

# Reproductive factors and the risk of incident peripheral arterial disease hospitalisation or death: A cohort study of UK Biobank participants

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## Background

This study examined reproductive factors and exogenous hormone use in relation to the risk of incident peripheral arterial disease (PAD) in women.

## Method

UK Biobank cohort study. Cox proportional hazard regressions used to estimate adjusted hazard ratios (adjHRs) for reproductive factors with incident PAD, adjusted for age, socioeconomic status, ethnicity, smoking status, systolic blood pressure, BMI, diabetes mellitus, cholesterol, antihypertensives, and lipid-lowering drugs.

## Results

Incident PAD recorded among 2,942/272,557 women and 5,432/227,403 men over 13.2 years. Compared to menarche at 13 years, multiple-adjusted HRs for age <12 and age >14 years demonstrated increased PAD risk (adj HR 1.43 95% CI[1.32, 1.55],  $p<.001$ , 1.36 [1.23, 1.49],  $p<.001$ , respectively). An inverse relationship with age at first birth was observed, with cumulative risk reduction per additional year (adjHR 0.95 [0.94, 0.96],  $p<.001$ ). Cumulative increase in PAD risk was observed per miscarriage (adjHR 1.06 [1.01, 1.11]  $p=.027$ ), per stillbirth (adjHR 1.18 [1.03, 1.36]  $p=.014$ ) and per abortion (adjHR 1.09 [1.01, 1.18],  $p=.028$ ). Longer reproductive life-span and older age at menopause had inverse associations with PAD, while hysterectomy or oophorectomy was associated with increased risk (adjHR 1.24 [1.13, 1.35],  $p<.001$ , 1.24 [1.10, 1.39],  $p<.001$ , respectively). Oral contraceptives were associated with reduced PAD risk (adjHR 0.85 [0.78, 0.93],  $p<.001$ ). Associations between parity and PAD were U-shaped. Multiple-adjusted HR for those with  $\geq 4$  children was 1.13 ([1.00, 1.25],  $p=.041$ ) women; 1.25 ([1.16, 1.34],  $p<.001$  men).

## Conclusion

Reproductive factors are associated with increased risk of PAD and should be considered in future risk stratification.

# Operative exposure for senior vascular trainees in peripheral vascular disease and abdominal aortic aneurysm over the last 10 years

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### Background

Over time, with the expansion in endovascular technologies, better medical therapy and reduced working hours, the vascular surgery (VS) training landscape has changed. This study explores how UK VS training has changed in the last 10 years.

### Method

Cross-sectional analysis of eLogbook data from ST8 VS trainees in 2013-14 (group 1), 2017-18 (group 2) and 2023-24 (group 3). Trainee involvement within PAD and AAA were reviewed.

### Results

Over time, a decline in total cases logged is seen. Between group 1 and 2, there was a 13.3% reduction; and a further 16.9% reduction between group 2 and 3. With 263 cases on average logged in group 1; and 153 in group 3. Relating to PAD, 33, 34 and 25 cases on average were performed in groups 1, 2 and 3 respectively; with a trend towards a greater proportion of endovascular cases over time; 7, 16 and 13 cases on average in groups 1, 2 and 3 respectively. The total number of AAA repairs has decreased over time (615, 531 and 291). Trainees were involved in 18, 15 and 7 cases on average in groups 1, 2 and 3 respectively. Involvement in Open AAA repair was poor; with 8, 4 and <1 cases performed on average in groups 1, 2 and 3 respectively.

### Conclusion

VS trainees are exposed to fewer operative opportunities compared to 10 years ago. Further work is required to understand surgical exposure at different training grades, aiming to identify and address deficits within modern day VS training.

# Spatiotemporal Trends in Peripheral Artery Disease Prevalence in England – Primary Care Registry Data Analysis

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### Background

Understanding peripheral arterial disease (PAD) trends, and geographical hotspots can allow insight into disparities in care and demand between regions. The majority of GP practices in England maintain a peripheral arterial disease (PAD) patient registry, as part of Quality and Outcomes Framework (QOF). We used these practice level data to characterise spatiotemporal patterns of PAD prevalence, and to examine association with social-deprivation, age, sex and co-morbidities over time.

### Method

PAD prevalence and co-variate QOF data were combined with ONS deprivation and demographic data from 2013 to 2024, and summarised across Lower Layer Super Output Areas. Correlation matrices between prevalence and co-variables were constructed using pairwise Pearson's correlation coefficient, adjusting for practice size. Prevalence hotspots were determined using Geits-Ord analysis.

### Results

Despite an increase in absolute numbers of patients recorded as having PAD (312,257 in 2013 to 353,814 in 2024), overall prevalence decreased from 0.65% to 0.58%. Age ( $r=0.477$ ) social-deprivation ( $r=0.451$ ), smoking status ( $r=0.304$ ), hypertension ( $r=0.596$ ), diabetes ( $r=0.275$ ), and coronary heart disease ( $r=0.801$ ) were positively correlated with PAD prevalence at practice level. Significant increases in PAD were identified in Yorkshire and Humber (z-score 3.11,  $p=0.002$ ) North-West England (z-score 2.55,  $p=0.01$ ), and North-East England (z-score 2.22,  $p=0.02$ ).

### Conclusion

PAD prevalence as recorded on primary care records is decreasing nationally, despite increasing population age. Further validation of this data against secondary care outcomes is needed to assess best medical therapy adherence and outcomes, and increase collaboration between primary and secondary care.

### **Stent configuration for endovascular ilio caval reconstruction - a systematic review**

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#### **Background**

Endovascular Iliocaval reconstruction is a potential option for managing chronic venous occlusive disease. A variety of stent configurations are described in the literature. This systematic review explores the evidence behind these options and whether there is a difference in patency rates based on the configuration used.

#### **Method**

A systematic review (Cochrane, Medline, PubMed, Embase) was performed for studies reporting outcomes for endovascular ilio caval reconstruction. The configurations of interest included: Inverted Y, double barrelled stenting, the 3 stent technique, and the skip stent technique. Weighted means are reported for primary and secondary patency rates for the different configurations.

#### **Results**

18549 studies were identified (11092 after manual and automatic deduplication). 11077 ineligible studies were excluded. Of the 15 included studies, there were no randomised control trials available for meta-analysis. The limited patency data is as follows (primary, secondary): Inverted Y (3 studies) – 42.9%, 90.1%; double barrel (4 studies) – 64.2%, 93.2%; skip stenting (1 study) – 74.0%, 97.0%; three stent (9 studies) – 77.0%, 87.6%. There was large variation in follow-up time (3 months – 36 months). No studies reported QoL data for comparison and there was heterogeneity in reported data. Minimal studies reported symptomatic outcomes.

#### **Conclusion**

There is limited evidence for a single technique being superior but configurations with 3-stents may offer greater primary patency. Clinicians should utilise their preferred method with appropriate governance and follow-up. Quality of life data is lacking as is consensus of definitions in reported data.

### **Femoropopliteal angioplasty for long lesions: Procedural success, patency, and reintervention in a high-risk cohort**

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#### **Background**

Femoropopliteal (fempop) angioplasty has become a key intervention for patients with peripheral arterial disease, yet the impact of lesion length, device selection, and comorbidities on outcomes remains under scrutiny. This study aimed to assess clinical success rates, reintervention frequency, and patency among a cohort of patients undergoing fempop angioplasty with various balloon and stent technologies.

#### **Method**

We retrospectively reviewed 122 consecutive patients treated for fempop lesions. Demographic data, comorbidities, lesion characteristics, intervention type (plain balloon, drug-coated balloon, bare-metal stent, or drug-eluting stent), and patency outcomes were collected. Primary endpoints included technical success and primary patency; secondary endpoints encompassed reinterventions, complications, and limb salvage.

#### **Results**

Among the 122 patients (mean age 69.6 years; 82 male), all presented with long fempop lesions (mean length 21.49 cm). Primary interventions were performed in 79.51% of cases, while 20.49% underwent secondary procedures. Technical success exceeded 80% overall, with an average patency period of 15.4 months. Drug-eluting stents and drug-coated balloons were frequently employed, especially in patients with extensive disease. Comorbidities such as diabetes, hypertension, and ischemic heart disease were prevalent, reflecting a high-risk population.

#### **Conclusion**

Fempop angioplasty using contemporary devices demonstrates encouraging procedural success and mid-term patency, even for long lesions in a comorbid population. Nonetheless, reinterventions remain necessary in a substantial minority of cases. These findings support the growing role of endovascular approaches in managing femoropopliteal disease, while underscoring the need for vigilant follow-up and timely secondary interventions.

### **The relevance, specificity, and usability of the current Patient-reported Outcome Measure for Chronic Limb Threatening Ischaemia: A systematic review of reported PROMs**

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#### **Background**

Chronic limb-threatening ischemia (CLTI) causes significant morbidity with profound negative effects on health-related quality of life (QoL). The use of Patient-reported Outcome Measures (PROMs) are increasing in clinical practice and research. The aim of this study was to identify all reported PROMs in research of CLTI and assess the usefulness of these measures in CLTI patients.

#### **Method**

This is a sub-study of a systematic review for development of Core Outcome Set in CLTI (PROSPERO: CRD42023412204). Studies recruiting CLTI patients and reported at least one PROM were included from the original search of Medline, Embase, CINAHL, and Cochrane Central from inception until March 2024. All PROMs, either validated or not, single outcome measure or QoL tools, were included.

#### **Results**

A total of 19,760 titles screened, 4,516 articles screened, and 475 studies included. Across the studies, 61 unique PROMs were identified. There were 13 health-related quality of life and 11 disease-specific tools. EQ-5D was the most frequently reported generic QoL and Vascu-QoL was the most used disease-specific QoL tool. Non-validated PROMs were used in 141(30%) of the studies. There were marked heterogeneity of the reported PROMs. No any specific PROM addresses all the aspects of the experience of patients with CLTI.

#### **Conclusion**

PROMs used to describe the experience of patients with CLTI are heterogeneous and lack specific applicability. Despite the multiplicity of tools, no single PROM encompasses all the components necessary to describe the experiences of patients with CLTI. Development of disease specific, concise PROMs for CLTI is essential.

### The impact of aneurysm extent on mid-term survival after elective fenestrated-branch endovascular aortic repair

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#### Background

To compare the early and mid-term outcomes of elective fenestrated and branch endovascular aortic repair (FBEVAR) according to aneurysm extent.

#### Method

Single-centre retrospective study of consecutive patients who underwent elective FBEVAR for primary aneurysms between December 2007 and December 2024. Patients who had prior AAA repair were excluded. Primary endpoint was Kaplan-Meier estimates of medium-term survival. Data are presented as median (IQR). A P-value of <0.05 was considered significant.

#### Results

797 patients [657 men; median age, 74 (69-79) years] were treated for primary juxtarenal (JR) AAA (n=456), extent IV (n=163) or extent I-III thoracoabdominal aortic aneurysms (TAAA) (n=178). There was no difference in 30-day mortality (2.4%; JR/AAA 2.6%, extent IV 2.5%, extent I-III 1.7%). Median follow-up was 46 months (19-80). Estimated 5-year survival ( $\pm$ SE) was 66% $\pm$ 2%: JR/AAA 69% $\pm$ 3%, extent IV 56% $\pm$ 5%, extent I-III 67% $\pm$ 4% (p=.2).

#### Conclusion

In an experienced centre, aneurysm extent does not have a significant impact on early or mid-term survival after elective FBEVAR. Patients with extent IV TAAA appeared to have worse mid-term survival but this did not reach statistical significance.

### **Effectiveness of the MANTA Vascular Closure Device for repair of ruptured abdominal aortic aneurysm by Endovascular Aneurysm Repair (RAAA-EVAR) in rAAA: A pilot study**

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#### **Background**

EVAR has quickly become the mainstay in managing RAAA if anatomically feasible. Femoral cutdowns were used due to the large profile devices. However, pEVAR is associated with shorter haemostasis and procedure completion times with less blood loss and groin pain. The MANTA is the first dedicated collagen plug-based vascular closure device used for large-bore arterial puncture. It is mainly used in cardiac procedures, but is finding increasing use in endovascular surgery, particularly in EVAR. It is deployed in a shorter time and have lower failure rate than proglide. We carried out a study looking at the effectiveness of the MANTA device at RAAA-EVAR.

#### **Method**

Nine patients (Male n=7, female n=2 mean age  $79 \pm 9$  years) underwent RAAA-EVAR, where the Manta was used as VCD. The median BMI was 29.5kg/m<sup>2</sup>. Overall, 16 large bore punctures were closed using the MANTA (Right n=9, Left n=7). Of these, 14 were virgin groins, and 2 were redo groins. The median arterial depth was 3.5cm.

#### **Results**

Our results showed that technical success was 93.75% (Haemostasis n= 14, safeguard dressing n=1, cutdown n=1). The median length of stay was 16 days. There were two mortalities in 30 days. None of the patients had PSA or stenosis from the closure site.

#### **Conclusion**

The MANTA can be used safely and effectively in RAAA. Our study shows that it has a high success rate with low complications and has clear advantages in minimal set-up time as a single-device-per-groin, with scope of usage even in redo groins.

### Central Blood Pressure and Variability Evaluation (CAVE-ON): Assessing the impact of blood pressure and blood pressure variability on AAA growth rates

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#### Background

Blood pressure (BP) and BP variability (BPV) are closely linked with cardiovascular health; hypertension is linked with increased risk of AAA rupture. We investigated the relationship between peripheral and central BP, BPV and AAA growth and time taken to reach repair threshold.

#### Method

A multicentre, prospective study recruited patients  $\geq 55$  years with AAA to undergo peripheral and central BP and AAA measurement every four months from June 2022-2024. Visit-to-visit BPV was estimated by standard deviation (SD), coefficient of variation (CoV) and variation independent of mean (VIM); AAA was measured using ultrasound, by the same assessor. Growth was estimated using linear mixed effects.

#### Results

137 patients (110 male) were followed over a mean of  $15 \pm 5.4$  months. Peripheral and central BP and BPV were not related to AAA growth, nor did they affect the time it took to reach repair threshold. The growth rate was 1.34mm/year. A 1cm greater baseline diameter increased the growth rate by 1.12mm/year. Current smoking was associated with faster growth ( $+0.93\text{mm/year}$ ,  $\text{CI}=0.3\text{--}1.6$ ,  $p=0.005$ ); ischaemic heart disease (IHD) was associated with slower growth ( $-0.56\text{mm/year}$ ,  $\text{CI}=-1.1\text{--}-0.01$ ,  $p=0.047$ ), independently of AAA diameter and smoking. More guideline compliant cardiovascular medication prescription including two-fold use of antihypertensives were noted in the IHD group; antihypertensive adherence was similar in both groups.

#### Conclusion

There was no relationship between peripheral and central BP or BPV and AAA growth. Reduced growth in the presence of IHD seems to be attributable to better prescription of cardiovascular medications, suggesting best medical therapy may have an important role in reducing AAA growth.

### Fenestrated-branch endovascular aortic repair in octogenarians

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#### Background

According to the NVR, endovascular repair accounts for over 80% of elective abdominal aortic aneurysm (AAA) repairs in octogenarians. This study compares the outcome of elective fenestrated and branch endovascular aortic repair (FBEVAR) in octogenarians and non-octogenarians.

#### Method

Single-centre retrospective study of consecutive patients who underwent elective FBEVAR between December 2007 and December 2024. Primary endpoint was Kaplan-Meier estimates of medium-term survival. Data are presented as median (IQR). A P-value of <0.05 was considered significant.

#### Results

A total of 701 non-octogenarians [581 men; median age, 72 (68-76) years] and 216 (24%) octogenarians [180 men; median age 82 (81-84) years] underwent repair. Octogenarians were more likely to have prior AAA repair (19% vs. non-octogenarians 11%;  $p<.001$ ) and require juxtarenal AAA repair (69% vs. non-octogenarians 53%;  $p<.001$ ). The 30-day mortality was 2.1% ( $n=19$ ; octogenarians 3.2% vs. 1.7%,  $p=.27$ ). Median follow-up was 46 months (19-80). Estimated 5-year survival ( $\pm$ SE) was  $52\%\pm 4\%$  in octogenarians compared with  $68\%\pm 2\%$  in non-octogenarians ( $p<.001$ ).

#### Conclusion

While early mortality was similar, mid-term survival was inferior which may be a consequence of the fact that octogenarians were a decade older than their younger counterparts and more likely to have had prior AAA repair.

### **The impact of introducing a surgeon-led emergency EVAR service on outcomes and cost efficiency in ruptured aortic aneurysm management: A UK single-centre experience**

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#### **Background**

Ruptured abdominal aortic aneurysm (rAAA) is a life-threatening emergency with high mortality. Open surgical repair (OSR) has been the standard treatment, endovascular aneurysm repair (EVAR) offers a potentially superior alternative. This study assesses the patient outcomes and cost-efficiency of an emergency EVAR service at a UK tertiary centre.

#### **Method**

A retrospective cohort study was conducted, including all patients presenting with rAAA from January 2019 to December 2023. Patients were split into two periods: Period A (2019-2020), when only OSR was available, and Period B (2021-2023), after the introduction of emergency EVAR. Patients were categorized into OSR and EVAR groups, and outcomes such as 30-day mortality, one-year mortality, reintervention rates, length of stay, and cost-effectiveness (using Quality-Adjusted Life Years [QALYs] and Incremental Cost-Effectiveness Ratio [ICER]) were evaluated.

#### **Results**

Seventy-one rAAA patients were identified, with 58 undergoing surgery. In Period A, all patients received OSR, while 36.8% of patients in Period B underwent EVAR. The 30-day mortality rate was significantly lower in the EVAR group (7%) compared to OSR (50% in Period B, 63.3% in Period A,  $p = 0.011$ ). One-year mortality was similar between groups, though OSR patients in Period B had increased late mortality ( $p = 0.00075$ ). Reintervention rates were higher for OSR (25% vs. 0% for EVAR,  $p = 0.044$ ). EVAR also showed superior cost-effectiveness, with an ICER of £202,526 per QALY.

#### **Conclusion**

The introduction of emergency EVAR service significantly improved short-term survival and reduced reintervention rates. EVAR showed superior cost-effectiveness, suggesting it should be preferred when possible.

### Bridging the Gap: A propensity-matched analysis of sex differences in complex EVAR

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#### Background

Recent evidence indicates that women undergoing aneurysm repair experience inferior outcomes relative to their male counterparts, irrespective of treatment modality. Moreover, female sex has been identified as an independent predictor of both one-year and five-year mortality following aneurysm repair.

#### Method

We performed an analysis of patients undergoing complex abdominal and thoracoabdominal aneurysm repair between 2010 and 2024. To adjust for major confounding factors, we applied propensity score matching (1:1 nearest neighbour method) for imbalanced covariates, including aneurysm extent, prior repair, referral source, modality, and number of target vessels.

#### Results

In total, 917 patients were identified (156 women, 17%), with a median age of 75 years (IQR 70-79). Of these, 781 (85.2%) underwent fenestrated EVAR (FEVAR) and 136 (14.8%) underwent branched EVAR (BEVAR), for juxtarenal aneurysms (519, 56.6%), Extent IV (190, 20.7%), and Extent I-III aneurysms (208, 22.7%). Women were more likely than men to be referred from other centres (70.5% vs 54.1%,  $p < 0.001$ ) and to present with thoracoabdominal aneurysms (62.8% vs 39.4%; OR=0.39, 95% CI 0.27-0.55,  $p < 0.001$ ). In the propensity score-matched cohort, 30-day survival did not differ significantly between men and women (2.1% vs. 1.3% mortality,  $p = 1.000$ ), and similar results were observed for survival (median follow-up 44.8 months [IQR 16.8;79.6]; HR(male)=0.88, 95%CI 0.64-1.20,  $p=0.425$ ).

#### Conclusion

Our findings suggest that perioperative mortality and overall survival following complex EVAR procedures are comparable between sexes. Detailed population-based analyses of the incidence of complex aneurysms are needed to elucidate potential sex discrepancies in this cohort.

### Long-term outcomes of Fenestrated Endovascular Repair (FEVAR): A GLOBALSTAR registry study

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#### Background

GLOBALSTAR contains 1401 FEVAR cases (UK, 2003-2022). The aims of this study are to report long-term outcomes for survival and freedom from re-intervention for FEVAR.

#### Method

Inclusion criteria: all aneurysm morphologies, cmFEVAR. Dissections excluded. Time-to-event analyses were conducted for survival and freedom from re-intervention. A 10% threshold was applied to determine data maturity.

#### Results

N= 1401 (14 centres). Demographics: median age was 75 years [69-80,IQR], 87.9% male, highly co-morbid, 44.8% ischaemic heart disease. Survival data maturity reached 10 years and estimated survival [n=1401] at 3, 5 and 10 years were 79.0% [76.9- 81.2%, 95%CI], 63.4% [60.9- 66.1%] and 31.2% [28.2- 34.5%]. Median survival was 6.8 years [6.5-7.2, 95%CI]. Re-intervention data maturity reached 7 years and estimated freedom from re-intervention [n=1395] at 3, 5 and 7 years were 75.3% [72.7-77.9%], 68.5% [65.5-71.6%] and 64.4% [61.1-68.0%]. Mean time to re-intervention was 3.2 years. Females have significantly worse early survival (78.9%, [73.0-85.4%]) than males (86.0%, [84.1-88.0%]) up to 2 years (log-rank, p<0.01). Beyond 2 years, differences in survival do not reach significance. Octogenarians have equivalent survival (89.5%, [86.3-92.7%]) to non-octogenarians (91.6%, [90.0-93.4%]) up to 1 year (log-rank, p=0.19). Beyond 1 year, survival differences reach statistical significance, though octogenarians' median survival is 5.3 years [4.9-6.1]. There were 27 secondary ruptures over follow-up (1.9%, n=1401), with late ruptures (>8 years) accounting for 3.9% of late deaths (n=129).

#### Conclusion

FEVAR carries risk, especially of re-intervention, but provided effective case selection, may offer an acceptable treatment option for complex AAA patients, including females and octogenarians.

### Comparison of outcomes of Physician Modified Grafts and Custom Made Devices: A matter of aesthetics?

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#### Background

Physician modified endografts (PMEGs) are increasingly used in the treatment of complex abdominal and thoracoabdominal aortic aneurysms, yet robust comparative data with Custom Made Devices (CMDs) remain scarce. This study compares outcomes between PMEG and CMD repairs.

#### Method

We analysed patients undergoing elective complex juxtarenal and thoracoabdominal aneurysm repair using CMD (fenestrated EVAR) and urgent PMEG (ruptures excluded) between 2010 and 2024. Propensity score matching (1:1 nearest neighbour) was applied to adjust for confounders including aneurysm extent, prior repair, referral source, proximal landing zone, and number of target vessels.

#### Results

A total of 898 patients (753 men, 83.9%) with a median age of 75 years (IQR 70–79) were identified. Aneurysm types comprised juxtarenal (554; 61.7%), Extent IV (217; 24.2%), and Extent I–III (127; 14.1%). Of these, 117 (13.0%) underwent PMEG repair and 781 (87.0%) underwent CMD repair. PMEG patients were more likely to be referred from other centres (79.5% vs 51.7%,  $p<0.001$ ) and to present with thoracoabdominal aneurysms (67.5% vs 32.8%; OR=0.25, 95% CI 0.16–0.37,  $p<0.001$ ). In the matched cohort, 30-day mortality was higher in the PMEG group (8.5% vs 0.9%,  $p=0.013$ ), although long-term survival was comparable (median follow-up 20.2 months; HR=1.20, 95% CI 0.74–1.94,  $p=0.456$ ).

#### Conclusion

In selected patients, PMEG represents a viable option for urgent repair with acceptable long-term outcomes. Multi-centre studies are warranted to further substantiate these findings.

### The detrimental effects of Endovascular Aneurysm Repair on aortic compliance

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#### Background

Aortic compliance cushions left ventricular ejection, converting pulsatile cardiac function into steady peripheral arterial flow. When the aortic wall stiffens, haemodynamics are impaired, provoking damage in multiple organs. Endovascular repair of aortic aneurysms (EVAR) may affect aortic compliance, with significant subsequent cardiovascular and other consequences. We sought to explore the exact effects of EVAR on aortic stiffness.

#### Method

We conducted a non-randomised, prospective study with 140 consecutive patients undergoing elective EVAR or (Open Surgical Repair) OSR for AAA. Aortic stiffness was measured pre-operatively (T0), within one week of the operation (T1), 4-6 weeks (T2), and at one year (T3), using a validated non-invasive device (Vicorder) to measure carotid-femoral (cfPWV) and brachial-femoral Pulse Wave Velocity (bfPWV), as accurate estimates of aortic stiffness.

#### Results

Of 140 patients, 130 (93%) underwent EVAR. CfPWV was significantly correlated with bfPWV ( $p=0.467$ ,  $p<0.001$ ). EVAR resulted in a significant increase in cfPWV (T0:  $9.9\pm1.3$ , T1:  $11\pm1.6$ , T3:  $12.2\pm3.8$ , and T4:  $12.5\pm2.6$  m/s;  $p<0.001$  for comparison with T0) and bfPWV (T0:  $34.6\pm12$ , T2:  $40.4\pm12.4$ , T3:  $44.2\pm14.6$ , and T4:  $44.3\pm12.6$ ;  $p=0.002$  for comparison of T1 to with T0,  $p<0.001$  for comparison of T2 and T3 with T0). There were no significant differences across all time-points post-OSR.

#### Conclusion

In this study, the first to use both CfPWV and bfPWV in this context, EVAR, but not OSR, significantly reduced aortic compliance not only immediately post-intervention, but steadily over one year. The clinical significance of enhanced stiffness post-EVAR remains to be explored.

# Unsupervised machine learning for identifying thrombogenic morphological phenotypes in abdominal aortic aneurysms using fully automated volume-segmented imaging

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## Background

Thrombo- and microembolic complications following abdominal aortic aneurysm repair are hypothesised to be associated with wall thrombus burden, which is higher in women. Fully automatic volume segmentation (FAVS) of imaging enables extraction of morphological features from which thrombogenic phenotypes may be identified.

## Method

This was a multi-centre retrospective cohort study using FAVS to examine pre-operative imaging for elective AAA repairs (2013-2023). Radiological data were matched with National Vascular Registry thromboembolic outcomes data (cerebral, bowel, renal or limb ischaemia). Principal component analysis was used for dimensionality reduction, followed by unsupervised machine learning with k-nearest neighbours (kNN) clustering based on radiological parameters. The optimal number of clusters was determined using silhouette scores. Clusters were compared using multivariate logistic regression, adjusting for aortic size index, cardiovascular risk parameters, and repair type.

## Results

Of 1655 patients, 1455 had sufficient quality imaging for FAVS (145 women, 1310 men). kNN clustering identified two morphological subtypes (n=878 and n=577), with notable sex imbalance (13.8% vs. 4.1% women,  $p<0.001$ ). The clusters differed in wall thrombus burden across 16 of 24 parameters ( $p<0.01$ ). Thromboembolic outcomes were few in both clusters (2.6% vs 1.7%,  $p=0.35$ ). Adjusted multivariate regression suggested a trend towards higher thromboembolic events in high thrombus burden cluster (OR 1.56 95%CI 0.71-3.43,  $p=0.23$ ).

## Conclusion

Unsupervised machine learning can identify distinct morphological phenotypes with significant thrombus burden difference. These phenotypes exhibit sex imbalance and may correlate with thromboembolic outcomes. Further research is needed to explore mechanisms underlying the increased thromboembolic event rate in women, which is likely multifactorial.

### Fenestrated-branch endovascular aortic repair after prior endovascular or open AAA repair is associated with inferior mid-term survival compared to primary repair

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#### Background

To compare the outcome of elective fenestrated and branch endovascular aortic repair (FBEVAR) in patients with and without prior abdominal aortic aneurysm (AAA) repair.

#### Method

Single-centre retrospective study of consecutive patients who underwent elective FBEVAR between December 2007 and December 2024. Primary endpoint was Kaplan-Meier estimates of medium-term survival. Data are presented as median (IQR). A P-value of <0.05 was considered significant.

#### Results

Of 917 patients [761 men; median age, 75 (70-79) years] treated for juxtarenal (JR) AAA (n=519) or thoracoabdominal aortic aneurysms (TAAA) (n=398), 120 (12.4%) had prior AAA repair. Patients with prior EVAR (n=72) were significantly older [median age 77 (71-82) yrs vs. prior OSR/primary repair 74 (69-79); p=.008] and more likely to have JRAAA repair (81%), while those with prior OSR (n=48) were more likely to have extent I-III TAAA repair (52%) (p<.001). 30-day mortality was 2.1% (n=19; none in the prior repair cohort; NSD). Median follow-up was 46 months (19-80). Estimated 5-year survival ( $\pm$ SE) was significantly worse in patients who had prior EVAR (53% $\pm$ 7%) and prior OSR (56% $\pm$ 8%) compared with primary repair (66% $\pm$ 2%; p=.002).

#### Conclusion

FBEVAR after prior AAA repair is as safe as primary repair, but mid-term survival is inferior. This may be a consequence of older patients being treated after prior EVAR, and more extensive disease requiring repair after prior OSR.

### Novel protocol for comprehensive assessment of Type B Aortic Dissection morphology: A validated and reproducible protocol for clinical and research applications

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Ian Loftus, Peter Holt  
St Georges University London, London

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#### Background

This study aims to demonstrate the reproducibility of a novel imaging protocol for the analysis of aortic morphology of Type B Aortic Dissection (TBAD) for clinical and research purposes.

#### Method

Protocol was designed based on systematic review and expert opinion. A total of 56 morphological parameters were assessed across six morphological domains. To validate the protocol, 4 observers measured these variables on 20 computed tomographic (CT) angiograms on a total of 10 patients using 3-dimensional imaging reconstruction software. One observer performed repeated measurements. The intra- and inter-observer variabilities were calculated for all continuous variables. Cohen's kappa was used to assess agreement between observers for categorical variables. Measurement time for all 56 features was recorded.

#### Results

Aortic arch; false lumen morphology; endovascular intervention and aortic remodelling showed strong levels of agreement. Aortic measurements showed satisfactory intra- and interobserver variability with maximum repeatability coefficient (RC) for interobserver variability of 5.02 mm and intraobserver variability of 2.42 mm across all measurements. Dissection morphology demonstrated least favourable levels of agreement. Entry tear morphology including primary entry tear (PET) size and distance from left subclavian artery (LSCA) showed small mean differences but was associated with high RCs. The measurement protocol was completed in a median time of 28 (22-35) minutes.

#### Conclusion

Accurate three-dimensional analysis of TBAD morphology can be reliably performed within a reasonable timeframe. Measurements based on consistent anatomical landmarks demonstrated the highest reproducibility. It is suggested that this protocol is adopted for clinical studies and trials on acute TBAD.

### Implementation of Machine Learning and Natural Language Processing in clinical practice facilitates identification of patients with Acute Aortic Syndrome

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#### Background

The efficiency of referral of AAS to specialist care teams and to research studies is poor. The machine learning (ML) using natural language processing (NLP) can enhance and automate this process. Our earlier work demonstrated that NLP could enhance and automate identification of cases by analysing radiology reports, as opposed to relying solely on Electronic Health Records (EHR) or HES data. This study aimed to perform external validation of developed ML algorithm and to compare the efficiency of identifying cases of Acute Aortic Syndromes (AAS) through NLP-aided screening of radiology reports with that of EHR/HES data using ICD-10 codes.

#### Method

External validation of the algorithm was performed using radiology reports issued between 2011 and 2021 in the neighbouring Trust. Simultaneously, local EHR/HES was searched for AAS cases using ICD-10 codes.

#### Results

External validation of the developed ML algorithm performed on 40,030 radiology reports showed good model performance with AUC of 0.85. The EHR/HES screen identified patients with corresponding aortic pathology codes were cross-validated against NLP-identified cases. The cross-check revealed that 1 in 3 cases (28.7%) was not coded in EHR/HES. Patients without an ICD-10 code in EHR/HES were twice as likely to die during follow-up compared to those with a recorded ICD-10 code (HR 2.07, 95% CI 1.06-4.04, p=0.032).

#### Conclusion

Good performance of ML model on external validation could facilitate early identification of patients with AAS and improve referral pathway when implemented in the clinical practice.

### **Systematic review and meta-analysis of matrix metalloproteinases in peripheral arterial disease**

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#### **Background**

Several studies have investigated the role of matrix metalloproteinases (MMPs) and their tissue inhibitors (TIMPs) in peripheral arterial disease (PAD). The aim of this study was to undertake a meta-analysis to determine which MMPs and TIMPs are key in PAD and the effect of endovascular intervention.

#### **Method**

Literature review identified 16 studies suitable for inclusion. Meta-analysis was conducted where possible and systematic review undertaken when not. Meta-analysis was carried out using Review Manager 5.4.1 using standardised mean difference and random effects.

#### **Results**

Meta-analysis identified a significant increase in both MMP9 and MMP2 in PAD patients (MMP9 SMD 0.80 (0.37, 1.23  $p=0.0003$ ), MMP2 SMD 2.39 (0.88, 3.91  $p=0.002$ )). Meta-analysis was not possible for MMP-1, 3, 7, 10, 12 or 13 or TIMP-1 or 2 however systematic review showed significant increases in all MMPs and TIMP-1 in PAD patients compared to controls. TIMP-2 had no significant difference and neither TIMP was significantly dysregulated by endovascular intervention. Systematic review also showed significant dysregulation of MMP-3 and MMP-7 post-endovascular intervention at both 24 hours and 6 months post-operatively. MMP-9 levels were not significantly dysregulated by endovascular intervention at 24 hours (SMD 0.93 (-0.59, 2.46  $p=0.23$ )), however 6 months following intervention there was a significant decrease in MMP9 (SMD -0.45 (-0.65, -0.24  $p<0.0001$ )).

#### **Conclusion**

A wide variety of MMPs are dysregulated in patients with PAD however their clinical value is not yet established. Further work correlating the levels of MMP to walking distance and the impact on intervention should be carried out.

### **Clinical predictors of two-year survival in patients with infrarenal and juxtarenal abdominal aortic aneurysms**

**Valentina Scarati<sup>1</sup>**, Katarzyna Powezka<sup>2,1</sup>, Thomas Lyons<sup>2,1</sup>, Massimo Vezzosi<sup>1</sup>, Martin Claridge<sup>1</sup>, Donald Adam<sup>1</sup>, Maciej Juszczak<sup>1,2</sup>

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#### **Background**

Assessing life expectancy is crucial for shared decision-making and patient selection in infrarenal and juxtarenal aneurysm repair. However, survival predictors derived from population-level data may not apply to local cohorts due to inherent differences. We evaluated factors associated with 2-year survival in patients treated at a tertiary referral centre in the West Midlands.

#### **Method**

We analysed patients undergoing elective infrarenal and juxtarenal aneurysm repair using standard EVAR and fenestrated EVAR (FEVAR) between 2007 and 2021. Survival was assessed using Kaplan-Meier analysis with right censoring at 730 days, and stepwise Cox proportional hazards regression evaluated the effect of covariates on survival.

#### **Results**

A total of 656 patients (91.0% men) with a median age of 75 years [IQR 70.2-80.0] underwent repair (64.6% EVAR, 35.4% FEVAR) for infrarenal and juxtarenal aneurysms (median diameter 61mm [IQR 58-67]). There was a high prevalence of smoking (72.8%), hypertension (85.8%), ischaemic heart disease (44.2%), hypercholesterolaemia (85.1%) and respiratory disease (27.6%). On multivariable analysis, age (HR 1.04, 95% CI 1.01-1.08,  $p=0.008$ ), COPD (HR 2.03, 95% CI 1.32-3.11,  $p=0.001$ ), CVA (HR 1.76, 95% CI 1.05-2.97,  $p=0.033$ ) and treatment modality (HR 0.63, 95% CI 0.41-0.97,  $p=0.034$ ) were independently associated with 2-year mortality.

#### **Conclusion**

Optimising patient selection is essential to achieve acceptable long-term outcomes in infrarenal and fenestrated aneurysm repair. Survival predictors are likely to vary with local population characteristics and should be carefully considered.

### Acute Upper Limb Ischaemia outcomes meta-analysis

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#### Background

Acute upper limb ischaemia (AULI) is a vascular emergency, potentially requiring urgent intervention to prevent irreversible limb damage. Depending on symptoms patients may be managed medically, surgically or endovascularly. This study aims to report outcomes for each treatment option of AULI to guide clinical decision-making.

#### Method

EMBASE and Medline were searched for studies reporting outcomes for AULI including technical success, complications, reintervention, stroke, amputation and mortality. Data were analysed using Stata/MP, and probabilities were pooled using a DerSimonian and Laird random effects model with Freeman-Tukey arcsine transformation.

#### Results

27 studies were identified for inclusion. Conservative management (10 studies, 214 patients), surgical embolectomy (17 studies, 2712 patients) and endovascular intervention (7 studies, 101 patients) identified overall success rates of 75.69% (95%CI: 50.43–94.71), 90.94% (95%CI: 85.27–95.50), and 69.43% (95%CI: 43.30–90.77) respectively. Reintervention rates were significant in both the surgical (16.24% 95%CI: 6.67–28.24) and endovascular groups (49.88% 95%CI: 31.50–68.28). Overall complication rates were high in those undergoing surgical intervention (19%), with significant rates of stroke 9% (95%CI: 3–14), amputation 6% (95%CI: 3–7), and mortality 10% (95%CI: 5–14).

#### Conclusion

Although surgical management appears to have the highest overall technical success, there remains a significant risk of complications in these patients, and paucity of data on endovascular and conservative management options. In addition, this cohort of patients has a significant risk of mortality. Further prospective and randomised studies are essential in this area.

### **A comprehensive systematic review of all reported outcome measures in studies of Chronic Limb Threatening Ischaemia: First step toward a core outcome set**

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#### **Background**

The prevalence of Chronic limb-threatening ischemia (CLTI) is increasing and associated with high morbidity and mortality. Published research in CLTI is evolving but there are currently no outcome reporting standards for research in CLTI. The aims of this review were to describe and categorise all reported outcome measures in published studies of CLTI, and review discrepancies in their definitions.

#### **Method**

Medline, Embase, CINAHL, and Cochrane Central databases searched from inception until March 2024 to identify all studies recruiting CLTI patients and reporting at least one outcome measure. Abstract, full text screening, and data extraction were performed by two investigators independently. Outcome measures extracted verbatim. (PROSPERO: CRD42023412204)

#### **Results**

A total of 19,760 abstracts and 4,516 full texts were screened: 1,284 studies were included. Across all the studies 678 unique outcomes were reported, 481 (71%) of these were reported once. All-cause mortality, primary patency, and Major Adverse Limb Events (MALE) were the most frequently reported outcome measures. Patient-reported Outcome Measures (PROMs) were reported in fewer than 37% of all the studies. Validated quality of life tools were used in only 26% of the studies. There were wide variations in definitions of commonly used endpoints across the studies.

#### **Conclusion**

There is substantial heterogeneity of outcome measures in studies of CLTI. Consensus regarding which outcomes to use, standardised definitions, and optimal methods to measure some of these outcomes are yet to be established. A core outcome set for CLTI is urgently needed to improve the quality and comparability of CLTI studies.

### Feasibility phase of Platelet Research in Optimising Response in Treatment for Angioplasty (PRiORiTY) Study

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#### Background

Lower limb revascularisation is a key treatment for critical limb ischaemia (CLI), aiming to restore perfusion and prevent limb loss. Dual antiplatelet therapy is widely used, yet patient response varies, and poor platelet inhibition is associated with poor outcome. The PRiORiTY study aims to evaluate platelet function testing to optimise treatment.

#### Methods

As part of feasibility phase of the PRiORiTY study, platelet function test was carried out in 28 patients undergoing revascularisation with the antiplatelet regimens. Platelet function was assessed using a thromboelastography with platelet mapping. An ADP value <42 was classified as poor platelet inhibition (Ferreira et al. 2024). Outcomes including revascularisation rates, amputation, and mortality were assessed.

#### Results

Poor platelet inhibition was observed in 19/28 patients (68%). Among 10 patients followed for 4–12 months, 6 (60%) required repeat revascularisation, 2 underwent major amputation, and 1 died with a median time of 7 months to repeat procedure. One patient remained event-free. In contrast, patients with optimal platelet inhibition had a 44% repeat revascularisation rate, no major amputations, and rest remained event-free with a longer median time.

#### Conclusion

Our initial data indicates a significant proportion of CLI patients exhibit resistance to standard antiplatelet therapy, leading to high rates of repeat revascularisation and major amputation. Despite identifying high-risk patients using platelet function testing, the lack of personalised treatment strategies may contribute to poor outcomes. The feasibility phase of the PRiORiTY study demonstrates the practicality of platelet function testing in real-world settings and its potential to guide personalised antiplatelet therapy.

### Real-world experience of Indigo aspiration thrombectomy for acute limb ischaemia

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#### Background

We evaluated the outcomes of the Indigo aspiration thrombectomy system (Penumbra Inc) in the management of acute limb ischaemia (ALI).

#### Method

All patients with ALI who were treated with Indigo aspiration thrombectomy at a single large UK tertiary centre between Jan 2021-Aug 2024 were identified via the Radiology Information System (RIS). RIS and Electronic Patient Record were used to record patient demographics, Rutherford score, device, adjunctive procedures, complications, and 30-day and 1-year mortality and amputation rates. Technical success was defined as Thromboaspiration in Peripheral Ischaemia (TIPI) score 2/3 evaluated by an interventional radiologist reviewing the procedural images.

#### Results

81 patients with ALI were treated with Indigo aspiration thrombectomy over a 3-year period. The mean age was 67 years and 70% were male. Adjunctive techniques included angioplasty (n = 55), stenting (n = 33) and thrombolysis (n = 19). Technical success (TIPI 2/3) was achieved in 85% of patients. No device-related adverse effects recorded. Follow-up data was available on 73 patients. At 30-day follow-up, there were 4 deaths and 18 major amputations. 30-day amputation-free survival was 74%. At 1-year follow-up, there were an additional 10 deaths and 6 major amputations. 1-year amputation-free survival was 59%.

#### Conclusion

Our results are comparable to TOPAS and STILE data on catheter-directed thrombolysis and surgical embolectomy. Our results are inferior to INDIAN and STRIDE registries, perhaps reflecting the real-world nature of our cohort, and also due to a learning curve with the Indigo system at the start of the study period.

### Endovascular vs. Open Surgical Repair of Popliteal Artery Aneurysms: A Meta-Analysis

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#### Background

Popliteal artery aneurysms (PAAs) are the most common peripheral arterial aneurysms, with endovascular (EVAR) and open surgical repair (OSR) being the primary treatment modalities. The optimal approach remains debated, with concerns regarding long-term durability and reintervention rates. This meta-analysis aimed to compare EVAR and OSR for PAAs, focusing on patency, limb salvage, reintervention, and complications.

#### Method

A systematic review was conducted using PubMed, Google Scholar, MEDLINE, Embase, Cochrane and Scopus. Studies reporting mid-term (1–5 years) or long-term (>5 years) outcomes of EVAR and OSR for PAAs were included. A total of 1140 records were screened, with 22 studies meeting the inclusion criteria. Extracted data included patient demographics, aneurysm characteristics, intervention type, follow-up duration, and key clinical outcomes. A random-effects model was used for meta-analysis, and heterogeneity was assessed using the  $I^2$  statistic.

#### Results

The meta-analysis included 22 studies with 1823 patients undergoing EVAR or OSR for PAAs. Primary and secondary patency rates at 12 and 24 months were comparable between EVAR and OSR (ORs: 0.74–1.25,  $p > 0.20$ ). Limb salvage rates remained high (98%–100%) across both groups. EVAR demonstrated a non-significant trend toward reduced reintervention. No significant difference in survival outcomes was observed at 12 and 24 months. Study heterogeneity was noted but did not alter findings.

#### Conclusion

EVAR and OSR provide comparable outcomes in PAA management. EVAR offers a minimally invasive alternative with faster recovery, whereas OSR remains suitable for complex cases. Treatment should be individualized based on anatomical and patient-specific factors.

### Endovascular treatment with intravascular lithotripsy for common femoral artery disease: A safe and feasible alternative to open surgery

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#### Background

Common femoral endarterectomy (CFAE) is considered the gold standard for common femoral artery (CFA) occlusive disease; however, it carries significant complications, with surgical-site infection reported in almost a third of cases. Endovascular innovations, such as intravascular lithotripsy (IVL) for vessel preparation, may provide an alternative to CFAE.

#### Method

Patients undergoing endovascular treatment with IVL for CFA occlusive disease at a single tertiary centre from January 2021 to September 2024 were identified, and their electronic records were reviewed. Descriptive analysis was undertaken including co-morbidities, Rutherford status, length of stay, complications, primary patency, freedom from revascularisation, amputation, and mortality rate.

#### Results

Thirty-two consecutive patients received endovascular treatment with IVL for CFA occlusive disease (male  $n=20$ ; median age=72, IQR 68-79). Most had hypertension ( $n=27$ , 84%) and diabetes ( $n=18$ , 56%), followed by hypercholesterolaemia ( $n=13$ , 41%) and ischaemic heart disease ( $n=10$ , 31%). Most presented with Rutherford 5 disease ( $n=16$ , 50%). Fourteen individuals had received previous revascularisation including CFAE ( $n=7$ , 22%) and CFA stenting ( $n=1$ , 3%). Median length of stay was 4 days (IQR 1-7). Three complications were reported: bleeding, acute limb ischaemia and infection. Six-month primary patency was 84%, freedom from target vessel revascularisation 94%, amputation rate 19% and mortality rate 54%.

#### Conclusion

Endovascular treatment with IVL for CFA occlusive disease is safe and feasible with low complication rates, short hospital stays and good freedom from target vessel revascularisation. Given the clinical equipoise, a randomised controlled trial is needed to assess the clinical and cost-effectiveness of CFAE versus endovascular treatment for CFA occlusive disease.

# The Fate of the Contralateral Limb after Major Lower Limb Amputation for Peripheral Arterial Disease or Diabetes Mellitus

**Robert Leatherby**<sup>1,2</sup>, **Bilal Azhar**<sup>1,2</sup>, **Peter Holt**<sup>1,2</sup>, **Iain Roy**<sup>1,2</sup>

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### Background

The contralateral limb (CL) is at risk after major lower limb amputation (MLLA) due to the systemic nature of the underlying disease. Establishing the fate of the CL will determine whether there is a role for clinical surveillance.

### Method

A single centre retrospective cohort study inclusive of all patients undergoing MLLA between 01/01/2013 and 01/07/2023 for PAD or DM was performed. Those with previous or concurrent CL MLLA were excluded. Kaplan-Meier survival plots and Cox-proportional hazard ratios were calculated for development of CL disease, and CL amputation-free survival (CL-AFS) was determined for those undergoing CL-revascularisation.

### Results

531 patients underwent first unilateral MLLA during the study period. Of these, 175 (33.0%) developed CL disease with 67% of this presenting within the 1<sup>st</sup> year. Patients primarily presented with CLTI (70.3%) and DFI (13.1%). Disease at presentation was severe with 76.5% of symptomatic patients presenting with tissue loss. Independent predictors of developing CL disease were chronic PAD, DM and significant radiological CL disease. 127/175 patients went on to have intervention, with 95 revascularized (137 procedures; 84.7% endovascular, 13.1% open, 2.2% hybrid) and 50 requiring a CL-MLLA. Two-year CL-AFS after revascularisation was 45.3%, with those representing with Rutherford 3/4 disease having a 2-year CL-AFS of 60.9% compared to 33.9% for Rutherford 5/6.

### Conclusion

CL disease after MLLA is common and presents early with severe clinical disease. High risk groups can be defined and intervention at an earlier clinical stage may improve outcome, creating a strong case for surveillance of the CL after MLLA.

# Clinical significance of high on-treatment platelet reactivity in patients taking P2Y12 inhibitors following lower limb revascularisation for peripheral artery disease: A systematic review and meta-analysis

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## Background

The effect of P2Y12 inhibitors such as Clopidogrel are known to be reduced in certain individuals due to a phenomenon named High on-treatment platelet reactivity, HTPR. However, the clinical effect of HTPR in patients on P2Y12 inhibitors following lower limb revascularisation for Peripheral Artery Disease, PAD is not clear. The aim of this study was to assess the clinical impact of HTPR following lower limb revascularisation.

## Method

Systematic review and meta-analysis of studies assessing platelet function following lower limb revascularisation was done. The primary outcome was all-cause mortality. Secondary outcomes were major adverse cardiovascular events, MACE; major adverse limb events, MALE; and target lesion revascularisation, TLR. Outcome quality was assessed using the Grading of Recommendations Assessment, Development, and Evaluation, GRADE tool.

## Results

A total of 24 studies enrolling 3121 patients were included. The pooled incidence of HTPR was 28% (95% CI 26–34). There was a slightly higher risk for all-cause mortality in patients with HTPR (OR 1.77, 95% CI 0.98 – 3.01,  $p = 0.05$ ), similarly for MACE (OR 5.12, 95% CI 0.72 – 37.61,  $p = 0.18$ ). HTPR was associated with MALE (OR 7.09, 95% CI 2.27 – 17.24,  $p = 0.001$ ). Clopidogrel was used in all the studies (either alone, with other P2Y12 Inhibitors, or other antiplatelets). All the outcomes were found to have very low level of evidence.

## Conclusion

HTPR was associated with increased risk of clinical outcomes in patients on P2Y12 inhibitors following lower limb revascularisation. Further studies are required to assess tailored antiplatelet therapy in PAD patients.