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**Misplaced vascular access devices: case series of diagnosis and endovascular management**

Zeeshan Ahmed, Sultan Khoja, Graham Roche-Nagle, George Oreopoulos, Thomas L. Forbes

**Objective:** Misplaced central venous access devices can have serious complications including arterial puncture which can be life threatening in some cases. Management is diverse and guidelines are lacking, therefore we present our study to contribute to the literature regarding this rare complication.

**Methods:** We present three cases of diagnosis of arterial puncture with central venous devices. We highlight the presentation, diagnosis and subsequent planning and management of these cases. All were managed endovascularly with a multidisciplinary team comprising vascular surgery, interventional radiology and cardiac surgery.

**Results:** We used vascular closure devices in two cases and covered stents in one case. None of the cases required conversion to open surgery. We achieved excellent haemostasis in all cases, however one patient passed away due to co existing medical complications. Our results are summarized in the following table.

Patient	Catheter size (Fr)	Symptoms	Device used	Sequelae
1	13.5	None	Angio-Seal x 2	Resolution
2	8	Hemorrhagic shock	Viabhan stent	Death
3	8	None	Angio-Seal x 1	Resolution

**Table 1:** Prestation and outcomes of patients in our series

**Conclusion:** Vascular closure devices and stents are safe and effective in management of inadvertent arterial puncture with central venous devices. Prompt diagnosis is necessary for satisfactory outcome.



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**Endothelial cells secrete extracellular vesicles in a polarized fashion to participate in cell-cell communication: Implications for atherosclerotic plaque development**

Sneha Raju, Kamalben Prajapati, Tse Wing Winnie Ho, Mark Blaser, Crizza Ching, Natalie J Galant, Lindsey Fiddes, Steven R. Botts, Ruilin Wu, Jamie Stark, Shawn Veitch, Elena Aikawa, Warren Lee, Jason E. Fish, Kathryn L. Howe

**Objective:** Endothelial cells (EC) are a major secretory organ that dynamically release biologically active molecules. Given that extracellular vesicle (EV)-encapsulated miRNAs and proteins mediate cell-cell communication, we hypothesized that their release will be altered by EC activation state and drive functional changes in circulating and resident vascular cells. Importantly, we explore bidirectional release of EVs as the mechanism allowing for EC based cell-cell communication.

**Methods:** EVs were isolated from supernatants of quiescent or activated ( $\pm$  IL-1 $\beta$ , 100pg/ml, 24h) human aortic endothelial cells (HAECs) via serial ultracentrifugation. EVs were validated as per MISEV2018 guidelines, quantified, and underwent transcriptomic and proteomic analysis. HAEC EVs were added to primary monocytes and vascular smooth muscle cells (VSMCs) at a physiological concentration ( $6.73 \times 10^9$  –  $2.98 \times 10^{10}$  particles/ml, 24 hours) prior to transcriptomic analysis. Total internal reflection fluorescence (TIRF) microscopy was performed to assess the fusion and exocytosis of extracellular vesicles at the basal membrane of live HAECs using a Leica DMI8 microscope.

**Results:** Activated HAECs increased EV release ( $6.73 \times 10^{10} \pm 1.81 \times 10^{10}$  particles/ml in quiescent vs.  $2.98 \times 10^{11} \pm 1.44 \times 10^{11}$  particles/ml in activated;  $p=0.028$ ). In comparison to quiescent ECs, EVs from activated ECs release EVs with microRNA and protein cargo that play important roles in atherosclerosis pathways. Furthermore, EC-EVs exert functional changes in circulating (CD14+ monocytes) and resident vascular cells (VSMCs). Specifically, EVs isolated from activated HAECs govern changes in pathways that are pro-inflammatory and involved in early atherogenesis. EC-EVs can drive changes in cells from different compartments given their ability to polarize EV secretion to apical and basolateral surfaces. HAECs polarize EV secretion to the apical membrane with mean EV concentrations in the apical and basolateral compartments being  $7.91 \times 10^9 \pm 1.35 \times 10^9$  and  $1.14 \times 10^9 \pm 4.18 \times 10^8$ , respectively ( $p<0.0001$ ). Cryogenic transmission electron microscopy and TIRF corroborate bi-directional EC-EV release.

**Conclusion:** ECs utilize EV-contents to mediate cell-cell communication in quiescent and activated states. Importantly, they can polarize vesicle release bidirectionally to affect functional changes in circulating and resident vascular cells.



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**Long-term outcomes of endovascular and open surgical revascularization for peripheral artery disease**

Jean Jacob-Brassard, Mohammed Al-Omran, Thérèse A Stukel, Muhammad Mamdani, Douglas S Lee, Charles de Mestral

**Objective:** To compare the long-term outcomes of endovascular and open revascularization for PAD.

**Methods:** We conducted a population-based retrospective cohort study including all Ontarians 40 years or older revascularized for PAD between April 1<sup>st</sup>, 2005 and March 31<sup>st</sup>, 2020, through an endovascular or open approach. The primary outcome was amputation-free survival (AFS: death or major [above-ankle] amputation). Secondary outcomes were major amputation, death, major adverse limb events (MALE: major amputation or reintervention) and major adverse cardiovascular events (MACE: death, myocardial infarct or stroke). Cox proportional hazards models were used to compare both approaches, with weighting by propensity score-based overlap weights to account for baseline characteristics.

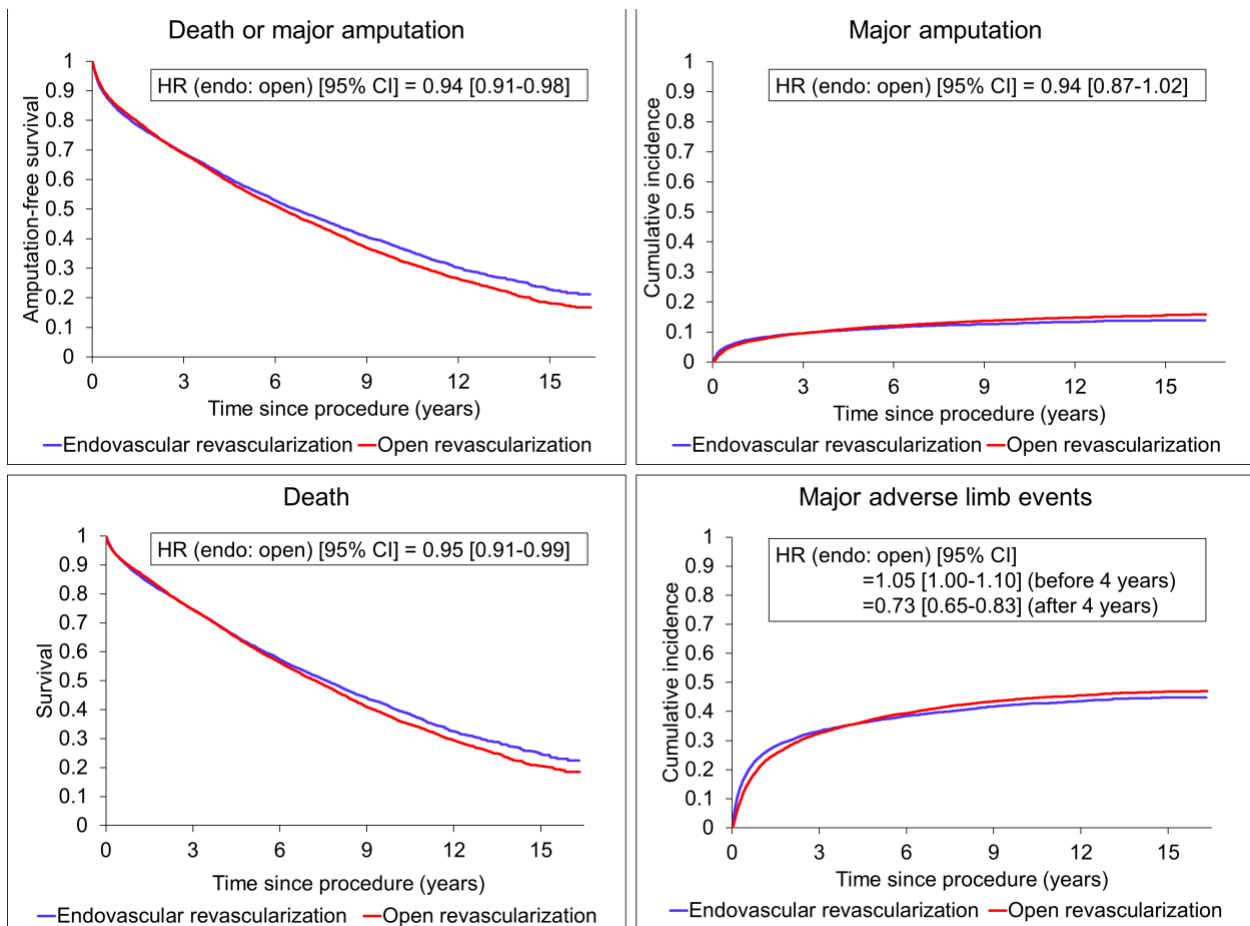
**Results:** We identified 28,862 patients revascularized for PAD, of which 39% (N=11,203) underwent endovascular revascularization. The median follow-up time was 4.42 years (IQR=2.18-7.70). In the full cohort weighted analyses, endovascular revascularization was associated with better AFS (HR [95% CI]= 0.94 [0.91-0.98]), no difference in major amputation (HR [95% CI]= 0.94 [0.87-1.02]), lower mortality (HR [95% CI]= 0.95 [0.92-0.99]), and lower hazard of MALE after 4 years (HR at 4-years [95% CI]= 1.05 [1.00-1.10], HR after 4-years [95% CI]= 0.73 [0.65-0.83]) (Fig 1). There were no differences in MACE (HR [95% CI]= 0.96 [0.93-1.00]).

**Conclusion:** Among real-world patients with PAD eligible for both revascularization strategies, open revascularization may not offer a long-term benefit over endovascular revascularization.



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Fig. 1. Propensity score overlap weighted outcomes of endovascular and open revascularization for peripheral artery disease.



Endo: endovascular; Major adverse limb events: major amputation or reintervention



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**Adjunctive hyperbaric oxygen therapy for spinal cord ischemia after complex aortic repair**

Angela Lee, Rita Katznelson, Maral Ouzounian, Darren Au, Jennifer Chung, Thomas F. Lindsay

**Objective:** To review our center's experience with hyperbaric oxygen therapy (HBOT) in addition to standard treatment in spinal cord ischemia (SCI) post-complex aortic repair (CAR).

**Methods:** A retrospective review of the Hyperbaric Medicine Unit database identified SCI patients post-CAR treated with HBOT between January 2013 and June 2021. Mean estimates of overall motor function scores were determined for pre-HBOT and final assessment using a linear mixed model. A subgroup analysis compared the mean estimates of overall motor function scores between improvement and non-improvement groups at given timepoints. Improvement of motor function was defined as either a  $\geq 2$ -point increase in overall muscle function score in patients with paraparesis or an upward change in motor deficit categorization (MDC: para/monoplegia, paraparesis and no deficit). To account for multiple testing, a two-sided p-value of  $\leq 0.01$  was used to assess statistical significance.

**Results:** Thirty patients were treated for SCI. Pre-HBOT, the MDC was 10 paraplegia, 3 monoplegia, 16 paraparesis and 1 unable to assess (Table II). At the final assessment, 14 patients demonstrated variable degrees of motor function improvement; eight patients demonstrated full motor function recovery. Seven of the ten patients with paraplegia remained paraplegic despite HBOT. The estimated mean of overall muscle function score for pre-HBOT was  $16.6 \pm 2.9$  (95%CI: 10.9, 22.3) and for final assessment was  $23.4 \pm 2.9$  (95%CI: 17.7, 29.1). The estimated mean difference between pre-HBOT and final assessment overall muscle function score was  $6.7 \pm 3.1$  (95%CI: 0.6, 16.1). The estimated mean difference of the overall muscle function score between pre-HBOT and final assessment for the improved group was  $16.6 \pm 3.5$  (95%CI: 7.5, 25.7) vs.  $-4.9 \pm 4.2$  (95%CI: -16.0, 6.2) for the non-improved group.

**Conclusion:** HBOT in addition to standard treatments did improve recovery in spinal cord function following SCI post-CAR. However, the benefits of HBOT are not equally distributed amongst subgroups. Future double-armed clinical studies are required to specifically define the benefit of HBOT.



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**Table 1: Hyperbaric oxygen therapy details and response**

	Overall (n=30 cases)
<b>Mean HBOT sessions per SCI case (SD)</b>	5.23 (2.62)
<b>Total HBOT sessions</b>	157
<b>HBOT complications (% of HBOT session)</b>	
Seizure	2 (1.27)
Middle ear barotrauma	2 (1.27)
Pneumothorax	1 (0.64)
<b>Pre-HBOT motor deficit categorization</b>	
Paraplegia	10
Monoplegia	3
Paraparesis	16
Unable to assess (a)	1
<b>Final assessment motor deficit categorization</b>	
Paraplegia	9
Monoplegia	1
Paraparesis	10
No motor deficit	8
Unable to assess (b)	2
<b>Response to HBOT - Motor function improvement</b>	
No response	11
Partial response	17
Full recover	8
Unable to assess	2

- a) Taken to HBOT immediately post-operatively for failure to recover motor evoked potentials intra-operatively
- b) Rupture aortic aneurysm following HBOT



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**Real-world machine learning classification of Doppler audio**

Brandon Van Asseldonk, Leslie Summers deLuca, Ahmed Kayssi

**Objective:** Continuous wave (CW) doppler is a relatively inexpensive and available tool used to assess lower extremity blood flow. The audible presence of arterial blood flow and the classification of the audible waveform into monophasic, biphasic and triphasic can aid in the diagnosis of acute and chronic arterial occlusive disease. Experience is necessary to correctly classify the audible waveforms and the authors sought to leverage their machine learning model to help.

**Methods:** Previously a visual waveform classification machine learning model using python (<https://www.python.org/>) with a 50 layer pretrained neural network (ResNet-50) was trained with an accuracy of about 90% using over 3000 waveform images. Audio recordings from CW dopplers were obtained. Python was used to interpret the audio records and conduct Fourier transforms to obtain frequency vs time plots. Figure 1 shows such a plot. These were inputted into the machine learning model for classification.

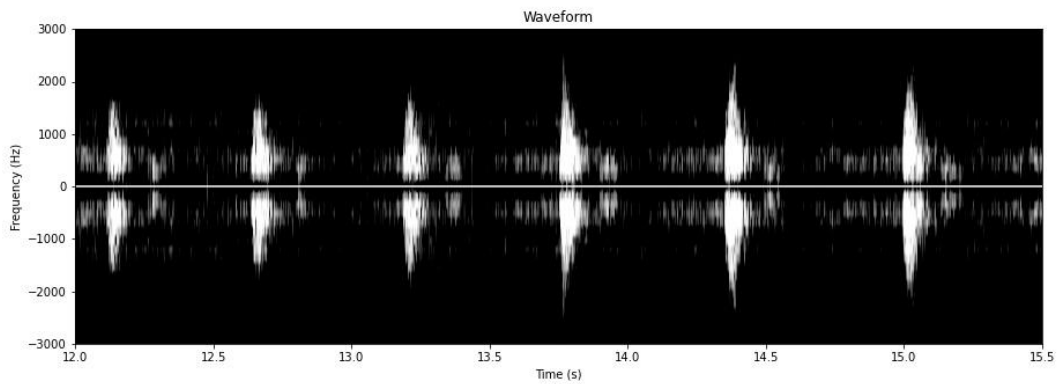
**Results:** Preliminary results with a small number of audio recordings show an ability to accurately classify the audio recordings turned waveform plots. By nature, the audio recordings do not contain directionality and therefore the plots are not able depict the direction of the blood flow, and instead show bidirectional flow. However, the plots do depict the velocity peaks which is helpful for interpretation. Figure 1 shows the resulting correct classification.

**Conclusion:** Our pilot work has confirmed the ability to correctly analyze CW doppler audio recordings, create frequency vs time plots, filter noise, and obtain correct classification with our previously trained neural network. Several challenges were encountered including acoustic noise associated with this process and the lack of directionality inherent with the audio recordings. We anticipate being able to package this process as a mobile application that could be used clinically by health care workers, possibly in the emergency department.





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```
1 learn.predict(path_r)

('Biphasic', TensorBase(0), TensorBase([0.7687, 0.0227, 0.2071, 0.0015]))
```

Figure 1: Interpreted Audio Recording with Associated Classification



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**Plasma Complement Protein C2 as a viable adjunct to prognostication of abdominal aortic aneurysm**

Tiam Feridooni, Mariya Popkov, Abdel Rahman Zamzam, Mohammad Qadura

**Objective:** The current management of abdominal aortic aneurysm (AAA) consists of serial surveillance of patients with known AAA using imaging modalities until a repair is indicated. To date, there are no adjunctive measures that can delineate high-risk patients from low-risk ones.

**Methods:** This prospective study recruited consecutive 150 subjects, patients with AAA (n=75) and patients that were not diagnosed with AAA (n=75). Plasma levels of complement proteins (Classical, Alternative and Lectin pathways) were measured at baseline. The primary outcome was the incidence of rapidly progressing AAA, defined as the change in AAA diameter by 0.5cm/6 months or 1 cm/12 months from baseline measurement. Secondary outcomes included the incidence of major adverse aortic events (MAAE) as well as major adverse cardiovascular events (MACE). Patients were followed for two years, with the frequency varying depending on the size of the AAA. Blood samples, AAA diameter, and incidence of MACE and MAAE were obtained during follow-up.

**Results:** Patients with AAA were found to have significantly higher plasma concentrations of C1q, C4, Factor B, Factor H and Factor D, and significantly lower plasma concentrations of C3, C2, and C4b ( $p = 0.001$ ). Among all complement factors, a decrease in plasma C2 (per  $\mu\text{g/mL}$ ) was associated with a significant increase in risk for rapid aortic expansion (HR 0.10,  $p = 0.040$ ), MAAE (HR 0.09,  $p = 0.001$ ) and MACE (HR 0.14,  $p = 0.011$ ). Using ROC analysis, we identified a C2 concentration of 0.202  $\mu\text{g/mL}$  (AUC of 0.709, with 91% sensitivity and 62% specificity) as the optimal cut-off point to stratify high-risk patients with AAA. Patients diagnosed with AAA (n=75) were divided into 2 groups, High C2 group (n=51) and Low C2 (n=24) and with C2 concentration above or below 0.202  $\mu\text{g/mL}$ , respectively. Relative to the High C2 group, higher rate of rapid aortic expansion (33% vs 4%,  $p=0.001$ ) and MAAE (67% vs 33%,  $p=0.007$ ) were noted in AAA patients in the Low C2 group.

**Conclusion:** Our study highlights the prognostic value of plasma complement factors, particularly C2, as an adjunctive measure for determining major adverse aortic events, including rapid expansion, eventual need for an aortic intervention or rupture of patients with AAA.



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**Survival after elective total arch replacement is comparable to hemiarch replacement**

Julia F. Chen, Maral Ouzounian, Mark D. Peterson, Francois Dagenais, Ali Hage, Michael W.A. Chu, Jennifer C.-Y. Chung

**Objective:** Hemiarch replacement has been associated with lower rates of death and major morbidity than total arch replacement. We compared the outcomes of hemiarch with total arch replacement in the contemporary era to determine if modern adjuncts to aortic arch reconstructive surgery have narrowed the difference in outcomes.

**Methods:** Between 2010 and 2021, a total of 978 patients underwent elective total arch (n=250, 25.6%) and hemiarch (n=728, 74.4%) replacement across 9 institutions. One-to-one propensity score-matched analysis using 27 baseline characteristics was performed resulting in 202 matched pairs. In-hospital outcomes were then compared, including death, stroke, sepsis, prolonged intubation, reoperation for bleeding, delirium, renal failure resulting in permanent dialysis, and spinal cord ischemia.

**Results:** Patients undergoing total arch replacement had longer cardiopulmonary bypass (median 201 (IQR 164-256) vs 160 (120-216) min,  $p<0.001$ ), cross-clamp (121(82.3-161.0) vs 94 (64-143) min,  $p=0.004$ ), and circulatory arrest times (33 (23-51) vs 16 (12-22) min,  $p<0.001$ ) than those undergoing hemiarch repair. The total arch group had lower nadir hypothermic circulatory arrest temperatures (24 (21-25) vs 26(24-28) degrees Celsius,  $p<0.001$ ), and antegrade cerebral perfusion was used nearly universally in both groups. Mortality in the unmatched cohort was 4.2% (31/728) in the hemiarch group and 5.2% (13/250) in the total arch group. Propensity matched analysis identified no significant differences in mortality (3.5% vs 3.0%,  $p=0.58$ ) or stroke (8.4% vs 4.0%,  $p=0.11$ ). However, higher rates of prolonged ventilation (>40 hours) (17.3% vs 7.9%,  $p=0.007$ ) and delirium (22.3% vs 19.4%,  $p=0.001$ ) were found after total arch repair. All other in-hospital outcomes were similar.

**Conclusion:** Elective total arch surgery is safe in the modern era with similar rates of death and stroke compared to hemiarch replacement. Total arch replacement still poses a higher risk of other complications.



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**Evaluating branch characteristics of off-the-shelf t-branch and custom-made stent grafts in endovascular repair of thoracoabdominal aortic aneurysms**

Apoorva Bhandari, Daniyal N. Mahmood, Rodolfo Rocha MD, Samantha M. Forbes, Kong Teng Tan, Maral Ouzounian, Jennifer C-Y Chung MD, Thomas F. Lindsay

**Objective:** To evaluate the branch characteristics of off-the-shelf T-branch and custom-made stent grafts used for thoracoabdominal endovascular aortic repair (TA-EVAR).

**Methods:** A retrospective single-centre review of consecutive patients who underwent TA-EVAR from November 2007 to July 2021. Three-dimensional computed tomography reconstructions (AquariusNET software, TeraRecon) of patients' first postoperative CT scan were used to measure branch total length (TL), vertical length (VL), tortuosity index (TI) and average curvature for the visceral arteries. Our outcomes of interest included branch instability measures (endoleaks, branch occlusions and reinterventions) and branch-related clinical outcomes (mesenteric ischemia and permanent dialysis).

**Results:** Eighty-nine custom-made (all males; mean age  $73.3 \pm 7.3$  years) and fifteen T-branch grafts (8 males, 7 females; mean age  $72.5 \pm 10.6$  years) were implanted. The majority of custom repairs were elective (82/89, 92%), whereas most T-branch repairs were urgent/emergent (10/15, 67%). Ten patients suffered in-hospital mortality (10/104, 10%). Ninety-four patients completed clinical follow-up and 85 (85/94, 90%) of those completed surveillance imaging. The post-implantation analysis included 181 down-going vessels from 60 patient CT scans (Table 1). There were 11 branch occlusions in 10 patients, mostly occurring in the renal arteries (7/11, 64%). None suffered mesenteric ischemia or required dialysis. The renal branch lengths were on average longer for T-branch versus custom grafts with the left renal being the most variable. TI and average curvature were similar across branches regardless of graft type, with the renal branches demonstrating the greatest TI compared to the celiac and SMA. Of the renal vessels that occluded, they were of similar length, TI, and curvature to those that remained patent.

**Conclusion:** Three-dimensional measurements of branch lengths and tortuosity did not predict branch occlusions, however the low numbers of branch-related adverse outcomes, stratified by vessel, makes drawing statistical conclusions difficult. Further research is required to evaluate the impact of branch characteristics and patency on TA-EVAR outcomes.



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**Table 1.** Post-implantation Branch Characteristics of Off-The-Shelf T-branch and Custom-made Stent Grafts for TA-EVAR

<b>T-Branch</b>				
	<b>Celiac (n=9)</b>	<b>SMA (n=10)</b>	<b>RR (n=9)</b>	<b>LR (n=11)</b>
<b>TL (mm)</b>	57.7 ± 17.6	60.8 ± 16.2	60.3 ± 23.5	73.4 ± 22.1
<b>VL (mm)</b>	18.1 ± 9.12	52.9 ± 16.6	54.8 ± 22.5	67.6 ± 22.6
<b>Tortuosity Index</b>	1.2 ± 0.2	1.1 ± 0.0	1.4 ± 0.4	1.4 ± 0.4
<b>Avg Curvature (cm<sup>-1</sup>)</b>	0.5 ± 0.2	0.4 ± 0.1	0.5 ± 0.1	0.4 ± 0.1
<b>Custom</b>				
	<b>Celiac (n=35)</b>	<b>SMA (n=46)</b>	<b>RR (n=33)</b>	<b>LR (n=28)</b>
<b>TL (mm)</b>	54.3 ± 15.7	57.4 ± 19.4	55.9 ± 18.7	53.1 ± 16.4
<b>VL (mm)</b>	18.6 ± 13.3	46.9 ± 20.6	48.2 ± 20.9	46.6 ± 15.9
<b>Tortuosity Index</b>	1.2 ± 0.2	1.1 ± 0.1	1.4 ± 0.2	1.3 ± 0.3
<b>Avg Curvature (cm<sup>-1</sup>)</b>	0.4 ± 0.1	0.4 ± 0.1	0.5 ± 0.1	0.6 ± 0.2
<b>Total Cohort</b>				
	<b>Celiac (n=44)</b>	<b>SMA (n=56)</b>	<b>RR (n=42)</b>	<b>LR (n=39)</b>
<b>TL (mm)</b>	55.2 ± 15.8	58.3 ± 18.7	56.6 ± 19.3	60.1 ± 19.6
<b>VL (mm)</b>	18.3 ± 12.4	48.0 ± 19.9	44.3 ± 30.6	50.6 ± 26.9
<b>Tortuosity Index</b>	1.2 ± 0.2	1.1 ± 0.1	1.4 ± 0.2	1.4 ± 0.4
<b>Avg Curvature (cm<sup>-1</sup>)</b>	0.4 ± 0.1 <sup>a</sup>	0.4 ± 0.1 <sup>b</sup>	0.5 ± 0.1 <sup>c</sup>	0.5 ± 0.2 <sup>d</sup>

Abbreviations: SMA = superior mesenteric artery; RR = right renal; LR = left renal; TL = total length; VL = vertical length  
A total of 60 patient CT scans were included: 50 custom, 10 T-branch.

<sup>a</sup>The celiac average curvature was unable to be calculated for two patients: n=42.

<sup>b</sup>The SMA average curvature was unable to be calculated for five patients: n=51.

<sup>c</sup>The RR average curvature was unable to be calculated for one patient: n=41.

<sup>d</sup>The LR average curvature was unable to be calculated for one patient: n=38.



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**Sex differences in outcomes following ruptured abdominal aortic aneurysm repair**

Ben Li, Naomi Eisenberg, Miranda Witheford, Thomas F. Lindsay, Thomas L. Forbes,  
Graham Roche-Nagle

**Objective:** To assess differences in perioperative and long-term mortality following ruptured abdominal aortic aneurysm (rAAA) repair in women vs. men.

**Methods:** A multicenter retrospective cohort study was conducted using the Vascular Quality Initiative (VQI) database. All patients who underwent ruptured endovascular or open AAA repair between 2003-2019 were included. Demographic, clinical, and procedural characteristics were recorded and differences between women vs. men were assessed using independent t-test and chi-square test. The primary outcomes were in-hospital and 8-year mortality. Associations between sex and outcomes were analyzed using univariable/multivariable logistic regression and Cox proportional hazards analysis.

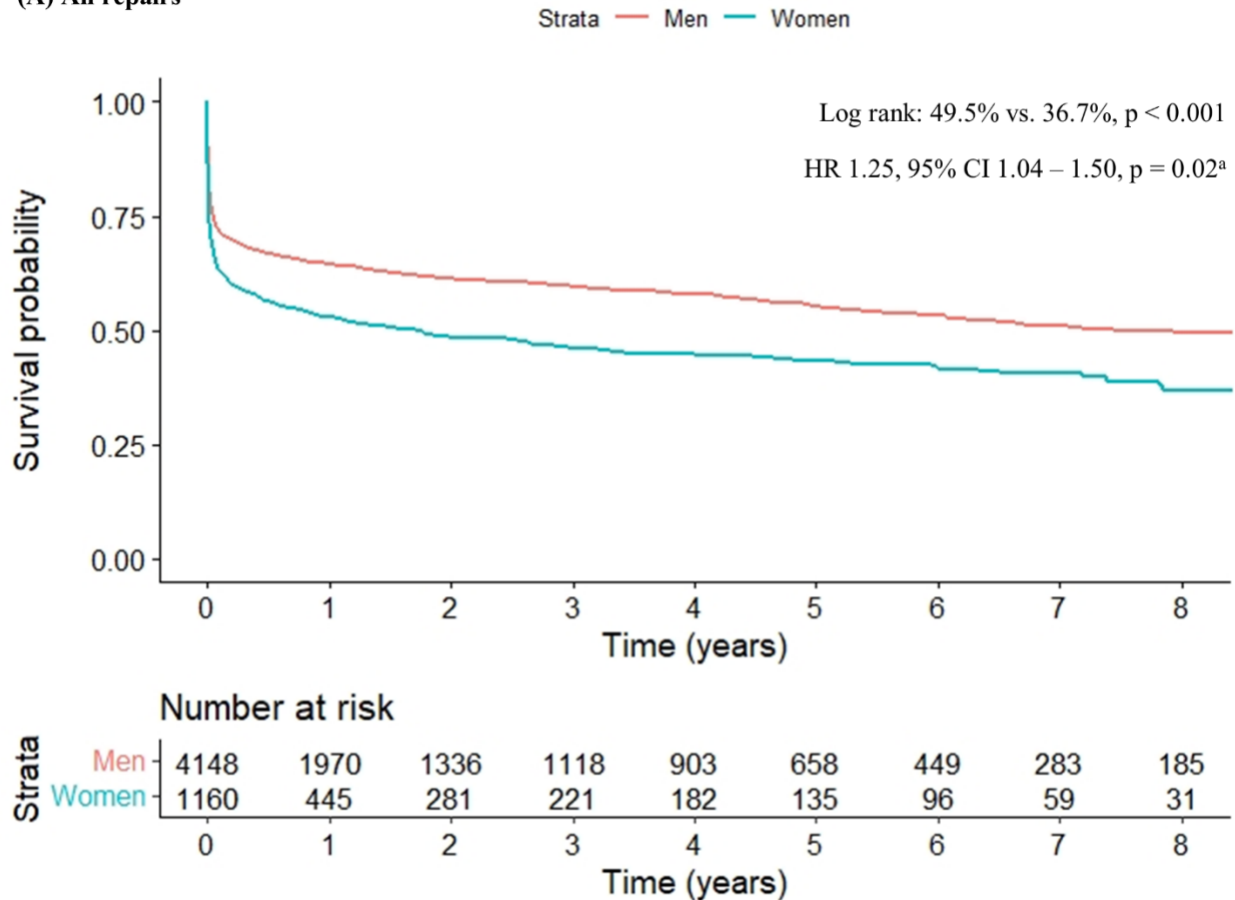
**Results:** 1,160 (21.9%) women and 4,148 (78.1%) men underwent rAAA repair during the study period. There was a similar proportion of endovascular repairs in women and men (56.4% vs. 57.5%). Women were older (75.8 vs. 71.7 years), more likely to have chronic kidney disease (61.9% vs. 52.7%) and presented with ruptured aneurysms at smaller diameters (mean 68 mm vs. 78 mm). In-hospital mortality was higher in women (34.4% vs. 26.6%, OR 1.44 [95% CI 1.25-1.66]), which persisted after adjusting for demographic, clinical, and procedural characteristics (adjusted OR 1.36 [95% CI 1.12-1.66],  $p = 0.002$ ). 8-year survival was lower in women (36.7% vs. 49.5%, HR 1.25 [95% CI 1.04-1.50],  $p = 0.02$ , Figure 1), which persisted when stratified by endovascular and open repair. Variables associated with long-term mortality included older age and chronic kidney disease.

**Conclusion:** Women that underwent ruptured AAA repair had higher perioperative and 8-year mortality following both endovascular and open repair compared to men. Older age and higher rates of chronic kidney disease in women were associated with higher mortality rates. Future studies should assess reasons for these disparities and opportunities exist to improve AAA care for women.



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(A) All repairs



**Figure 1. Long-term (8-year) survival following ruptured abdominal aortic aneurysm repair in women and men.**

<sup>a</sup>Controlled for demographics (age, body mass index, race, ethnicity, primary insurer, pre-operative living status), comorbidities (hypertension, diabetes, smoking status, family history of abdominal aortic aneurysm, coronary artery disease, prior coronary artery bypass graft, prior percutaneous coronary intervention, congestive heart failure, chronic obstructive pulmonary disease, chronic kidney disease, dialysis, prior abdominal aortic aneurysm repair, prior carotid endarterectomy/stent, prior peripheral artery bypass, prior peripheral artery angioplasty/stent, prior major amputation), medications (acetylsalicylic acid, P2Y12 antagonist, statin, beta blocker, angiotensin converting enzyme inhibitor, anticoagulant), clinical presentation (transfer from another hospital, lowest pre-intubation blood pressure, heart rate on arrival to operating room, highest intra-operative heart rate, mental status, cardiac arrest, pre-operative hemoglobin, aneurysm diameter, concomitant iliac artery aneurysm), and operative characteristics (time from symptom onset to incision or access, time from hospital admission to incision or access, procedure time, procedure year).

Abbreviations: HR (hazard ratio), CI (confidence interval).



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**Development of an artificial intelligence tool for intraoperative guidance during endovascular aneurysm**

Allen Li, Arshia P. Javidan, Babak Namazi, Amin Madani, Thomas L. Forbes

**Objective:** This study aims to train and test the performance of a deep learning artificial intelligence model that can identify inappropriate landing zones on fluoroscopy during endovascular aneurysm repair (EVAR).

**Methods:** A deep learning model was trained to identify a “No-Go” landing zone (zone 8, Society for Vascular Surgery reporting guidelines for type B dissections), as defined by coverage of the lowest renal artery during EVAR. Fluoroscopic images from elective EVAR procedures from a single institution and from open access sources formed the dataset. Annotations of the “No-Go” zone were performed by trained annotators. A 10-fold cross-validation technique, where the dataset was divided randomly into 10 partitions with nine being used for training and the tenth being used for testing, was used to evaluate the performance of the model against human annotations. Primary outcomes were intersection-over-union (IOU) and F1 score (validated spatial overlap indices) and secondary outcomes were pixel-wise accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV).

**Results:** The AI model was trained using 369 images procured from 110 different patients/videos. 18 patients/videos (44 images) were obtained from open access sources. For the primary outcomes, IOU and F1 were 0.43 (standard deviation  $\pm 0.29$ ) and 0.53 ( $\pm 0.32$ ) respectively. For the secondary outcomes, accuracy, sensitivity, specificity, NPV, and PPV were 0.97 ( $\pm 0.002$ ), 0.51 ( $\pm 0.34$ ), 0.99 ( $\pm 0.001$ ), 0.99 ( $\pm 0.002$ ), and 0.62 ( $\pm 0.34$ ) respectively. Figure 1 shows an example of the segmented No-Go zone.

**Conclusions:** AI can effectively identify sub-optimal areas of stent deployment during EVAR. This model has the potential to augment intraoperative decision-making and minimize the risk of adverse events associated with endovascular stent graft deployment.





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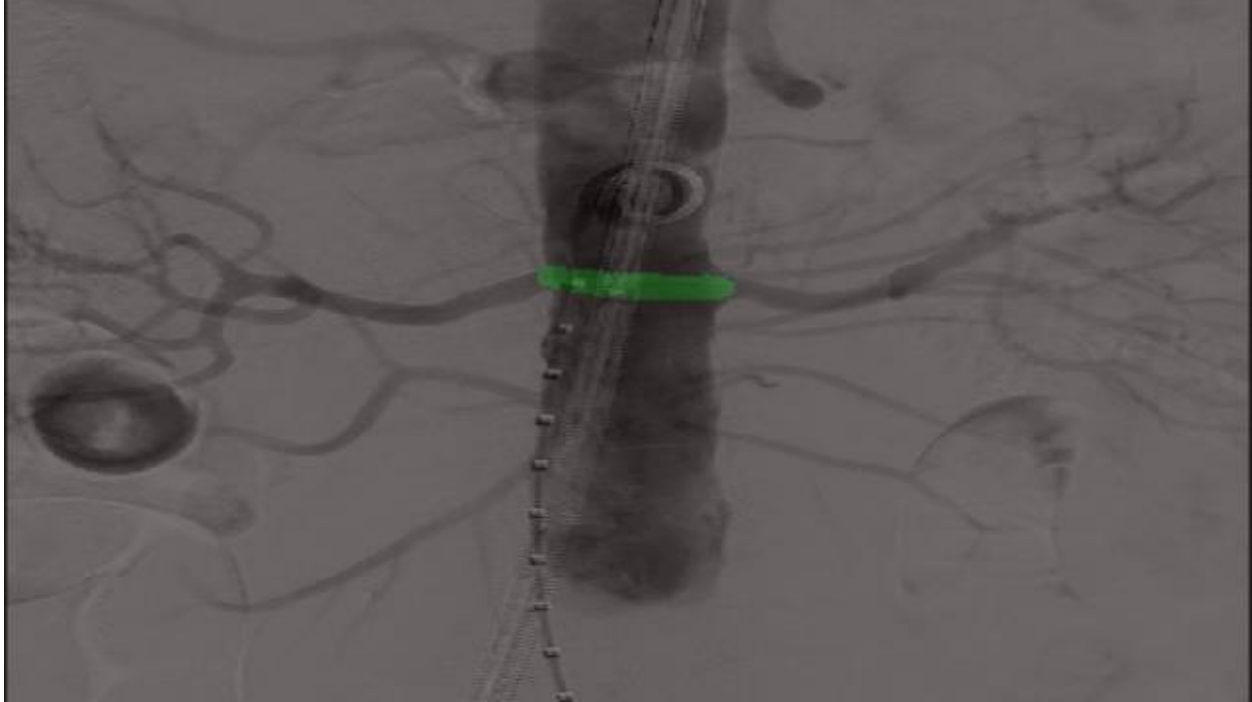


Figure 1. Prediction of the “No-go” zone (green) by the AI model.



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**Examining access to vascular care for Indigenous populations in North West Ontario**

Asha Behdinan, Mary MacDonald, Richard Foty, Ahmed Kayssi

**Objective:** Indigenous patients face a disproportionately higher rate of lower extremity amputation as a complication of diabetic foot wounds and peripheral disease compared with the general population. The primary objective of this study is to identify systemic barriers impeding access to vascular surgery care and propose areas for intervention to ultimately improve limb salvage for Indigenous patients requiring vascular intervention in North West Ontario. This will be achieved by delineating the patients' pathway to care, from their initial presentation to a health care provider to consultation with a vascular surgeon, through consulting with these workers at each step of care delivery.

**Methods:** Semi-structured interviews will be conducted with health care workers and will focus strictly on their scope of practice as it pertains to our topic of investigation. Process mapping will be conducted to engage key stakeholders to model the flow of the system, and subsequently identify areas for improvement.

**Results:** 12 individuals across six specialties who work within Northwestern Ontario were identified through snowball sampling and participated in semi-structured interviews. Key themes that were identified included the paucity of data on the topic, perceptions surrounding surgical colonialism, geographic and language barriers, knowledge gaps for providers and patients, social constraints, and interprofessional communication.

**Conclusion:** The barriers to accessing vascular surgery care faced by Indigenous patients with tissue loss are complex and multi-faceted. A systemic and coordinated approach is required to address the multitude of interacting factors along the patient care pathway to incite change.



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**The refinement of the Diabetic Wound Assessment Learning Tool [DiWALT] for competence in diabetic wound assessment and management**

Konrad Salata, Omar Selim, Andrew Dueck

**Objective:** Competence by Design [CBD] represents an empirical approach to assessment of competence and requires assessment tools with evidence-based validity. The Diabetic Wound Assessment Learning Tool (DiWALT) was previously developed for assessment of competency in diabetic foot ulcer (DFU) evaluation and management but was judged to be too long and redundant for effective implementation. The objective of this study was to refine the DiWALT to facilitate its use in a CBD framework.

**Methods:** The initial DiWALT development process demonstrated a Cronbach's alpha of 0.95, suggesting redundancy within the assessment tool. To address this issue and improve its usability, the tool was truncated using a two-stage process. Quantitative analysis first assessed the psychometric properties of each item within the tool. Item-total correlations, discriminative indices, and error variances were calculated to assess redundant items, which were then eliminated to create a truncated tool. The truncated tool was then used to analyze thirty participants in two separate simulated wound assessment cases. Each participant was simultaneously graded by four independent raters. The generalizability and Phi coefficient were then recalculated for assessments using the truncated DiWALT to confirm the psychometric properties of the refined tool.

**Results:** The DiWALT was refined from a 23 to a 16-item tool and was judged by the research team to have face validity. This new tool was evaluated on 55 simulated DFU cases across 30 subjects. The generalizability coefficient of the refined DiWALT was calculated to be 0.87. This value was identical to that for the parent tool, indicating maintenance of ability to make rank order decisions between subjects. The Phi coefficient for the refined tool was 0.75, compared to 0.86 for the parent tool. Truncation decreased the ability of the tool to make criterion referenced assessments.

**Conclusion:** The DiWALT refinement process yielded a significantly shortened assessment tool while retaining very good reliability coefficients. The easier to use tool maintained its ability to rank subjects, while maintaining good ability to judge subjects against a criterion standard. External validation studies are required before formal widespread implementation of the DiWALT.



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**Evaluation of the efficacy of an online learning module to increase wound care theoretical knowledge amongst medical students**

Cesar Cuen-Ojeda, Gar-Way Ma, Arshia Javidan, Leslie Summers DeLuca, Julien Bernatchez, Ahmed Kayssi

**Objective:** The purpose of this study is to create an online curriculum, tailored for the needs of medical students at the University of Toronto, to teach key concepts of wound care, test its efficacy in improving theoretical knowledge and in helping to put into practice evidence-based approaches to treatment.

**Methods:** This is an ongoing quasi-experimental trial with a pre and post-test design. Participants are being recruited via an email from the surgery clerkship leads at the University of Toronto. Completion of the module is not mandatory to successfully complete the surgery clerkship. Students who want to participate are completing a pre-test exam, and then access the wound care module. After finishing the module, they have 2 weeks to complete the post-intervention test. Paired t-tests were used to evaluate for statistical significance in pre- and post-test results, with an alpha value of 0.05 considered to be statistically significant.

**Results:** Currently we are recruiting participants from UofT. So far, 12 participants have completed the module as well as some component of the pre- or post-test. All twelve participants completed some part of the pre-test, and seven participants (58%) completed the pre- and post-test in full. The mean (standard deviation) pre-test and post-test scores were 61.8% (10.8%) and 76.8% (6.2%,  $P = 0.037$ ). Improvements in pre- and post-test scores ranged from 0 to 38% (mean 15%, SD 13%).

**Conclusions:** A brief but comprehensive wound care module may potentially improve short-term knowledge retention of key concepts relating to wound care. Next steps include the recruitment of additional participants required to further power this study.



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**Investigating the role of gender, ethnicity, and visible minority in cardiovascular residency training – an interim analysis**

Shaidah Deghan Manshadi, Sneha Raju, Jean Jacob-Brassard, Thomas L. Forbes, Elisa Greco

**Objective:** Publications have highlighted the prevalence of gender and race-based discrimination in surgical residency programs. There are no studies looking at these important demographics in cardiovascular specialties, from a Canadian lens. The primary objective of our study was to better understand the impact of gender and visible minority (VM) status for training experience in cardiovascular (CV) residents.

**Methods:** This is a prospective survey-based study, which aims to utilize a previously validated survey to better characterize the role of gender and VM diversity in CV medicine and surgical resident education. All program directors from residency programs across the country were contacted to distribute the surveys (English and French).

**Results:** This is an interim report on 41 respondents to the survey. Majority of respondents are from surgical programs(51.3%), Canadian medical graduates(85.4%), non-immigrant(63.4%), and from a Caucasian background(48.8%). Respondents agreed that fostering diversity in a CV program with diverse genders, ethnicities, and broad age groups was important. Of note, diversity with respect to sexual orientation was limited. Overall majority of the residents felt that they were well supported, had a collegial relationship within the program, and that they fit within their program irrespective of gender, ethnicity, or sexual orientation.

Comparing to male residents, females reported lack of gender diversity in clinical staff. Females were more concerned for having a family and practice as a specialist, reported being called “doctor” less often, and that patients were more surprised that they are a cardiovascular specialist compared to male residents. Additionally, they felt that their gender played a role in dismissal of their medical advice, opened them to harassment from patients, and receipt of more unsolicited personal life advice. Age, sexual orientation, or accent were not a factor.

**Conclusion:** This interim report highlights that in cardiovascular training programs across Canada, age, sexual orientation, and ethnicity are not adverse implications in training programs but gender appears to play a role. Further analysis on whether there are differences between surgical versus non-surgical residents in cardiovascular medicine remains to be studied.



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**Table 1 – Baseline Characteristics**

<b>Demographics</b>	<b>N=41</b>
<b>Program</b>	
Cardiology	41.5(17)
Cardiac Surgery	22.0(9)
Vascular Surgery	29.3(12)
<b>University</b>	
Dal	4.9(2)
Laval	7.3(3)
Ottawa	2.4(1)
UofT	26.6(15)
McMaster	7.3(3)
Western	7.3(3)
UofM	7.3(3)
UofA	12.2(5)
UofC	2.4(1)
prefer not to answer	2.4(1)
Unknown	9.8(4)
<b>Academic Year</b>	
PGY1	14.6(6)
PGY2	12.2(5)
PGY3	4.9(2)
PGY4	26.8(11)
PGY5	19.5(8)
PGY6	12.2(5)
PGY7+	0
SSTP resident	9.8(4)
Prefer not to answer	
<b>Entry Point</b>	
CMG	85.4(35)
IMG	7.3(3)



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Visa Trainee	7.3(3)
<b>Age Group:</b>	
25-29	31.7(13)
30-34	56.1(23)
35-39	9.8(4)
40+	2.4(1)
<b>Gender</b>	
Female	46.3(19)
Male	51.2(21)
Prefer not to say	2.4(1)
<b>Immigrant Identification</b>	
Yes	34.1(14)
No	61.0(25)
Prefer Not to say	2.4(1)
<b>LGBTQ Identification</b>	
Yes	12.2(5)
No	85.4(35)
Prefer Not to say	2.4(1)
<b>Relationship status</b>	
Single	19.5(8)
Common-law	22.0(9)
Married	36.6(15)
In a relationship	19.5(8)
prefer not to say	2.4(1)
<b>Children</b>	
Yes	26.8(11)
No	73.2(30)
<b>Ethnicity:</b>	
Caucasian (European, North American, Oceanic)	48.8(20)
Caribbean	0



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Latin, Central or South American	4.9(2)
African	4.9(2)
East Asian (Chinese, Japanese, Korean, Filipino)	7.3(3)
South Asian (East Indian, Pakistani, Sri Lankan)	0
South East Asian (Vietnamese, Cambodian, Malaysian, Laotian, etc.)	9.8(4)
West Asia (Iranians, Levant, Arabian Peninsula, Mesopotamia)	14.6(6)
Prefer not to answer	2.4(1)
Other (please specify)	3 (7.1)
<b>Minority status</b>	
Yes	46.3(19)
No	53.7(22)
Prefer not to say	0
<b>First Language</b>	
English	63.4(26)
French	7.3(3)
Other	29.3(12)
<b>Immigrant</b>	
Yes	34.1(14)
No	63.4(26)
Prefer not to say	2.4(1)





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**Evaluating YouTube as a source of patient education for patients undergoing surgery**

Arshia Javidan, Allen Li, Yung Lee, Matthew Nelms, Ahmed Kayssi, Faysal Naji

**Objective:** Online video sharing platforms such as YouTube have become a substantial source of health information that patients are likely to access before surgery. The objective of this systematic review is to characterize the peer-reviewed literature investigating YouTube as a source of patient education for patients undergoing surgery.

**Methods:** A comprehensive literature search was conducted using EMBASE, MEDLINE, and Ovid from inception to December of 2021. Study screening and data extraction occurred in duplicate. All primary studies evaluating YouTube as a source of patient education relating to surgical procedures for the selected specialties (general, cardiac, urology, otolaryngology, and plastic) were included. Descriptive statistics were used to describe data in aggregate.

**Results:** Among 6,453 citations identified, 56 studies were identified that examined 6,524 videos with 399 hours of content and 1.1 billion views. Among 49 studies that evaluated the educational quality of the videos, 43 quality assessment tools were used, with each study using a mean of 1.88 assessment tools. Per the global rating for assessments, 34/49 studies (69%) concluded that the overall quality of educational content was poor (Table).

**Conclusions:** While the impact of non-peer-reviewed YouTube videos on patient knowledge and preparedness for surgery is unclear, the large amount of online content suggests that they are in demand. The overall educational content of these videos is poor, however, and there is substantial heterogeneity in the quality assessment tools used in their evaluation. A peer-reviewed and standardized approach to online education with video content is needed to better support patients.



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Surgical specialty	Total videos, n	Total content (hours), n	Total views (millions), n	Studies rated as poor quality/studies that performed quality assessment of videos (%)
Urology	1677 (26%)	72 (18%)	28.9 (2.6)	12/16 (75%)
General	1243 (19%)	121 (30%)	115.7 (10.4)	5/9 (55%)
ENT	1125 (17%)	68 (17%)	9.6 (0.9)	7/9 (78%)
PRS	1312 (20%)	89 (22%)	950.0 (85.8)	7/9 (78%)
Vascular	787 (12%)	9 (2%)	2.2 (0.2)	2/4 (50%)
Cardiac	380 (6%)	41 (10%)	0.6 (0.1)	1/2 (50%)
TOTAL	6524	399	1106	34/49 (69%)

**Table.** Analysis of included studies according to studied specialty, total videos included in study, total hours of video content, views, and global quality assessments in studies where it was assessed. ENT: otolaryngology; PRS: plastic and reconstructive surgery