BSET

British Society of
Endovascular Therapy

Annual Meeting 2017

Thursday 29th – Friday 30th June
Tortworth Court Hotel, South Gloucestershire

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Endovascular Therapy

Annual Meeting 2017

Thursday 29th – Friday 30th June
Tortworth Court Hotel, South Gloucestershire

Programme

Abstract Sessions

Programme: Thursday 29th June

09.30-09.35 **Welcome**
Mike Jenkins, BSET President

09.35-10.10 **Rouleaux Club Symposium**

Chair: Mike Jenkins & Phil Stather

Endovascular training in 2017
Celia Riga

Advanced training in endovascular procedures
Martin Claridge

Rouleaux Club Presentation
Phil Stather

10.10-10.50 **Abstract Session 1**
6 papers 6 (4+2) minutes

Chairs: Paul Hayes & Colin Bicknell

10.10-10.16 **Trajectory and sequence analysis of elective AAA repair: 5 year follow up**
A Rao[1] C Bicknell[2] A Bottle[1] A Darzi[2] P Aylin[2]
[1]*Dr Foster Unit, Imperial College London*
[2]*Department of Surgery and Cancer, Imperial College London*

10.16-10.22 **Premorbid function, comorbidity, and frailty predict outcomes after elective abdominal aortic aneurysm repair**
D Bowen MM Chowdhury JR Boyle K Varty PA Coughlin
Department of Vascular Surgery, Addenbrooke's Hospital, Cambridge

10.22-10.28 **A questionnaire based survey to ascertain UK clinicians' preferences for the management of a complex abdominal aortic aneurysm**
E Atkins[1] R Narlawar[2] F Torella[3] G Antoniou[1]
[1]*Department of Vascular Surgery, The Royal Oldham Hospital, Pennine Acute Hospitals NHS Trust, Manchester*
[2]*Department of Radiology, The Royal Oldham Hospital, Pennine Acute Hospitals NHS Trust, Manchester*
[3]*Liverpool Vascular and Endovascular Service, Royal Liverpool University Hospital,* Liverpool

10.28-10.34 **Post-implantation syndrome following endovascular aneurysm sealing for abdominal aortic aneurysm**
K Stenson J De Bruin P Holt I Loftus
St George's Vascular Institute, London

10.34-10.40 **Repair of ruptured AAA: 5-year follow-up of high-impact users**
A Rao[1] C Bicknell[2] A Bottle[1] A Darzi[2] P Aylin[1]
[1]*Dr Foster Unit, Imperial College London*
[2]*Department of Surgery and Cancer, Imperial College London*

10.40-10.46 **Abdominal Aortic Artery Calcification (AAAC) scores are associated with poor overall and cardiovascular outcomes in patients with Abdominal Aortic Aneurysms (AAA)**
MM Chowdhury LP Zielinksi JJ Sun SC Harrison JR Boyle PA Coughlin
Department of Vascular Surgery, Addenbrooke's Hospital, Cambridge

10.50-11.10 **Guest Lecture**

Chairs: Paul Hayes & Colin Bicknell

Deep venous stenting: Determinants of success – Patient selection, placement, post operative care and profit
Peter Neglén

11.10-11.40 **Coffee**

11.40-11.55 **Guest Lecture**

Chairs: Mike Jenkins & Peter Neglén

Endovenous treatments for venous ulceration – current concepts and the EVRA trial
Manj Gohel

11.55-12.15 **Society Sponsor: Medtronic**

Chairs: Mike Jenkins & Hence Verhagen

Simple Solutions for Complex Patients
Vincent Riambau

12.15-12.45 **The Aortic Arch**

Chairs: Bijan Modarai & Donald Adam

Surgical approaches to treating dissection around the aortic arch
Ulrich Rosendahl

The current state of aortic arch branch stenting
Mo Hamady

12.45-13.00 **The Paper That Changed My Practice**

Chairs: Bijan Modarai & Donald Adam

Hence Verhagen
Rob Williams

13.00-14.00 **Lunch**

14.00-14.20 **Guest Lecture**

Chairs: Rachel Bell & Rao Vallabhaneni

Acute aortic syndrome: Current concepts
Firas Mussa

14.20-15.00 **Abstract Session 2**

Chairs: Rachel Bell & Rao Vallabhaneni

6 papers 6 (4 + 2) minutes

14.20-14.26 **Anatomical Applicability of Endovascular Aneurysm Sealing Techniques in a Continuous Cohort of Fenestrated Endovascular Aneurysm Repairs**
I Roy[1 2] M Gharib[2] S Zerwes[3] R Jakob[3] F Torella[1 4]
R McWilliams[5] R Fisher[1 4]
[1]Liverpool Vascular & Endovascular Service
[2]Institute of Ageing & Chronic Disease, University of Liverpool
[3]Department of Vascular Surgery, Hospital of Augsburg, Germany
[4]School of Physical Sciences, University of Liverpool
[5]Department of Interventional Radiology, Royal Liverpool Hospital

14.26-14.32 **Midterm Results Following Repair of Short Neck and Juxtarenal Aortic Aneurysms with the Fenestrated Anaconda Endograft**
K Forbes AS Patel M Chaudery J Brownrigg M Cleanthis
A Hatrick DJ Gerrard
Frimley Health NHS Foundation Trust

14.32-14.38 **Endograft infection after endovascular aneurysm repair: A systematic review and meta-analysis**
I Asghar C Argyriou GS Georgiadis MK Lazarides
E Georgakarakos GA Antoniou
Department of Vascular and Endovascular Surgery, The Royal Oldham Hospital, Pennine Acute Hospitals NHS Trust, Manchester

14.38-14.44 **Survival after infrarenal EVAR. Experience of 387 EVAR patients with and without adverse post-operative surveillance findings**
T Hardy S Hossaini A Dhillon J Olivier T Ward
K Balasubramania K Augustine R Keogan J Coulston P Eyers
K Darvall I Hunter A Stewart
Musgrove Park Hospital

14.44-14.50 **Proof on Concept: Semi-automated Alignment of EVAR Surveillance Radiographs – Increasing the Sensitivity to Device Migration and Distortion**
I Roy[1 2] Y Zheng[2] G Czanner[2 3] R Williams[2]
S R Vallabhaneni[1 2]
[1]Liverpool Vascular & Endovascular Service
[2]Institute of Ageing & Chronic Disease, University of Liverpool
[3]Department of Biostatistics, University of Liverpool

14.50-14.56 **Minimally Invasive Fistula Salvage: The Success of Endovascular Interventions**
C Dawkins[1] K Overbeck[1] M Karasek[2]
[1]Department of Vascular Surgery, Sunderland Royal Hospital
[2]Department of Radiology, Sunderland Royal Hospital

15.00-15.20 **Society Sponsor: Gore**

Chairs: Chris Twine & Patrick Coughlin

Advancing Care in the Treatment of Thoracic Aortic Disease: Are new devices the answer to overcoming current limitations?
Rick Gibbs, Imperial College, London

15.20-15.40 **Quick Fire Debate**

Chairs: Chris Twine & Patrick Coughlin

Infrarenal aortic aneurysms should be repaired at 5cm to save more lives
Rao Vallabhaneni *vs* Matt Thompson

15.40-16.10 **Tea**

16.10-16.20 **BSET Sponsored Papers**

Chairs: Paul Hayes & Ray Ashleigh

The Effect of Internal Iliac Artery Exclusion for Patients Undergoing EVAR
Dave Bosanquet

Setting a standard for post market registries
Graeme Ambler

16.20-16.40 **Quick Fire Debate**

Chairs: Paul Hayes and Ray Ashleigh

Endovascular treatment of the CFA is not safe or durable, surgical treatment is the gold standard
For: Bijan Modarai
Against: Rob Williams

16.40-17.00 **Society Sponsor: Cook**

Chairs: Paul Hayes and Ray Ashleigh

Zenith Alpha – The Next Generation
Mark Tyrrell, Guy's & St Thomas' Hospital

Cook Medical-educational programmes supporting clinician development
Declan Dunne, Cook Medical

17.00-18.00 **Aortic Prize Abstract Session**
6 papers 9 (6 + 3) minutes

Chairs: Mike Jenkins & Firas Mussa & Hence Verhagen

17.00-17.09 **Cardiovascular risk in patients screened for AAA**
DA Sidloff A Saratzis RD Sayers MJ Bown
University of Leicester, Department of Cardiovascular Sciences, Leicester

17.10-17.19 **No evidence of a 'weekend effect' in the management of acute abdominal aortic aneurysm in the UK**
GK Ambler[1 2] NBG Mariam[3] U Sadat[3] PA Coughlin[3]
IM Loftus[4] JR Boyle[3]
[1]*South East Wales Vascular Network, Aneurin Bevan University Health Board, Royal Gwent Hospital, Newport*
[2]*Division of Population Medicine, Cardiff University, Cardiff*
[3]*Cambridge Vascular Unit, Cambridge University Hospitals NHS Foundation Trust, Cambridge*
[4]*St George's Vascular Institute, London*

17.20-17.29 **Have we become risk averse in treating abdominal aortic aneurysms after introduction of surgeon specific mortality data reporting?**
A Saratzis[1] D Sidloff[1] MJ Bown[1] CH Imray[2] RD Sayers[1]
[1]*Department of Cardiovascular Sciences and Leicester NIHR Cardiovascular Biomedical Research Unit, Leicester University, Leicester*
[2]*University Hospital Coventry and Warwickshire, Coventry*

17.30-17.39 **Comparative Analysis of the Outcomes of Elective Abdominal Aortic Aneurysm Repair in England and Sweden: Context for Contemporary Practice**
MJ Grima[1] A Karthikesalingam[1] PJ Holt[1] A Vidal-Diez[1]
MM Thompson[1] A Wanhainen[2] M Bjorck[2] K Mani[2]
[1]*St George's Vascular Institute*
[2]*Department of Surgical Sciences, Section of Vascular Surgery, Uppsala University, Uppsala, Sweden*

17.40-17.49 **Variation in ruptured AAA mortality in the UK**
DA Sidloff O Jones A Saratzis RD Sayers MJ Bown
University of Leicester, Department of Cardiovascular Sciences

17.50-17.59 **Personalised EVAR Surveillance Intervals Based on Stratification of Individual Patient Risk of Secondary Intervention from Readily Measurable Parameters**
I Roy[1 2] G Czanner[2 3] S R Vallabhaneni[1 2]
[1]*Liverpool Vascular & Endovascular Service*
[2]*Institute of Ageing & Chronic Disease, University of Liverpool*
[3]*Department of Biostatistics, University of Liverpool*

18.00-18.15 **The Presidents' Debate**
Introduced by Colin Bicknell

The standards in vascular surgery are slipping quickly – we must radically change the training of vascular surgeons
For: Mike Jenkins
Against: Rob Sayers

19.00 **Drinks Reception**

19.45 **Dinner**

Programme: Friday 30th June

08.30-09.10 **Abstract Session 3**
6 papers 6 (4 + 2) minutes

Chairs:
Rick Gibbs
& Colin Bicknell

08.30-08.36 **UK Trainee Exposure to Aortic and Venous endovascular practice**
T R A Lane[1 2 3] J Pancholi[1 4] P Stather[1 5] Rouleaux Club[6]
[1]*Vascular and Endovascular Research Network*
[2]*Imperial College London*
[3]*Imperial College Healthcare NHS Trust*
[4]*University of Leicester*
[5]*Addenbrooke's Hospital, Cambridge University Hospitals NHS Foundation Trust*
[6]*Rouleaux Club*

08.36-08.42 **Trainee Experience of Simulation Training in Vascular Surgery**
H.C. Travers[1] R.A. Benson[2] P.W. Stather[3] S Renton[4]
[1]*Sandwell General Hospital, Birmingham*
[2]*University Hospital Coventry and Warwickshire, Coventry*
[3]*Addenbrooke's Hospital, Cambridge*
[4]*West London Vascular and Interventional Centre, Northwick Park, Harrow*

08.42-08.48 **Systematic review and meta-analysis of endovascular treatment for acute mesenteric ischaemia**
M El Farargy[1] A Abdelhadi[1] M Abou Eisha[1] K Bashaeb[2] GA Antoniou[1]
[1]*Department of Vascular Surgery, Pennine Acute Hospitals NHS Trust*
[2]*Department of Radiology, Pennine Acute Hospitals NHS Trust*

08.48-08.54 **Systematic review and meta-analysis of Carotid endarterectomy versus Carotid artery stenting versus Best medical therapy for asymptomatic carotid artery disease**
M Barkat[1] I Roy[1 2] S A. Antoniou[3] F Torella[1 4] G A. Antoniou[5]
[1]*Liverpool Vascular and Endovascular Service, Royal Liverpool University Hospital, Liverpool*
[2]*Institute of Ageing and Chronic Disease, University of Liverpool, Liverpool*
[3]*Department of Surgery, University Hospital of Heraklion, University of Crete, Heraklion, Greece*
[4]*School of Physical Sciences, University of Liverpool, Liverpool*
[5]*Department of Vascular and Endovascular Surgery, The Royal Oldham Hospital, Pennine Acute Hospitals NHS Trust, Manchester*

08.54-09.00 **Factors predicting outcome following catheter-directed thrombolysis in lower limb arterial occlusion**
H Abbas P Maghsoudlou S Kotecha L Mihaila L Biasi T Donati M Sallam H Zayed SD Patel
Guy's and St Thomas' Hospitals NHS Foundation Trust

09.00-09.06 **Comparison of outcomes following infra-popliteal plain balloon angioplasty in the Bypass versus Angioplasty in Severe Ischaemia of the Leg (BASIL) trial (1999-2004) and in a contemporary UK series (2009-2013)**
MA Popplewell[1] HO Davies[1] M Renton[1] G Bate[1] S Patel[2] J Deeks[2] AW Bradbury[1]
[1]*University of Birmingham, Department of Vascular Surgery*
[2]*Department of Statistics Birmingham Clinical Trials Unit*

09.10-09.25 **BSET Fellowship Reports**

Chairs:
Rick Gibbs
& Colin Bicknell

BSET Fellowship Update
Rick Gibbs

BSET Fellowship 2016-17
Rachel Barnes

09.25-09.35 **Gold Sponsor: Bolton Medical**

Chairs:
Rick Gibbs
& Colin Bicknell

Establishing a thoracic aortic service and issues treating the aortic arch
Nick Matharu, Walsgrave Hospital

09.35-09.55 **Guest Lecture**

Chairs:
Donald Adam
& Vincent Riambau

How can we rationalise aortic stent surveillance?
Hence Verhagen

09.55-10.05 **Gold Sponsor: Endologix**

Chairs:
Donald Adam
& Vincent Riambau

Nellix: Where are we now?
Matt Thompson, Chief Medical Officer, Endologix

10.05-10.20 **The Paper That Changed my Practice**

Chairs:
Donald Adam
& Vincent Riambau

Peter Neglén
Firas Mussa

10.20-10.50 **Coffee**

10.50-11.20 **Vascular Society Session**

Chairs:
Rob Sayers
& Jon Boyle

ASPIRE update
Ian Chetter

Making the case for run through training in vascular surgery
Mark McCarthy

Curriculum and Training Programme update
Andy Garnham

11.20-11.30 **Gold Sponsor: Lombard Medical**

Chairs:
Rob Sayers
& Jon Boyle

One-year experience with the ALTURA stent graft
Jon Ghosh, University Hospital South Manchester

11.30-11.50 **Managing Services In The NHS**

Chairs:
Rob Sayers
& Jon Boyle

The current climate – GIRFT
Mike Horrocks

Commissioning: The Clinician's perspective
Rachel Bell

Commissioning: The Industry perspective
Matt Thompson

11.50-12.00 **Gold Sponsor: Vascutek**

Chairs:
Rachel Bell
& Hany Zayed

The longer term results of the Fenestrated Anaconda Stent Graft
Dr Rob Williams, Freeman Hospital, Newcastle

12.00-13.00 **Peripheral Prize Abstract Session**
6 papers 9 (6 + 3) minutes

Chairs:
Rachel Bell
& Hany Zayed

12.00-12.09 **Medium-term results of venous stenting for acute ilio-femoral vein thrombosis**
J Silickas[1] P Saha[1] A Smith[1] A Gwozdz[1] B Hunt[2] B Cohen[2] K Breen[2] V McDonald[2] N Karunanithy[3] S Black[1]
[1]*Academic Department of Vascular Surgery, King' College London, London*
[2]*Clinical Haematology Department, Guy's and St Thomas' NHS Foundation Trust, London*
[3]*Interventional Radiology Department, St Thomas' Hospital, London*

12.10-12.19 **Stenting across the inguinal ligament in post thrombotic syndrome using nitinol venous stents: one-year patency outcomes**
P Saha[1] AM Gwozdz[1] T El-Sayed[1] N Karunanithy[2] K Breen[3] BJ Hunt[3] AT Cohen[3] V McDonald[3] A Smith[1] S Black[1]
[1]*Academic Department of Vascular Surgery, Cardiovascular Division, King's College London*
[2]*Department of Interventional Radiology, St. Thomas' Hospital, London*
[3]*Department of Haematology, St. Thomas' Hospital, London*

12.20-12.29 **Quantifying potential radiation exposure in real life endovascular cases – implications for practice**
E Atkins[1] A Mayes[2] R McBride[1]
[1]D*epartment of Vascular Surgery, The Royal Oldham Hospital, Pennine Acute Hospitals NHS Trust, Manchester*
[2]*Department of Radiology, The Royal Oldham Hospital, Pennine Acute Hospitals NHS Trust, Manchester*

12.30-12.39 **Supervised Exercise Therapy versus Percutaneous Angioplasty versus Combined Angioplasty and Exercise for Intermittent Claudication: Systematic Review and Bayesian Network Meta-Analysis of Randomized Controlled Trials**
H Elwan R Brar SD Patel L Biasi T Donati T Lea K Katsanos H Zayed
Guy's and St Thomas' NHS Foundation Trust

12.40-12.49 **An Anatomical and Morphological Assessment of Common Femoral Disease and Potential Suitability for Endovascular Intervention**
JJ Sun MM Chowdhury PA Coughlin
Division of Vascular & Endovascular Surgery, Addenbrooke's Hospital, Cambridge University Hospital Trust, Cambridge

12.50-12.59 **Perioperative blood glucose levels influence outcome after infrainguinal bypass and endovascular therapy**
J Silickas SD Patel L Biasi T Donati T Lea H Zayed
Guy's and St Thomas' NHS Foundation Trust

13.00-13.30 **Chee Soong Memorial Lecture**
Introduced by Mike Jenkins and Rachel Bell

Getting it right first time, every time, for the rest of time
Professor Mike Horrocks

13.30-13.35 **Presentation of Prizes and Close**

13.35-14.30 **Lunch**

Abstract Sessions

Trajectory and sequence analysis of elective AAA repair: 5 year follow up

A Rao[1] C Bicknell[2] A Bottle[1] A Darzi[2] P Aylin[2]
[1]*Dr Foster Unit, Imperial College London*
[2]*Department of Surgery and Cancer, Imperial College London*

Previous models have performed poorly to predict post-surgical patients with high readmission rate, which is vital to appropriate set-up of health services. The aim of the study was to identify trends in the long-term readmission rate and common distinct sequences of causes of readmissions among the high-impact users, those with high readmission rate, following an elective abdominal aortic aneurysm (AAA) repair.

The patient cohort (2006-2009) was identified through national administrative data from all NHS English hospitals. Trajectory and sequence analysis was performed on the administrative data.

Both elective EVAR (endovascular repair) (n=6172) and open repair (n=10,801) were shown to have 5 subgroups with similar trends in readmission rate: chronic high-impact, short-term high-impact, impending high-impact, intermediate-impact and low-impact. Chronic high-impact users were associated with highest number of readmissions for vascular and other elective procedures ($p < 0.001$).

Determinant of chronic high-impact users was socio-economic deprivation in EVAR (OR 1.28 [1.16-1.42], p 0.013) and open repair (OR 1.32 [1.22-1.43], p <0.001). Impending high-impact users, with annual rise in readmission rate, were associated with non-Caucasian ethnicity in EVAR (OR 1.57 [1.30-1.90], p 0.019) and open repair (OR 1.42, [1.21-1.67], p 0.028). Common causes of non-elective readmissions in high-impact users with multiple readmissions were cardio-pulmonary conditions.

The predictors, trends and sequence of causes of readmission rate were different in high-impact users compared to other groups. The long-term trends of readmission rate among various subgroups of patients were similar in EVAR and open repair patients despite obvious differences in treatment pathways. Common distinct sequences of readmission among high-impact users mainly consisted of cardio-pulmonary causes suggesting possible beneficial use of cardiac rehabilitation after aneurysm repair in this group.

Premorbid function, comorbidity, and frailty predict outcomes after elective abdominal aortic aneurysm repair

D Bowen MM Chowdhury JR Boyle K Varty PA Coughlin
Department of Vascular Surgery, Addenbrooke's Hospital, Cambridge

Early outcomes following elective abdominal aortic aneurysm (AAA) have significantly improved. The ageing population, however, continues to make the decision to intervene often difficult, especially given that traditional risk models do not reflect issues of ageing and frailty. This study aimed to integrate measures of function alongside comorbidity- and frailty-specific factors to determine outcome.

Consecutive patients over the age of 65 years undergoing elective AAA repair were assessed (time period 27/10/14 – 31/07/16). Demographics, mode of surgery and a variety of measures of function (physical, social, and psychological) and comorbidity were recorded. The primary outcome was mortality with secondary outcomes of prolonged LOS (defined as >/= 7 days) and unplanned readmission. Statistical analysis was performed using multivariate logistic regression.

We analysed 198 patients (169 men, median age 77 years, mean AAA diameter 6cm). The median follow up period was 15 (9.8-21) months and median LOS 2 days. The overall mortality rate was 3.5%. Thirty patients had a prolonged LOS and 32 patients an unplanned readmission.

Independent predictors of mortality was the Katz score (p=0.006). Independent predictors of a prolonged LOS was open repair (as opposed to EVAR – p=0.047).

Independent predictors of unplanned readmission were gender (p=0.033), anaemia (Hb < 11 – p=0.002) and a previous history of falls (p=0.014).

A number of frailty related factors predict poorer patient specific outcomes following elective AAA repair. These may highlight appropriate patients who would benefit from targeted comprehensive assessment and frailty specific interventions.

A questionnaire based survey to ascertain UK clinicians' preferences for the management of a complex abdominal aortic aneurysm

E Atkins[1] R Narlawar[2] F Torella[3] G Antoniou[1]
[1]*Department of Vascular Surgery, The Royal Oldham Hospital, Pennine Acute Hospitals NHS Trust, Manchester*
[2]*Department of Radiology, The Royal Oldham Hospital, Pennine Acute Hospitals NHS Trust, Manchester*
[3]*Liverpool Vascular and Endovascular Service, Royal Liverpool University Hospital, Liverpool*

Our objective was to quantify potential variability across the UK in the management of a complex abdominal aortic aneurysm (AAA).

An online survey was emailed to all members of the Vascular Society for Great Britain and Ireland. The survey presented a complex AAA vignette of a 63-year-old woman with significant respiratory co-morbidity whose computed tomographic (CT) angiogram demonstrated a 54 mm AAA with a short (7 mm) proximal neck but no other adverse morphological features for a standard or complex endovascular aneurysm repair (EVAR). The survey included images and questions related to AAA management as well as surgeon location, experience, and access to operating facilities. 111 valid responses were received, 91% from consultants.

47% of participants indicated a first line preference for continuing surveillance, 29% for fenestrated EVAR and 7% each for no operative intervention and open surgical repair. The remainder indicated various preferences including standard EVAR (3%), standard EVAR with endoanchors (3%), chimney EVAR (2%), EVAS (endovascular aneurysm sealing) (1%) and chimney EVAS (1%). Of the 47% who wanted to continue surveillance, once their threshold was reached, 73% would manage with a fenestrated EVAR, 17% with open repair and the remainder with EVAS (2%), chimney EVAS (2%) or standard EVAR with endoanchors (2%). 49% of participants carried out endovascular procedures in hybrid theatres, 36% in radiology angiosuites and 15% in standard operating theatres.

The study results support anecdotal variation in practice among vascular specialists. This variation reflects the lack of solid evidence on the optimal management of complex AAA.

Post-implantation syndrome following endovascular aneurysm sealing for abdominal aortic aneurysm

K Stenson J De Bruin P Holt I Loftus
St George's Vascular Institute, London

Post-implantation syndrome (PIS) is a common complication following endovascular aneurysm repair (EVAR). It is defined according to the criteria for systemic inflammatory response syndrome. This study aims to assess the incidence of PIS following EVAR and endovascular aneurysm sealing (EVAS).

A retrospective analysis of 229 patients who underwent endovascular treatment for intact, infrarenal abdominal aortic aneurysm. 123 patients underwent EVAS and 109 underwent EVAR. Pre-, intra- and postprocedural data were collected.

The 229 patients had a mean age of 75.3 years and 89.1% were male. There were no significant differences in age or gender between the EVAR and EVAS groups. The patients in the EVAS group had a greater comorbid burden, however the only significant difference was a greater number of patients with coronary artery disease in the EVAS group. PIS was observed in 10 patients following EVAR and in 2 patients following EVAS (P=0.014). PIS was also significantly more common in male patients (P=0.03). No significant differences were seen in the incidence of PIS in terms of age, aneurysm diameter, procedure time or comorbidity. Hospital and intensive therapy unit (ITU) stays were longer in patients who developed PIS (P<0.0001).

This study shows that PIS is significantly less common after EVAS than after EVAR. The diagnosis of PIS was also associated with significantly longer ITU and hospital stays.

Repair of ruptured AAA: 5-year follow-up of high-impact users

A Rao[1] C Bicknell[2] A Bottle[1] A Darzi[2] P Aylin[1]
[1]*Dr Foster Unit, Imperial College London*
[2]*Department of Surgery and Cancer, Imperial College London*

Little is known about the risk factors for high-impact use of health service and causes of emergency readmissions amongst high-impact users after ruptured abdominal aortic repair (rAAA). The aim of the study was to subdivide patient groups, examine trends in number and causes of emergency readmissions following rAAA and to assess their chronological order to identify strategies to reduce long-term readmission rate.

The patient cohort (2006-2009) was identified through national administrative data from all NHS English hospitals and followed up for5 years.

Open repair (n=3877) were shown to have 5 subgroups: low-impact (71.7%), intermediate-impact (13.9%), short-term high-impact (8.9%), impending high-impact (4.2%) and chronic high-impact (1.3%). Determinant of chronic high-impact users was heart failure (OR 3.74 [2.12-6.62], p 0.023) and the commonest sequences of readmissions were: chest infection-COPD (n=9 [18.3%]), COPD-chest infection-COPD (n=4 [8.1%]), COPD-chest infection-chest infection-COPD (n=4 [8.1%]) and chest infection-COPD-COPD-chest infection (n=4 [8.1%]).

Two subgroups, low- (78.1%) and high-impact (21.9%), were derived from best fit model for EVAR (endovascular repair) (n=267). Determinants of chronic high-impact users were diabetes (OR 19.11 [5.87-62.18], p=0.012) and prolonged length of stay (OR 2.44 [1.82-3.25], p=0.002) and common sequences of readmissions were: COPD-chest infection (n=3 [5.8%], rAAA-iatrogenic injury (n=3 [5.8%]), chest pain-iatrogenic injury (n=2 [3.9%]), COPD-COPD-chest infection (n=2 [3.9%]) and COPD-constipation (n=2 [3.9%]).

Predictors of high-impact users were identified to help clinicians to stratify long-term management needs. A focus on prevention of iatrogenic injuries and reduction of recurrent admissions for cardiopulmonary conditions is required to prevent patients becoming high-impact.

Abdominal Aortic Artery Calcification (AAAC) scores are associated with poor overall and cardiovascular outcomes in patients with Abdominal Aortic Aneurysms (AAA)

MM Chowdhury LP Zielinksi JJ Sun SC Harrison JR Boyle PA Coughlin
Department of Vascular Surgery, Addenbrooke's Hospital, Cambridge

Focus is increasingly moving towards prediction of longer tem cardiovascular related outcomes in patients with aneurysmal disease. Arterial calcification is a recognised predictor of poor cardiovascular (CV) outcome yet limited aneurysm-specific data is available. Assessment of the predictive role of calcification in abdominal aortic aneurysm (AAA) patients is therefore clinically relevant, specifically with regard to CV outcome.

AAAC scores from the CT scans of a consecutive series of AAA patients were calculated using a modified Agatston score (Jan 2011 – Dec 2012). The primary outcome was all-cause mortality. Secondary outcomes were cardiovascular mortality and morbidity.

196 patients (median age 78 [72-84], 160 [81.6%] male) were analysed with a median follow up of 22 (3-48) months. The primary outcome was reached in 38 (19.4%) patients. AAAC score was associated with all-cause mortality (OR 1.023; 95% CI 1.002-2.120; p=0.038) and with cardiac mortality (OR 2.121; 95% CI 1.675-2.879; p=0.003) and morbidity (OR 1.897; 95% CI 1.023-2.342; p=0.042). The area under the curve of the receiver operator curve for the AAAC score was 0.815 (95% CI [0.755-0.875]; p<0.001) for the primary outcome. An AAC score of > 21000 had the best diagnostic accuracy to determine the outcome measure, with sensitivity and specificity of 84% and 74.6%, respectively.

Higher AAAC scores are associated with poor overall and cardiovascular specific outcomes. AAAC may aid in identifying high-risk patients who would benefit from intensive treatment aimed at reducing CV risk.

Anatomical Applicability of Endovascular Aneurysm Sealing Techniques in a Continuous Cohort of Fenestrated Endovascular Aneurysm Repairs

I Roy[1 2] M Gharib[2] S Zerwes[3] R Jakob[3] F Torella[1 4] R McWilliams[5] R Fisher[1 4]
[1]*Liverpool Vascular & Endovascular Service*
[2]*Institute of Ageing & Chronic Disease, University of Liverpool*
[3]*Department of Vascular Surgery, Hospital of Augsburg, Germany*
[4]*School of Physical Sciences, University of Liverpool*
[5]*Department of Interventional Radiology, Royal Liverpool Hospital*

Endovascular Aneurysm Sealing (EVAS) with off-label use of chimneys (ChEVAS) offer a novel alternative to FEVAR in treating complex AAA. Both ChEVAS & FEVAR are complex endovascular interventions and have limitations associated with anatomical suitability. We undertook a comparison of how planned ChEVAS & FEVAR interventions varied in the same patient cohort.

An analysis of consecutive patients who underwent FEVAR in our institution, between 2013-15, was undertaken. Pre-operative CT angiograms were anonymised and sent to two experienced ChEVAS planners who were blinded to the purpose of the study. They agreed upon a suitable EVAS/ChEVAS plan. The primary outcome was the percentage of the FEVAR patients who were anatomically suitable for EVAS/ChEVAS. The secondary outcomes were a comparison of: seal zones, number of target vessels and device cost.

60 patients, 54 male with median age 76.3 years (IQR 71.7-79.7) and aneurysm diameter 62.0mm (IQR 59.3-69.0) were included. An EVAS based intervention was possible in 56 (93%).The median seal zone was significantly more distal in EVAS/ChEVAS vs FEVAR (Median Zone 8 vs Zone 7, Z=-6.650, p<0.001). Less target Vessels were involved by EVAS/ChEVAS vs FEVAR (Median 2 vs 3, Z=5.908, p<0.001). The cost of the EVAS/ChEVAS device was 66% of the FEVAR device.

EVAS/ChEVAS is anatomically applicable to the majority (93%) of patients undergoing FEVAR in our institution. The seal zone was more distal and fewer target vessels were involved in the planned EVAS/ChEVAS intervention than the actual FEVAR repair. Planned device cost was lower for EVAS/ChEVAS.

Seal zone or target vessel number should not be used as surrogates of aortic anatomy when comparing outcomes of EVAS & FEVAR techniques

Midterm Results Following Repair of Short Neck and Juxtarenal Aortic Aneurysms with the Fenestrated Anaconda Endograft

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The fenestrated Anaconda endograft (Vascutek) has showed promising results for the treatment of short-neck or juxtarenal aneurysms. The aim of this study was to present the midterm results from a regional vascular centre and compare outcomes following two and three-fenestrated repairs.

Data from patients treated with the fenestrated Anaconda endograft between 2011 and 2016 were analysed.

62 patients (median age 78yrs [range 63-89], 82.3% male) underwent repair with a total of 167 fenestrations incorporated into one-fenestrated (n=4 [6.1%]), two (n=19 [30%]), three (n=31 [50%]) and four (n=8 [12.9%]) fenestrated devices. Median follow-up was 35 months with 1, 2 and 5 year survival rates of 91%, 82% and 62% respectively. Primary patency of the renal, SMA, coeliac and iliac arteries were 97.5%, 97.5%, 87.5% and 98.4% respectively and re-intervention rates were 3.3%, 2.5%, 0% and 4.8% respectively.

The 30 day mortality for two and three-fenestrated repair was 1/19 and 3/31 respectively (P=NS). 39% of patients undergoing two-fenestrated repair had a decline in renal function compared with 36% of three-fenestrated cases (P=NS); of these, the decline was 28% and 23% respectively (P=NS).

High target vessel patency and low re-intervention rates contribute to encouraging overall midterm results using the Anaconda device. The incidence and rate of decline in renal function in patients undergoing two or three-fenestrated repairs is similar. These data support the continued use of two-fenestrated repairs using this device as a durable option in a proportion of patients with potentially favourable 30 day mortality.

Endograft infection after endovascular aneurysm repair: A systematic review and meta-analysis

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Endovascular repair (EVAR) is currently the predominant treatment for abdominal aortic aneurysms. Stent graft infection is a rare but potentially lethal complication after EVAR. Our objective was to undertake a systematic literature review and analyze the evidence on the management and outcomes of endograft infection after EVAR.

Electronic database (PubMed/MEDLINE, CENTRAL) and bibliographic reference lists were searched using free text and controlled vocabulary searches to identify studies reporting cases of endograft infection. The methodological quality of the selected studies was assessed using the Newcastle-Ottawa scale. Our review conformed to the PRISMA standards.

Sixteen articles reporting a total of 329 patients were identified fulfilling the inclusion criteria. The incidence of graft infection after EVAR was 0.6%. The time from implantation to diagnosis ranged from 1 to 128 months (mean 26 months) . 96% of the patients underwent surgical explantation of the infected endograft; 13 patients (4%) received supportive treatment only. Aortic replacement with a prosthetic graft was performed in 40% of patients, whereas cryopreserved allografts and autologous grafts were used in 23% and 11% of patients, respectively. 40% of the patients had emergency surgery; the rest underwent an urgent or elective procedure. Perioperative mortality was 24.7%. 30-day/in-hospital mortality for patients treated conservatively was 63.3%. Mortality for patients treated with surgical explantation was 44.6%, and for patients receiving conservative treatment was 58.6% .

Complete surgical explantation of the infected endograft seems to be the optimal management in selected patients. Supportive medical treatment without surgical intervention has a significant associated mortality.

Survival after infrarenal EVAR. Experience of 387 EVAR patients with and without adverse post-operative surveillance findings

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Recent long-term outcomes from early EVAR trials have reported a significant rise in delayed mortality possibly due to delayed graft complications. The aim of this study was to determine the long term survival of patients undergoing infrarenal EVAR in a single centre and the significance of adverse surveillance findings and re-interventions on patient survival.

All patients undergoing infrarenal EVAR from 2008-2016 were identified. EVAR related adverse post-operative surveillance findings (endoleaks, graft occlusion, stenosis, cranial migration and infection), re-interventions and treatment strategies were reviewed. Mortality data and patient survival were compared using Kaplan Meier analysis.

387 patients undergoing EVAR were reviewed. Median age at procedure was 76yrs (IQR = 69.8-81.2). 9.5% of patients had a significant adverse finding requiring re-intervention (37/387), 27/52 interventions were undertaken for endoleaks with the remainder for graft occlusion (13), graft stenosis (9), graft infection (1), cranial migration (1) and fistula (1).

Survival of patients with any adverse surveillance finding was not significantly different to patients without adverse findings (p=0.118) with a trend to improved survival in patients with adverse findings. A similar trend was noted in patients undergoing re-intervention with once again no significant survival advantage in either group (p=0.126).

This data represents a large series from a single centre. Endoleaks and other adverse surveillance findings were common, with approximately 10% of patients undergoing reintervention. Adverse surveillance findings and re-intervention has not however detrimentally affected survival to date. Ongoing long-term surveillance remains necessary.

Proof on Concept: Semi-automated Alignment of EVAR Surveillance Radiographs – Increasing the Sensitivity to Device Migration and Distortion

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Biplanar radiography used in EVAR surveillance varies in rotation and projection even when conducted to standardised protocols. This is further exacerbated by the limitation inherent to side by side visual comparison of sequential films. These limitations compromise the sensitivity of the technique and necessitate large movements/changes in stent-grafts to confidently diagnose migration and other complications.

We developed a protocol using commercially available medical software (i2K Retina, DualAlign) to create automated alignment of serial radiographs which compensate for variations in magnification and angulation. Aligned images are displayed serially in the same frame for ease of visual comparison. Optimum settings were developed to allow: 1) The largest proportion of sequential radiographs to be automatically registered and aligned, and 2) To achieve the smallest variation in alignment of reference landmark, as defined by pixel coordinates of the four corners of L1 vertebral body.

This was tested on 119 sets of AP and LAT radiographs of 18 patients. 110 (92%) AP and 83 (70%) LAT radiographs could be registered and aligned. Changes in in bone morphology, most commonly due to a wedge fracture of the lumbar spine, were noted in 39 out of the 45 unaligned radiographs. Aligned radiographs showed low variance of L1 alignment with the SD of positional alignment being only 41 pixels for AP radiographs and 63 pixels for LAT radiographs.

Automatic registration and alignment of plain radiographic images in EVAR surveillance is possible. This could improve the sensitivity and utility of plain radiography in detecting stent-graft migration and distortion.

Minimally Invasive Fistula Salvage: The Success of Endovascular Interventions

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Currently arteriovenous fistulas carry a primary failure rate of up to 40%. Research has suggested that early intervention in failing fistulas improves patency and successful use of fistulas. In this paper we have assessed the outcome of early salvage using endovascular techniques in a single centre.

A retrospective study of digital records in a single centre was performed from 1st January 2014 until 31st January 2017. Data recorded included date of procedure, site, complications, salvage procedure and its success as measured by successful dialysis via fistula within 6 months without further intervention.

108 procedures in 78 patients were identified. The fistula site included 49 (45%) brachiocephalic, 49 (45%) radiocephalic, 9 (8%) brachiobasilic and 1 leg graft. The complications observed included 62 cases of insufficient flow or inadequate clearance (57%), 12 needling difficulties (11%), 11 poor maturation (10%), 9 thrombosis/occlusion (8%), 8 aneurysm formation (7%), 4 arm swelling (3.7%), 1 steal (0.9%) and 1 bleeding (0.9%). The median time to first intervention was 14 months.

Overall success rate for fistula salvage was 72%. 83% of patients undergoing central vein plasty (10/12 patients), 74% peripheral vein plasty (44/59), 71% juxta-anastamotic plasty (20/28), 100% arterial plasty and 0% thrombolysis (0/5).

Endovascular fistula salvage can give good results with 72% of otherwise insufficient or unusable fistulas successfully salvaged. Angioplasty of identified stenotic lesions showed good results, particularly in arterial stenosis. Thrombolysis in this small series was unsuccessful in all cases. Patients with occlusive complications may be better served with surgical intervention.

Cardiovascular risk in patients screened for AAA

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Ultrasound screening for AAA is cost effective and reduces AAA related mortality. Excess cardiovascular morbidity and mortality is well recognised in patients with AAA, however, AAA screening has no formal role yet in cardiovascular risk reduction which may be a missed opportunity.

Consent was gained to link data from the 2013/14 NHS AAA screening cohort with the UK Hospital Episode Statistics/Office for National Statistics datasets. Patients who did not attend screening were excluded. Aortic diameter, screening date, date of death and cause of death (ICD-10) were extracted from the linked datasets. Cardiovascular death included those ICD codes pre-specified by the Global Burden of Disease studies. Relative risks were calculated to compare groups and log-rank survival analysis was performed.

240,954 patients were included; mean aortic diameter was 18mm (SD 3mm). 3,235 patients (1.34%) had a sub-aneurysmal aorta (25-29mm) and 2,981 (1.24%) had an AAA (>30mm). Cardiovascular mortality was 0.30% (95% CI 0.28-0.32%) for individuals with an abdominal aortic diameter ≤2.5cm; 0.81% (0.51-1.11) for those between 2.5 and 2.9cm; and 1.30% (0.90-1.71) for those ≥3.0 cm. Death from a cardiovascular event was more likely for individuals with an AAA than for those with a normal aorta (risk ratio 4.33, 95% CI 3.15-5.97). Cardiovascular survival decreased with progressive aortic diameter (Figure 1, Long Rank P=0.0001).

The natural history of an enlarging aorta is progressive cardiovascular risk. Aortic screening is currently an opportunity missed to address this risk in those with and without AAA.

No evidence of a 'weekend effect' in the management of acute abdominal aortic aneurysm in the UK

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The 'weekend effect' is a phenomenon whereby patient outcomes appear worse at the weekend compared to during the week. Recent evidence has suggested that the effect may be due to a combination of inadequate correction for confounding factors and inaccurate coding. We investigated the effects of these factors in patients with acute abdominal aortic aneurysm (AAA).

All patients entered into the non-elective AAA repair section of the UK National Vascular Registry from January 2013 until December 2015 were eligible. Patients were divided into those treated during the week (8am Monday-5pm Friday) and those treated at the weekend (5pm Friday-8am Monday). Coding issues were investigated by looking separately at patients treated for ruptured, symptomatic or asymptomatic AAA. The primary outcome was in-hospital mortality. Secondary outcomes included length of stay and cardiac, respiratory and renal complications.

5439 patients were treated for acute AAA over the study period. Mortality appeared higher for patients treated at the weekend (odds ratio (OR) 1.65, 95% confidence interval (CI) (1.44-1.89), P<0.001), but this effect disappeared when confounding factors and coding issues were corrected for (corrected OR for ruptured AAA 1.09, 95% CI (0.92-1.29), P=0.33). Differences in outcomes were similar for prolonged length of stay (uncorrected OR 1.42, 95% CI (1.26-1.60), P<0.001; corrected OR for ruptured AAA 1.06, 95% CI (0.91-1.10), P=0.48) and morbidity outcomes.

After appropriate correction for confounding factors and coding effects, there is no evidence of a significant 'weekend effect' in the treatment of non-elective AAA in the UK.

Have we become risk averse in treating abdominal aortic aneurysms after introduction of surgeon specific mortality data reporting?

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Reporting surgeons' outcomes may lead to risk aversion. We aimed to investigate whether reporting surgeon specific mortality data (SSMD) for Abdominal Aortic Aneurysm (AAA) repairs impacted on the number and risk-profile of those offered elective treatment.

Hospital Episode Statistics (HES) databases were used to assess the number of patients undergoing open or endovascular AAA-repair yearly from 2008/09 until 2014/15. National Vascular Registry (NVR) reports were used to compare number of AAA-repairs in the units that reported outcomes in 2013 (years 2008-2012), 2014 (2009-13), and 2015 (2010-14). Risk profiles of patients referred for elective AAA repair in one unit were analysed yearly between 2010 and 2015 based on cardiopulmonary-exercise test (CPET) results (available for all patients).

Admissions for elective AAA-repair in England increased yearly based on HES databases: 4,955 in 2008/09 to 5,601 in 2014/15. The median number of AAAs treated per unit yearly based on NVR reports increased from 192 (2008-2012 reporting-period) to 214 (2010-2014 reporting period) for the 85 centres that reported in all the 5-year periods (p=0.006). In the single-centre study, the % of patients offered elective AAA-repair increased yearly from 74% in 2009/10 to 81% in 2013/14. The age, AAA-size, and CPET anaerobic threshold levels of those offered AAA-repair did not differ significantly between 2010 and 2015.

There hasn't been a decrease in the number of AAAs treated based on HES and NVR databases after introducing SSMD-reporting; the risk profiles of patients in the single centre study did not differ before and after SSMD-reporting.

Comparative Analysis of the Outcomes of Elective Abdominal Aortic Aneurysm Repair in England and Sweden: Context for Contemporary Practice

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There is substantial international variation in mortality from abdominal aortic aneurysm (AAA) repair and many non-operative factors influence risk-adjusted outcomes. A contemporary international study provides perspective for evaluating current practice. This study compared 90-day and five-year mortality for patients undergoing elective AAA repair in England and Sweden.

Patients undergoing elective AAA repair were identified from English Hospital Episode Statistics and Swedish Vascular registry (Swedvasc) between 2003 and 2012. 90-day mortality and five-year survival were compared after age/gender adjustment. Separate within-country analyses were performed to examine the impact of co-morbidity, hospital teaching status and hospital annual caseload.

The study included 36,412 patients with AAA in England, of whom 87.24% were male with median (interquartile range, IQR) age 74 (69-79) years. There were 7806 AAA patients in Sweden, of whom 82.87% were male, with median (IQR) age 73 (68-78) years. 90-day mortality (5.35% vs 3.89%, p<0.001) and five-year survival (70.3% vs 72.8%, p<0.001) were poorer in England but equivalent after 2007. Utilisation of EVAR was initially lower in England, but surpassed that in Sweden after 2010. In both countries, poorer outcome was associated with a lower proportion of EVAR, increased age, operation at institutions with lower operative annual volume and/or without teaching status. EVAR was significantly better than open repair in younger patients in both countries in terms of 90-day mortality but significantly worse in young patients in terms of five-year survival.

Mortality for elective AAA repair was poorer in England than Sweden, but improved over time alongside greater uptake of EVAR. Mortality is now equivalent in both countries. High-caseload centres performing a greater proportion of cases with EVAR achieve better results in both countries.

Variation in ruptured AAA mortality in the UK

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Geographical and social inequality influence the prevalence of cardiovascular disease and have well known associations with smoking and ethnicity. The aim of this study was to analyse variation in ruptured AAA (rAAA) incidence in England and its relationship with healthcare, social and geographical factors.

Number of deaths from rAAA in England and population data were obtained from the Office of National Statistics (ONS) for each local authority (LA) area for the years 2013-14. Mortality was then calculated per 100,000 population to allow direct comparison. Data on ethnicity, smoking prevalence and index of multiple deprivation (IMD) were obtained from Public Health England. Year of introduction of AAA screening and distance from each LA to its vascular hub were then calculated and multivariate regression performed.

There is a 17-fold difference in rAAA mortality between the highest and lowest ranked LA in England (mean 5.7 deaths per 100,000 population). The longest distance between a LA and its vascular hub was 48 miles (mean 12.8 miles), with a mean smoking prevalence of 18.9%. Multivariate regression suggests that ethnicity, IMD and local smoking prevalence were significantly associated with rAAA mortality whilst distance from vascular hub and year of introduction of AAA screening were not (P=0.0001).

Variation in rAAA mortality in each local authority is associated with local rates of smoking, deprivation and differences in ethnicity. Local initiatives to identify patients at highest risk of rAAA may reduce this inequality in outcomes.

Personalised EVAR Surveillance Intervals Based on Stratification of Individual Patient Risk of Secondary Intervention from Readily Measurable Parameters

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Personalised EVAR surveillance based on individual patient risk of secondary intervention (SI) could improve service.

The aims of this project:
A) to develop a model that predicts an individual's risk of SI in the future based on the last surveillance imaging.
B) to develop personalised surveillance intervals without increasing the risk of a SI between surveillance visits compared to existing surveillance programme.

All 3,160 sets of reports of Duplex Ultrasound and Abdominal X-ray performed on 797 patients for EVAR surveillance in one institution (2008-15) were retrieved and 35 variables were noted from each. Data was split 70:30 for model creation and validation.

Weibull regression modelling was performed to the point of first SI, using the model creation dataset. Goodness of fit of the model was confirmed. Individual patient's cumulative risk of secondary intervention over time was calculated.

Mean risk of SI during a standard 1 year surveillance interval was 5.5% and considered the maximum allowable risk. The time to reach this risk was calculated for each individual in the validation group, using the risk model and was proposed the new surveillance interval. Median personalised surveillance interval was 1.9 years (IQR 0.8 – 3.6)

Computational risk modelling can be used to accurately estimate risk of SI after EVAR and this in turn to personalise surveillance intervals without exceeding overall risk associated with current surveillance regimens. Clinical adoption of this model will render surveillance programmes more efficient without compromising the overall safety.

UK Trainee Exposure to Aortic and Venous endovascular practice

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With the advent of the bespoke vascular training syllabus arterial and superficial venous endovascular competence are required objectives. The aim of this study was to investigate the exposure offered to trainees by vascular centres.

An online survey sent to UK vascular surgery trainees was employed to conduct a retrospective audit of all vascular procedures performed over a 3 month period (01/11/2015-31/01/2016). Data on region and hospital was obtained.

Fifty (35.7%) vascular surgery trainees responded to the survey, accounting for 13 regions and 37 hospitals. Endovascular exposure showed extensive variation in both arterial and venous treatments. Trainees participated in 257 standard EVARs (median 5, inter-quartile range 3-7), and 80 complex endovascular aortic procedures (median 1.86, IQR 0-2), compared to 174 open repairs (median 3, IQR 2-5). Only 16% of trainees had exposure to EVAS (13 procedures). No trainee experienced all aneurysm exclusion procedure types.

Endovenous ablation was the most common vein treatment (322 procedures, median 4, IQR 0-10) and three times more common than surgery (98 procedures, median 1, IQR 0-4), however 10% of trainees had no venous exposure at all in 3 months, 40% no surgical exposure and 50% no sclerotherapy exposure.

UK regional variation in trainee exposure is extensive and strategic unit placement may optimise training

Trainee Experience of Simulation Training in Vascular Surgery

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Surgical training is traditionally an apprenticeship however with shortened training; simulation has become a validated tool to enhance experience. This study aimed to establish regional differences in provision and access to simulation within vascular training programmes
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In November 2016 a 20 question survey was sent from the Rouleaux Club to all vascular surgery trainees in the UK focusing on their previous post. Questions included the presence of deanery teaching programmes, courses attended, topics in which they had received simulation training, and funding avenues. Individual results were analysed to allow regional comparisons and stratification according to provision of simulation training.

86 of 120 (72%) trainees responded. The mean score was 17.6 (range 2-64). 62% of trainees had received simulated training in EVAR, 12% in peripheral angioplasty and stenting, 28% in ultrasound assessment of varicose veins, and 56% in open vascular surgical techniques. There was significant variation in average scores across the deaneries (range 7-27). Provision of good training did not correlate to the number of trainees in the region. 12% of respondents did not think they had access to a deanery teaching programme. 16% of trainees from 5 deaneries had received no simulation training.

This simulation survey is a useful tool to compare regional training programmes. It provides an opportunity for positive feedback providing ideas for improving the provision of training, and can be used to influence future trainee allocation. Compliance with completing the questionnaire and trainee perception of what simulation is needs to be addressed.

Systematic review and meta-analysis of endovascular treatment for acute mesenteric ischaemia

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Acute mesenteric ischaemia (AMI) is associated with a significant morbidity and mortality. Endovascular techniques have emerged as a viable alternative treatment option to conventional surgery. Our objective was to conduct a systematic review of the literature and perform a meta-analysis of reported outcomes.

We searched electronic information sources and bibliographic lists of relevant articles to identify studies reporting outcomes of endovascular treatment for AMI of embolic or thrombotic aetiology. We defined 30-day or in-hospital mortality and bowel resection as the primary outcome measures. We used the Newcastle-Ottawa scale to assess the methodological quality of observational studies. We calculated combined overall effect sizes using random effects models; results are reported as the odds ratio and 95% confidence interval.

We identified 19 observational studies reporting on a total of 3362 patients undergoing endovascular treatment for acute mesenteric ischaemia. The pooled estimate of peri-interventional mortality was 0.245 (95% confidence interval 0.197-0.299), that of the requirement for bowel resection 0.326 (95% confidence interval 0.229-0.439), and the pooled estimate for acute kidney injury was 0.132 (95% confidence interval 0.082-0.204). Eight studies reported comparative outcomes of endovascular versus surgical treatment for acute mesenteric ischaemia (endovascular group, 3187 patients; surgical group, 4998 patients). Endovascular therapy was associated with a significantly lower risk of 30-day mortality (odds ratio 0.45, 95% confidence interval 0.30-0.67, P=0.0001), bowel resection (odds ratio 0.45, 95% confidence interval 0.34-0.59, P<0.00001) and acute renal failure (odds ratio 0.58, 95% confidence interval 0.49-0.68, P<0.00001). No differences were identified in septic complications or the development of short bowel syndrome.

Endovascular treatment for acute mesenteric ischaemia is associated with a considerable mortality and requirement of bowel resection. However, endovascular therapy confers improved outcomes compared to conventional surgery. An endovascular-first approach should be considered in patients presenting with acute mesenteric ischaemia.

Systematic review and meta-analysis of Carotid endarterectomy versus Carotid artery stenting versus Best medical therapy for asymptomatic carotid artery disease

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The optimal treatment of patients with asymptomatic carotid disease remains controversial with no clear consensus as to which is the optimal therapy for them. Our objective was to undertake a systematic literature review and perform a meta-analysis to assess the outcomes of carotid endarterectomy (CEA), stenting (CAS) and best medical therapy (BMT) on asymptomatic carotid disease.

Electronic information sources (MEDLINE, EMBASE, CINAHL, CENTRAL) and bibliographic reference lists were searched to identify randomised controlled trials (RCTs) reporting comparative outcomes of CEA, CAS and BMT on asymptomatic carotid disease. Primary outcomes were 30-day/long-term mortality and stroke of intervention. Secondary outcomes were transient ischemic attack (TIA), myocardial infarction (MI). We performed pairwise direct treatment comparisons and network meta-analysis using the random effects model. We obtained a hierarchy of the competing interventions using rankograms and the surface under the cumulative ranking curve (SUCRA) and mean ranks.

Eleven RCTs were identified reporting a total of 8,954 patients with asymptomatic carotid artery stenosis. The principle results from this network meta-analysis were, for long term mortality/ipsilateral stoke, CEA remain superior to BMT reducing the odds by 30% for long-term mortality and 41% for ipsilateral stroke. In regards of 30-day mortality and ipsilateral stroke, BMT is ranked the best treatment option for these patients with 100% probability.

Surgical intervention with CEA remains the superior method to reduce the long-term risk of ipsilateral stroke and mortality for patients with asymptomatic carotid disease. However, further RCTs are required to investigate the role of modern BMT on these patients.

Factors predicting outcome following catheter-directed thrombolysis in lower limb arterial occlusion

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Catheter-directed thrombolysis (CDT) is a well-recognised treatment for acute lower limb ischaemia. Our aim was to analyse for factors independently influencing outcome.

We analysed outcomes in consecutive patients undergoing CDT for limb ischaemia at a single institution. The primary end points were amputation free survival (AFS) and limb salvage (LS) at 1 year. Secondary end points included primary, assisted primary and secondary patency using Kaplan-Meier at 1 year.

CDT was performed in 91 (56.5%) native vessel and 70 (43.5%) bypass grafts. Median CDT infusion duration was 28 hours (1-96 hours) with a technical success rate of 68.9%. Major complications included retroperitoneal heamatoma (n=2, 1.2%), haematemesis (n=4, 2.5%) and acute renal failure (n=2, 1.2%). AFS and LS at 1 years were 66.9 % and 74.8% respectively. Primary, assisted primary and secondary patencies were 38.2%, 43.7% and 51.2% respectively at 1 year. Cox regression analysis identified CKD (P=.04), poor run-off (P<0.001) and lack of antiplatelet therapy (P=.01) as independent factors predicting worse AFS.

CDT had a high technical success and low complication rate resulting in good limb salvage rates. Better renal function, arterial run-off and the use of aspirin were associated with better outcomes.

Comparison of outcomes following infra-popliteal plain balloon angioplasty in the Bypass versus Angioplasty in Severe Ischaemia of the Leg (BASIL) trial (1999-2004) and in a contemporary UK series (2009-2013)

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We compared outcomes in 48 patients randomised to infra-popliteal (IP) plain balloon angioplasty (PBA) for chronic limb threatening ischaemia (CLTI) within the BASIL trial with outcomes in 73 consecutive patients undergoing IP PBA for CLTI in a UK vascular unit between 2009 and 2013 (Contemporary Series, CS).

Individual patient data were obtained from prospectively gathered computerised databases. Both cohorts had a minimum of 3 years follow up. The outcomes studied were amputation free survival (AFS), overall survival (OS), major (above ankle) limb amputation, re-intervention, immediate technical success and length of hospital stay during index procedure and the following 12 months. Statistical analysis was performed using SAS version 9.4©.

Both cohorts were well matched for gender, age, presence of diabetes, previous stroke, myocardial infarction, previous arterial intervention and tissue loss. More BASIL patients underwent concomitant treatment of the superficial femoral (60% vs. 37%, p=0.01) and above knee popliteal (60% vs. 34%, p=0.005) arteries. Immediate technical success increased from 73% (BASIL) to 90% (CS) (p=0.01). There was no difference in AFS (p=0.8), OS (p=0.9), major amputation (p=0.7) or re-intervention (p=0.2). Median length of stay after the index intervention and in the following 12 months was significantly shorter in the CS (p=0.02 and p=0.002 respectively).

Despite an improvement in immediate technical success of IP PBA for CLTI between the two cohorts we observed no significant improvement in clinical outcomes. Further randomised trials are required to define evidence-based revascularisation strategies in patients presenting with CLTI due to IP disease.

Medium-term results of venous stenting for acute ilio-femoral vein thrombosis

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Deep vein thrombosis (DVT) occurs in about 100,000 patients a year in the United Kingdom. Post-thrombotic syndrome (PTS) is a major long term complication which develops in about 50% of the patients and is associated with significantly decreased quality of life. Catheter directed thrombolysis (CDT) with stenting of the stenosed segment improves the outcomes.

Patients with acute ilio-femoral DVTs in whom a venous stent was inserted after CDT between April 2012 and December 2015 were included. Demographic details, number and type of stents were recorded as well as stent patency, re-interventions, complications and clinical outcomes. Primary patency was defined as stenosis of <50%, primary assisted – incomplete occlusion requiring intervention, and secondary patency – successfully treated complete occlusion.

In total, 165 stents were placed in 73 patients. The median age was 43 years. 44 patients (60.3%) were female and 14 (19%) were diagnosed with a clotting disorder. 79% of patients had a DVT on the left side and in 11% of the cases it was bilateral. 28.8% (21) of the patients required a re-intervention and of those 16 patients required a further procedure. After at least 1 year follow-up primary, primary-assisted and secondary patency were 66%, 85% and 90% respectively.

It is now widely accepted that stenting of significant flow limiting stenoses should be considered to avoid long term complications of proximal DVTs. We have shown that this can be done successfully in 90% of the cases. However, patients should be counselled about a significant rate of re-intervention.

Stenting across the inguinal ligament in post thrombotic syndrome using nitinol venous stents: one-year patency outcomes

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Endovenous stents can be used for deep venous reconstruction to treat patients with post-thrombotic syndrome (PTS). Guidelines on iliocaval stenting suggest stenting across the inguinal ligament should be avoided, however stenting from a normal peripheral inflow segment is more important, therefore stenting across the ligament may be necessary. The aim of this study was to examine patency rates when stenting across the inguinal ligament using nitinol venous stents.

Consecutive patients in whom a venous stent was inserted for symptomatic PTS between 2012-2015 were included. All patients had a minimum of one-year follow-up, with pre-operative Villalta scores taken before intervention and at one-year. Patency was assessed peri-operatively using intravascular ultrasound and post-operatively using duplex ultrasonography.

Of 168 patients, 102 (61%) were treated for post-thrombotic obstruction; 94/102 (92%) had a nitinol venous stent of which 71 (76%) crossed the inguinal ligament. Primary, primary-assisted and secondary patency rates were significantly better in stents placed above the inguinal ligament compared with across it (72%, 100%, 100% vs. 52%, 80%, 82%, respectively; P<0.05). There was a significant improvement in Villalta scores of both patients with patent stents in those placed above the inguinal ligament (median improvement of 9 points, range 0-18) and those with stents placed across it (median improvement of 11, range 0-25).

Maintaining stent patency when the stents cross the ligament can be challenging and close surveillance is required as re-intervention may be required. However, nitinol venous stent patency is good at one-year in both groups and significant clinical improvement can be achieved.

Quantifying potential radiation exposure in real life endovascular cases – implications for practice

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Our objective was to use live dosimeters to quantify actual radiation exposure to primary operators during endovascular procedures and evaluate the success of our current practice in radiation protection. The limits on effective dose are set out by the Health and Safety Executive (HSE) in the Ionising Radiations Regulations (1999). Employees are limited to 20 millisieverts (mSv – 1mSv = 1000μSv) to body or eye in a calendar year, with investigation triggered at 2mSv and the operator becoming a classified worker at 6mSv.

The potential radiation dose to primary operators was quantified by monitoring 5 procedures over a 3 week period. These included 3 endovascular aneurysm repairs, 1 aortic cuff and 1 aorto-uni-iliac graft. Phillips live dosimeters were placed in several locations through the operating theatre for the duration of the procedures evaluated.

Cumulative doses for each location are shown in brackets. The locations were as follows: primary operator shin (3017μSv); primary operator chest under leads (2μSv); primary operator chest over leads (13445μSv); inside the lead skirt (3171μSv); and at the radiographer control station (327μSv).

Extrapolating the results to a year-long period for one operator indicates the radiation dose outside leads could reach 200mSv, vastly exceeding HSE limits if lead gowns or eye protection were inadequate. This has consequences for both personal safety and workforce availability due to classified worker restrictions. It is important we recognise this and ensure lead gowns and eye protection are correctly worn and maintained, lead shields and lead skirts used, and film badge dosimeters are worn.

Supervised Exercise Therapy versus Percutaneous Angioplasty versus Combined Angioplasty and Exercise for Intermittent Claudication: Systematic Review and Bayesian Network Meta-Analysis of Randomized Controlled Trials

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Guy's and St Thomas' NHS Foundation Trust

The authors report the results of a Bayesian network meta-analysis of randomized controlled trials (RCTs) comparing supervised exercise therapy alone (SET), percutaneous tranluminal angioplasty (PTA) alone, or a combination of SET and PTA for the treatment of intermittent claudication.

Medical databases were searched with the PRISMA statement and 39 RCTs (including five 3-arm studies) comprising 2,983 patients with 12 months median follow-up (range, 3-24 months) were analysed in total. Outcome measures included improvements of Maximal Walking Distance capacity (MWD; meters on treadmill) and Quality of Life (QoL; SF-36 and EQ-5D instruments) compared to best medical therapy (BMT) as the anchor control treatment. Bayesian random effects models were employed (WinBUGS).

There were significant improvements of MWD with PTA (+85m, 95%CrI: +4 to +170), SET (+180m, 95%CrI: +130 to +230) and PTA+SET (+290m, 95%CrI: +180 to +390). SET was better than PTA alone (MWD difference +85m, 95%CrI: +16 to +170). PTA+SET were the best treatment with an MWD difference over SET of +110m (95%CrI: +16 to +200). Quality of life was significantly and strongly improved only in case of PTA+SET (QoL Cohen's d standardized effect size 1.8; 95%CrI: 0.21 to 3.4).

Results were stable on sensitivity and consistency analyses without any significant publication bias. Healthcare systems need to invest in supervised exercise programmes as the first standalone treatment for intermittent claudication and in order to augment the results of peripheral revascularization.

An Anatomical and Morphological Assessment of Common Femoral Disease and Potential Suitability for Endovascular Intervention

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Open surgery for common femoral artery stenosis is safe and effective in the long-term. Endovascular interventions of the common femoral artery (CFA) is becoming more common. This study determines the anatomy and lesion morphology relevant for endovascular management of CFA atherosclerosis.

We assessed a consecutive series of patients who underwent a common femoral endarterectomy over a one-year period. Where possible, CT imaging was assessed for the following relevant finding (a) contralateral iliac TASC scoring (b) angulation of the aortic bifurcation (c) CFA length and PFA (to the first bifurcation) length (d) presence of significant plaque within the ipsilateral proximal SFA (e) calcium burden within the CFA.

A total of 56 patients underwent CFA endarterectomy of which 36 patients (32 men; median age 73 [68-76] years) had suitable CT imaging for analysis. Seven patients had contralateral iliac TASC C lesions, 10 TASC B and 19 TASC A. Eight patients underwent concomitant ipsilateral iliac angioplasty. The mean angle of the aortic bifurcation was 53.7°. 42% of patients had a CFA stenosis >75%. Median CFA length was 39 mm, PFA length 57 mm and 19% of patients had significant SFA disease (TASC C/D). Overall median CFA calcium score was 1543 (747 – 2047).

While the endovascular enthusiasts suggest angioplasty / stent of the CFA has low peri-procedural morbidity, & study suggests that there are a number of anatomical challenges that may provide challenges for its widespread use.

Perioperative blood glucose levels influence outcome after infrainguinal bypass and endovascular therapy

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Guy's and St Thomas' NHS Foundation Trust

Poor perioperative blood glucose management is associated with increased morbidity and mortality after infrainguinal and coronary artery bypass surgery. The influence of perioperative hyperglycaemia on restenosis and patency following infrainguinal revascularisation among diabetic patients is largely unknown.

Consecutive diabetic patients undergoing primary infrainguinal bypass surgery (BS) or endovascular therapy (EV) for critical limb ischaemia were identified. Daily capillary blood glucose (CBG) data was collected retrospectively up to 7 days post operatively along with pre and 3 month post procedural haemoglobin A1C levels and analysed against the study endpoints (primary, assisted primary and secondary patency and binary restenosis).

In patients undergoing infra-inguinal bypass (N=42) a mean peri-operative CBG level greater than 7mmol/L was associated with reduced primary patency (P=0.01) and a higher level of binary restenosis (P=0.042), with no significant difference in assisted primary patency (P=.36) and secondary patency (P=.46). A lower primary patency was also found in patients with a HbA1C level of greater than 48mmol/mol both pre (P=0.027) and 3 months post operatively (P=0.047). The EV group consisted of 76 patients with 160 vessels treated. A high perioperative CBG level (>7) and HbA1C level (>48) was associated with lower primary patency (P=.011 and P.004), assisted primary patency (P=.019 and P=.004), secondary patency (P=.047 and P=.018) and a higher binary restenosis rate (P=0.042 and P=.032). Cox regression analysis showed high pre-procedural HBA1C levels (P=0.001) and CBG level (P=0.02) to be an independent predictor of patency.

Poor perioperative glycaemic control is associated with lower patency and higher incidence of restenosis after infrainguinal revascularisation in diabetic patients.

Posters & Faculty

Posters

Poster 1
Early experience with the Altura™ stent-graft
C Lowe[1] D Seriki[1] D Murray[2] S Richardson[1] J Ghosh[1]
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Poster 2
Lower Limb Diagnostic Angiography for peripheral vascular disease, are we exposing our patients to unnecessary risks?
A Elshiekh F Kahloon A Mahmood
University Hospitals Coventry and Warwickshire NHS Trust

Poster 3
One stop dual treatment for Varicose Veins, is it associated with higher success rates and lower re-treatment rates?
A Elshiekh N Matharu A Vepa
University Hospitals Coventry and Warwickshire NHS Trust

Poster 4
Selective puncture of the superficial femoral artery for antegrade angioplasty is safe and effective
H Britton A Tiwari
University Hospitals Birmingham NHS Foundation Trust

Poster 5
Early Experience of Complex EVAR at a Major Trauma Centre in the UK
A Jones C Oliver J Harding A Vohrah K Ivancev C Imray D Higman S Sayed D Srinivasamurthy N Matharu A Mahmood O Agu
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Poster 6
Bypass surgery for chronic lower limb ischaemia
I Asghar G S Georgiadis S A Antoniou R R Makar J D Smout F Torella G A Antoniou
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Poster 7
Online distance learning supports academic development of Vascular Surgeons
U Tufail-Hanif[1] PJ Burns[2] OJ Garden[1] AL Tambyraja[2]
[1]University of Edinburgh
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Poster 8
A Comparison of Manual and 3D Modalities for Predicting Nellix Polymer Volume
N A Mughal A Elbasty M Delbridge
Department of Vascular Surgery, Norfolk and Norwich University Hospital

Poster 9
Non-device specific audit of endovascular interventions within the Superficial Femoral Artery (SFA). Is there a need for protocolised care?
MM Yan MM Chowdhury PA Coughlin
Department of Vascular Surgery, Addenbrooke's Hospital, Cambridge

Poster 10
Arterio-arterial prosthetic loop, a reliable alternative approach for hemodialysis
NMM Hamada M Zaki AM Salem
Ain Shams University, Cairo, Egypt

Poster 11
A systematic review of ruptured popliteal artery aneurysms
J Akman[1] E Kastogridakis[1 2] G A Antoniou[1]
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[2]*Academic Surgery Unit, University Hospital of South Manchester, United Kingdom*

Poster 12
Provision of simulation-based training (SBT) within UK vascular surgery training programmes
V Robertson R Davies
Department of Vascular Surgery, Leicester Royal Infirmary

Poster 13
Single institution experience and midterm results with the Ovation stent graft system
NS Greaves J Ghosh D Seriki
University Hospital of South Manchester

Poster 14
Investigating the role of education and socioeconomic status on clinical outcomes following lower-limb bypass surgery
A Tulloch[1 2] AH Morbi[1 2] C Pettengell[1 2] G Martin[1 2]
AE Sharrock[1 2] CD Bicknell[1 2]
[1]*Department of Surgery and Cancer, Imperial College London*
[2]*Imperial Vascular Unit, Imperial College Healthcare NHS Trust, London*

Poster 15
Single centre experience of establishing a FEVAR service
A Duncan G Saggu S Whitaker R O'Neill G Ramjas A Oluwole SL Khan
Department of Vascular Surgery, Queen's Medical Centre, Nottingham University Hospitals NHS Trust

Poster 16
Do EndoAnchors provide benefits in preventing and treating endoleaks and graft migration in patients with challenging proximal aortic neck anatomy?
Sadia Tasleem
The Royal Oldham Hospital, Manchester

Faculty

Firas F Mussa

Firas F Mussa, MD, is Assistant Professor of Surgery at Columbia University Medical Centre. Having been an investigator in more than 20 clinical trials, Dr Mussa is nationally and internationally recognized as a thought leader in the treatment of aortic dissection. Dr Mussa was the first physician from New York to become a member of the prestigious International Registry of Aortic Dissection (IRAD). He serves on the Editorial Board of Vascular, Vascular Endovascular Surgery, Endovascular Today and Reviewer for Lancet, Annals of Surgery, and Distinguished Reviewer for the Journal of Vascular Surgery.

Dr Mussa's ultimate passion is educating the next generation of leaders in vascular surgery. He has been actively involved teaching, mentoring and training medical students, residents and fellows.

Dr Peter Neglén

Dr Peter Neglén received his medical degree at University of Lund, Sweden in 1974. After completing his internship, he continued with Residency in General Surgery at the University of Lund. His subspecialty training focused on vascular surgery. It was at that time obligatory to perform in-depth research at the University simultaneously with clinical training. In 1980, Dr Neglén received a PhD in Surgery defending his thesis: Aortic Clamping Skeletal muscle metabolism and central circulation during abdominal reconstructive vascular surgery for arteriosclerotic disease. In 1981 he was Board Certified in General Surgery in Sweden. This was followed by a clinical research fellowship at Duke University, North Carolina, for one year. In 1988, he was appointed Docent (Associated Professor) at the University of Lund. He was part of a team of surgeons developing the Dept of Surgery at Kuwait University from 1983. This endeavour was interrupted by the invasion of Kuwait in 1990, when Dr Neglén joined Professor Raju at the University Medical Center in Jackson, MS, for one year as a visiting professor. After returning to the Middle East to become a Professor at the United Arab Emirates University in Abu Dhabi, he obtained a license to practice surgery in Mississippi, and joined Dr Raju in Jackson in private practice from 1997 to 2011.

Dr. Neglén has now retired from full clinical service and resides in Cyprus. He works as a consultant in venous disease at SP Vascular Center. He is a member of the Strategic Advisory Board of Veniti, Inc., Proctor and Speaker for Volcano Europe, Speaker for Cook Medical and Director of the European Venous Forum Hands-on Workshop on Venous Disease (EVF HOW) and Board Member of European Venous Forum.

Professor Michael Horrocks

Professor Michael Horrocks qualified from Guy's Hospital Medical School in 1970. He acquired the FRCS in 1974 and was appointed consultant surgeon at the Bristol Royal Infirmary in 1982, moving to Bath in 1991 to take up the Postgraduate Chair in Surgery. Professor Horrocks has been secretary general of the European Society of Vascular Surgery; President of the Vascular Society of Great Britain and Ireland; and the Association of Surgeons of Great Britain and Ireland. He was Vice-President of the Royal College of Surgeons of England from 2012-2014. Professor Horrocks is currently Vascular Clinical Lead for Getting It Right First Time (GIRFT), a programme designed to improve clinical quality and efficiency within the NHS by reducing unwarranted variations.

Hence JM Verhagen

Hence JM Verhagen is a Professor and Chief of Vascular Surgery at the Erasmus University Medical Centre in Rotterdam, Netherlands. He completed his medical degree in 1992 and defended his thesis entitled "Cell seeding on Vascular Grafts" in 1996, both at Utrecht University. During his vascular fellowship at The Royal Prince Alfred Hospital in Sydney, Australia, he developed a special interest in minimally invasive endovascular therapies and the endovascular treatment of aneurysms.

In 2002 Dr Verhagen accepted a position as Associate Professor of Vascular Surgery held at the University Medical Centre in Utrecht. In 2007 he was appointed as Professor and Head of the Department of Vascular Surgery at Erasmus MC, University Medical Centre in Rotterdam. As an early adopted of advanced endovascular treatments, he has acquired an international reputation in this field. He has organised a large number of basic and advanced courses organized for EVAR and Tevar and is the founder of the Dutch course on peripheral percutaneous vascular interventions for vascular surgeons. Prof. Hence Verhagen has a specific interest in aortic intervention, including state-of-the-art endovascular techniques, in which he has extensive experience. Furthermore, his specific expertise includes dynamic imaging of aortic pathology, carotid surgery, chronic intestinal ischemia and peripheral vascular interventions.

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