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The Vascular Society for Great Britain and Ireland

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The Vascular Society of Great Britain and Ireland (VSGBI) is the pre-eminent organisation in the country promoting vascular health by supporting and furthering excellence in education, training and scientific research.

The Society represents and provides professional support for over 600 members, including vascular surgeons, vascular radiologists and others involved in independent vascular practices in Great Britain and Ireland.

The Society focuses on non-cardiac vascular disease, including diseases of the aorta, peripheral arteries, veins and lymphatic. Vascular specialists are trained in the diagnosis and management of conditions affecting all parts of the vascular system.

The VSGBI is a charitable organisation funded by members subscriptions, an annual scientific meeting, grants and donations. It has a professional structure including a permanent Secretariat, Executive Officers and Council elected by Members.

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Membership of the Society is widely recognised in the vascular community as a mark of professional achievement.

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- The VSGBI **publishes a quarterly journal,** the *Journal of the Vascular Societies Great Britain and Ireland*, which is available to its members.
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Editor's foreword

Welcome to the February 2025 edition of the *JVSGBI*.

The first editorial provides a response from (past) presidents of the VSGBI and Rouleaux Club regarding findings from a survey, also in this edition, of UK vascular surgeons regarding the role of physicians' associates in vascular surgery. This survey highlights concerns regarding scope of practice, governance and impact on trainees. These concerns persist in those vascular surgeons who have experience of working with physicians' associates. Hopefully the upcoming Leng report will recommend solutions to this complex and difficult problem.

Our second editorial provides guidance on the establishment of "hot clinics" to address the increasing service provision challenges associated with chronic limb threatening ischaemia.

The second original article provides an 8 year audit of ruptured AAA management in a single centre, highlighting the importance of capturing information on those patients who were managed conservatively / with palliative care.

The third original article, an international survey, highlights the extreme variability in VTE prophylaxis following superficial endovenous ablation therapy, most likely due to the paucity of evidence based guidelines and emphasising the importance of the ongoing THRIVE trial.

This edition also contains the protocol for a systematic review of treatment strategies for mixed arteriovenous leg ulcers. This systematic review once completed will hopefully provide valuable information regarding the optimal management of these difficult cases. Additionally there is a review of the management of carotid webs, a rare but important carotid pathology.

Finally this issue contains two case reports, the second from New Zealand, perhaps signifying the reach our relatively new journal has achieved.

Once again I would like to take this opportunity to thank our reviewers for their time and effort in reviewing articles, authors for submitting to our journal and admin / editorial team for their hard work in processing submitted articles and formatting articles for publication.

Ian Chetter
Editor in Chief JVSGBI
Vascular Society GBI President

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EDITORIAL

Is there a cuckoo in the nest? How to rear and develop a new professional group

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In this edition of *JVSGBI*, we can see the views of VSGBI members at various stages of their career on working with a new group of colleagues, Physician Associates (PAs).[1] This survey followed a vigorous debate that played out in both social and mainstream media. The ramifications spread to the highest levels of medical leadership, with strong support from the Department of Health. After an extraordinary meeting of the Royal College of Physicians it led to the resignation of the sitting president. This new group of workers, the PAs, has generated discussion across all colleges and the Academy of Royal Colleges and there was debate at the Surgical Forum of Great Britain and Ireland early in 2024. In the end we are a membership organisation, interested in how we can work best to support our patient group. Knowing our members' views will be fundamental to any change.

Why such a negative perception around what on the face of things can be interpreted as additional help? For the answer we need to look at the current pressure points within vascular surgery and the wider profession. Over the last few years there has been unprecedented industrial action, led by the British Medical Association, around pay and terms and conditions for both consultants and resident doctors. This reflects a workforce that is deeply dissatisfied with its value and professional standing. Resident doctors feel that, with the current complex working conditions, their training and professional development are under threat. Added to this, in order to develop they need time from experienced consultant clinical supervisors. It is therefore no surprise that the emergence of a new professional group is associated with a perceived threat to both training opportunities and supervision time of consultants. The survey results published in this edition detail some real-world experiences, including training opportunities being undertaken by PAs and the presence of PAs creating additional work for vascular trainees.

The plan for professional regulation is clearly important. The use of the General Medical Council (GMC), as opposed to other bodies, has brought suspicion about the potential conflation of roles. In particular, the language around medical professionals may be perceived as implying a medical qualification. Whilst wanting to regulate PAs, the GMC is clear that it will not take a lead on scope and role. It is also clear that, as a group of graduates pursuing further education, PAs are capable individuals who will seek development.

For years in surgery, however, we have cried out for more support for the surgical workforce. How will we be perceived if we now dismiss this offer of help? The paper published in parallel shows that there is concern at a consistent level, irrespective of whether PAs are employed within the unit reporting. PA roles within each of the units vary considerably. In vascular surgery we have offered great clarity over the years in the development of our service models and teams, with serial additions of POVS.[2,3] We need to challenge ourselves to articulate where we need additional help and support to develop our service. As consultants, we want to maximise time with patients and resident doctors in the clinic, ward and operating theatre. In addition, residents need to feel supported and enabled to use all the learning opportunities within our units as the first priority. We need to be clear about what activity we feel can be delegated under a level of supervision. Amongst this will be some

Key words: Physicians Associate, training

administrative roles that may not suit the PA role when it is defined. If we are to integrate PAs within a service, we need to be clear about their role and the capacity to provide clinical supervision. As a professional group we need to be certain that PAs will, rightly, seek professional development, and we need to be part of that consultation.

We welcome the Leng report and hope that it will provide a thorough review of the situation to date, after listening to all the stakeholder feedback. We hope, having taken due time to reflect, to formulate a helpful guide to take things forward.

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EDITORIAL

Models of same-day emergency care for vascular limb salvage

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Introduction

The efficient and effective management of patients with chronic limb-threatening ischaemia (CLTI) is a challenge for UK vascular services, due to the volume and complexity of patients and centralisation of services.[1,2] In an attempt to provide comprehensive limb salvage services in keeping with the global vascular guidelines,[3] more than 14,000 revascularisation procedures are performed in the NHS every year.[4] Despite our best efforts, outcomes (amputation and mortality) for these patients remain relatively poor, and may be related to delays in revascularisation.[5]

The recent Vascular Society of Great Britain and Ireland (VSGBI) Peripheral Arterial Disease Quality Improvement Framework (PADQIF) recommends intervention for CLTI within five days for inpatients and 14 days for ambulatory outpatients.[6] In an attempt to achieve these targets, certain UK centres have established emergency vascular or "hot" clinics. These one-stop clinics incorporate full clinical assessment of patients with CLTI with consultant review, supported by laboratory and imaging facilities. This facilitates multidisciplinary discussion prior to intervention and may prevent unnecessary hospital admission.

The challenges of establishing and managing these "hot" clinics may minimised by the knowledge and experience of those who have already been through this process.

Hot clinics in other specialities

Broadly speaking, hot clinics facilitate the rapid outpatient assessment and management of those urgent presentations which are not urgent enough to trigger admission. There is often variation in specific staffing, available investigation modalities and management pathways, depending on the speciality or available resources.

Trauma (plastics and orthopaedics)

Both plastic surgery and orthopaedics have a long history of using the hot clinic model to manage minor trauma. This approach helps to improve patient flow, reducing lengthy waiting times in the emergency department. In hand trauma, hot clinics and hot emergency operating lists can reduce waiting times and length of stay and they save the department approximately £1,000/day.[7]

General surgery

The diversity and severity of presentations of acute vascular patients are perhaps more reminiscent of the acute general surgical than the minor trauma population. Despite this challenge, general surgery has increased the use of ambulatory clinics for the assessment and management of non-critical abdominal pain. Observational studies suggest a large reduction in unnecessary admissions and increased patient satisfaction.[8] Indeed, this approach has been so successful that most emergency general surgical services utilise some form of Same Day Emergency Care (SDEC) service.

Care of the elderly

With particular relevance to vascular surgery, the development of an acute frailty service is part of the NHS long term plan (2019), which aims to provide multidisciplinary comprehensive geriatric assessments (CGA) in acute medical services.[9] These services, often an acute outreach service rather than a true hot clinic, share our speciality's objectives of avoiding unnecessary admission, and may reduce mortality and improve quality of life.[10–12]

Key words: peripheral arterial disease, chronic limb-threatening ischaemia, emergency vascular clinic

Hot clinics in vascular surgery

Several UK vascular units have introduced hot clinics in recent years, in response to the increasing CLTI workload, poor patient pathways and long inpatient waits for urgent care. However, as of 2021, fewer than half of vascular units utilised hot clinics for urgent assessment of patients with CLTI,[13] even though they were recommended in the 2019 Global Vascular Guidelines.[3] Ambulatory pathways can reduce inpatient stay, particularly in the pre-operative period, with subsequent reduction in deconditioning and opportunity for prevention of functional decline. The benefits to patients are complemented by economic efficiencies and therefore NHS Trusts are generally supportive of these initiatives.

Presented are three UK examples of early adopters, whose ambulatory emergency care model has undergone iterative changes with growing experience. The benefits and challenges in each example are discussed, recognising that many other excellent models exist. Sharing learning points may help to meet the challenges of UK vascular service provision and plan future models of care. Figure 1 provides a summary of the three services.

Figure 1 Diagram summarising each of the three services described in the manuscript.

	GSTT	Bristol	Leicester
Indication	Admission avoidance	Rapid assessment	Rapid assessment
Funding	Business case: Bed day savings	Business case: Bed day savings	Initially research grant funded, now fully funded NHS clinic
Initial staffing	CNS On-call consultant input	CNS Dedicated consultant	CNS and consultant input
Current staffing	CNS 2-3x Dedicated consultant	Band 5 nurse Dedicated consultant	Band 5 nurse Dedicated consultant
Condition seen	Any acute vascular (except life threatening emergencies)	Any acute vascular (except life threatening emergencies)	CLTI only
Referral source	Any clinician	Any clinician	Any clinician
Referral pathway	Via Vascular SpR oncall (via referapatient)	Via Vascular SpR oncall (via referapatient) or CNS triage (via an electronic referral system)	Direct to clinic
Hours	Mon-Fri Less than full time	Mon-Fri 9am to 1pm	Mon-Fri 9am to 1230pm

Bristol

This service was designed as a Clinical Nurse Specialist (CNS)-led, consultant-supported service to reduce unnecessary admissions. The business case was based on admission avoidance and bed day cost savings. The service, which started in 2014, reviews patients with any suspected acute vascular diagnosis, excepting life- or limb-threatening emergencies, within 48 hours of referral. The clinic is staffed by a CNS and supported by the on-call consultant, with duplex ultrasound (DUS) availability. It runs during weekday mornings. Referrals are accepted from any doctor in primary or secondary care and are reviewed on a case-by-case basis to determine their suitability for hot clinic review and the timeframe.

Although the initial model utilised both CNS and consultant expertise, over time this staffing model has been revised. It now includes a band 5 and a band 3 nurse to support a consultant-delivered service, in order to avoid skill-set duplication and to free CNS expertise to support other service areas.

Model-specific successes include support from a dedicated clinical vascular scientist, and additional clinic room availability to ensure maximal service efficiency. Same-day pre-assessment appointments to facilitate rapid access to operating slots following clinic review have also proved invaluable. Additional band 3 nurse training has extended the role to completing ankle and toe brachial pressure index (ABPI and TBPI) assessments.

In this setting, there was a trial of utilising the hot clinic for follow-up appointments when other clinics were overbooked. This was found to be an inappropriate use of resources and was stopped.

Guy's and St Thomas' (GSTT)

The emergency vascular clinic (EVC) at GSTT was established to reduce unnecessary admissions for urgent but non-emergency presentations, incorporating CLTI, symptomatic carotid stenosis, iliofemoral deep venous thrombosis (DVT) and embolic presentations. The clinic is CNS-led with support from a consultant vascular surgeon, offering DUS and cross-sectional imaging (computed tomography angiography [CTA] and magnetic resonance venography [MRV]). The service has been demonstrated to be a safe and efficient pathway, avoiding unnecessary admissions.[14] The original model, developed as a pilot, utilised a seconded senior vascular ward nurse (Band 6). This required investment in training, with both the advanced assessment skills course and non-medical prescriber courses being undertaken to support the CNS-led role in the service.

Referrals were taken by the registrar on call and triaged as being appropriate for EVC review. The CNS undertook initial assessment, blood tests and organised imaging, and following review by the on-call consultant of the week, an ongoing management plan was made. In ambulatory cases, the CNS assisted with multidisciplinary team (MDT) referral and admission

planning. Additionally, a prospective database was maintained to ensure no patient was 'lost' in the system.

This service was deemed safe and both clinically effective and cost-effective. A successful three-year business plan application guaranteed that the service continued and expanded. Early challenges included variability in the availability of the consultant of the week to review patients, resulting in occasional long patient delays or discharge without a clearly defined management plan. In response to this, and during COVID when the clinic was both very busy and physically remote from the arterial hub site, a dedicated rotating EVC consultant was introduced. This system has remained, and the CNS numbers have been expanded to facilitate a training rotation for less experienced CNS staff. In addition, administrative support has been provided to assist in the booking of appointments and uploading relevant referral information to the electronic patient record in advance of the patient attendance. A band 3 health care assistant with an enhanced role including phlebotomy has been added to the team.

The current model is largely based on a CNS-led clinic for the assessment of urgent patients and expedited post-operative review to facilitate early discharge, with consultant review for decision making, definitive planning and 'ownership' of patients, which has been identified as a key component of care.

Leicester

The Leicester vascular limb salvage (VaLS) clinic model was established to address delays in the management of patients presenting to their community healthcare teams with suspected CLTI. It was initially funded through a philanthropic clinical research donation and, following its successful trial, is now a fully funded NHS clinic. The clinic focuses on suspected CLTI and accepts referrals from all sources, with no specific inclusion or exclusion criteria. Other vascular pathologies are not routinely reviewed in this clinic. Initially the clinic was designed as a nurse-led clinic with consultant oversight to see only new CLTI patients. However, over time, due to service demands, it has evolved into a consultant-delivered service with nursing support, with additional capacity allowing early post-operative review following revascularisation. The clinic runs every weekday morning, can accommodate 10 patients per clinic, and is supported by a dedicated clinical vascular scientist. Uniquely, in addition to ring-fenced outpatient scanning facilities for cross-sectional imaging, this service has dedicated angiography and hybrid theatre slots available to ensure timely intervention in the case of confirmed CLTI. The Leicester VaLS model is associated with improved freedom from major amputation.[15]

Challenges

The CLTI patient population present unique challenges. The triple threat of frailty, multimorbidity and polypharmacy raises some specific issues in ambulatory services. Many patients will require multiple medications to be dispensed during their time in the hot clinic, including analgesia, diabetic medications, anticoagulation and hydration (especially around CT angiograms), and the nature of CLTI often has implications for mobility and transport.

The PADQIF targets for CLTI necessitate prompt MDT discussion and revascularisation. Daily "mini" MDTs to ensure timely discussion and decision-making have been introduced in some centres. Revascularisation challenges include appropriate list, environment and skill set availability. Ring fencing specific lists for hot clinic patients reduces overall capacity for vascular inpatients. A common question in daily vascular practice is whether inpatients should receive operative priority over ambulatory patients. Although a hot clinic helps with assessment and planning, implementing the management plan still poses significant challenges. The ever-evolving sub-specialisation of services and expansion in the range of technologies and techniques available to treat complex disease also pose a challenge to scheduling patients rapidly, adding an additional dimension of matching the patient to the physical environment (open, hybrid or endovascular suite) and skill mix of the surgical team required to offer optimal care. This is a challenge which also presents opportunities for teams to embrace closer collaboration with colleagues and ongoing professional development in this context. However, this requires the support of senior decision-makers within a Trust.

The hub and spoke model presents specific challenges and frequently results in inequality in patients' access to vascular services, with spoke CLTI patients experiencing longer peri-operative journeys. This situation may be exacerbated by hosting the emergency vascular services in a hub site. Potential solutions include spoke hot clinics, scan support for diabetic foot clinics, and reserved hot slots in routine vascular clinics with rapid access to imaging.

The future

Virtual clinics

Trauma and orthopaedics have successfully implemented virtual hot clinics.[16,17] Virtual vascular surgery hot clinics incorporating video or photographs would minimise patient transport and associated environmental costs and perhaps alleviate some spoke/community podiatry support challenges. This might, however, increase workload as virtual appointments are often easier to obtain and may require more time and digital functionality.

Post-revascularisation care

The post-discharge management of CLTI patients following revascularisation is often complex, and complications are not uncommon. Hot clinics have the potential to support this care, similar to how general surgery same day emergency clinics (SDECs) are often used, but it would require a rapid expansion of staff and funding. This is currently being trialled in Leicester, using a parallel hot clinic to review urgent non-CLTI referrals (aneurysms and carotids) and undertake post-operative reviews. This is very

much in an early phase, and it remains to be seen whether it provides enough utility to merit continued funding.

The approach of expedited discharge, with heavy community support, has been trialled in post-stroke care.[18] It is unclear whether this type of post-operative outpatient service would be cost-effective by reducing inpatient stays in vascular surgery, especially given the expense of establishing such a service.

Complex geriatric assessment and anaesthetic input

A geriatric / anaesthetic assessment service embedded within the hot clinic itself may be a useful addition to current service models. This would facilitate same-day CGA, expedite and direct investigations and would holistically inform decision-making.

Same-day treatment

Despite the complexity of vascular patients and interventions for CLTI, the increasing use of endovascular surgery has provided the option of day-case angioplasties. This provides a completely ambulatory treatment pathway for carefully selected patients with CLTI. These day case pathways must be carefully developed to select appropriate patients and manage potential complications safely but may avoid admission completely.

Conclusion

Hot clinics have the potential to improve urgent access to acute vascular services. Inherent in the success of such services is a reliable pathway to rapid and efficient assessment, investigations, decision-making and intervention. Such models are likely to have a positive effect on time to revascularisation, major lower limb amputation and mortality.

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ORIGINAL RESEARCH

The Vascular Society of Great Britain and Ireland and Rouleaux Club membership survey on the role of Physician Associates in vascular surgery

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Plain English Summary

Why we undertook the work: Increasing the number of people who work for the NHS is part of the UK government's NHS Long Term Plan. One way of doing this is to employ Physician Associates (PAs). PAs were introduced in 2003 and are trained to support the multidisciplinary team, under supervision. Recently there has been a big increase in the number of PAs in the NHS. This has caused some vascular surgeons to raise concerns about PAs in vascular surgery departments.

The purpose of this survey was to understand the role PAs currently have in providing care to people with vascular diseases. The survey also wanted to gather vascular surgeons' opinions on how PAs should be involved in providing care to people with vascular diseases.

What we did: A group of vascular surgeons developed and tested the survey, which contained a mix of multiple choice and free text questions. The survey had four parts which asked questions about:

Part 1: The tasks PAs are currently undertaking in vascular departments

Part 2: How PAs are supervised and trained in vascular departments

Part 3: Vascular surgeons' opinion on PAs and patient care in vascular surgery

Part 4: Vascular surgeons' opinion on PAs and doctor workloads and opportunities to train in vascular surgery.

We used an online survey tool to send out the survey to vascular surgeons and trainees in the UK and Ireland in June 2024.

What we found: 194 vascular surgeons from 59 NHS Trusts in the UK and two vascular units in the Republic of Ireland completed the survey. 52 out of 194 (27.8%) vascular surgeons worked with PAs in their vascular department. 60 out of 194 (30.9%) vascular surgeons support the introduction of PAs in the NHS workforce.

The most frequent tasks carried out by PAs included taking a patient's medical history, examining patients and requesting scans (for example ultrasounds).

Vascular surgeons felt that PAs should not be involved in:

- Performing operations:
  - 43 out of 52 (82.7%) vascular surgeons who work with PAs
  - 114 out of 142 (80.3%) vascular surgeons who do not work with PAs
- Prescribing medications:
  - 33 out of 52 (63.5%) vascular surgeons who work with PAs
  - 70 out of 142 (49.3%) vascular surgeons who do not work with PAs
- Training doctors and medical students
  - 31 out of 52 (59.6%) vascular surgeons who work with PAs
  - 95 out of 142 (66.9%) vascular surgeons who do not work with PAs

Vascular surgeons who completed the survey felt that PAs could have a positive impact on patient care, but the way PAs have been introduced in the NHS has resulted in problems with patient safety, reduced the opportunity for postgraduate doctor training and increased doctors' workloads.

What this means: Currently, the majority of vascular surgeons who completed this survey do not support the introduction of PAs in vascular surgery departments. Vascular surgeons' concerns about patient safety, appropriate tasks for PAs and postgraduate doctors' training need to be addressed before more PAs are employed by vascular surgery departments.

Abstract

Background: The UK government's proposed expansion of the role of Physician Associates (PAs) in the NHS is an ongoing topic of debate. This survey aimed to capture the opinion of members of the Vascular Society of Great Britain and Ireland (VSGBI) and The Rouleaux Club on the role of PAs in vascular surgery.

Methods: A Qualtrics online survey tool was used to distribute a pre-piloted survey through relevant mailing lists to vascular surgeon members of the VSGBI and the Rouleaux Club. Data were captured on the current role of PAs in vascular surgery and the perceived impact of PAs on patient care, workload and training opportunities. The survey collected responses between 7th and 25th June, 2024.

Results: The survey received 194 responses from 59 NHS Trusts in the UK and two vascular units in the Republic of Ireland. Most respondents were consultant vascular surgeons (98/194; 51%). Of the respondents 26.8% (52/194) worked with PAs. 69.1% (134/194) of respondents do not support the presence or introduction of PAs in vascular surgery. The most frequent tasks carried out by PAs included taking a medical history (42/52; 86.5%), physical examinations (40/52; 76.9%) and requesting diagnostic investigations (excluding ionising radiation) (37/52; 71.2%). Respondents felt that PAs should not be involved in performing procedures (units with PAs: 43/52, 82.7%; units without PAs: 114/142, 80.3%), prescribing (units with PAs: 33/52, 63.5%; units without PAs: 70/142, 49.3%), training resident doctors/medical students (units with PAs: 31/52, 59.6%; units without PAs: 95/142, 66.9%). Themes that arose from the free text responses included the potential positives of PAs, organisation flaws that have led to the perceived problematic introduction of PAs and the negative impact of PAs on patient safety, resident doctor training and doctors' workload.

Conclusions: Fewer than a third of the vascular surgeons who responded to this survey were supportive of the introduction of PAs into vascular surgery. This is driven by concerns for patient safety, unclear scope of practice and perceived negative impact on medical training.

Key words: physician associates, vascular surgery, survey

Background

Physicians Associates (PAs) were first introduced in the UK in 2003. They work under the supervision of doctors and undertake day-to-day tasks in general practice and hospital settings. They undertake a two-year postgraduate degree which focuses on the general aspects of adult medical care.[1] PAs are not part of the medical or nursing staff and are classified as medical associate professionals.[2] They are paid on the agenda for change pay system, with a band 6 starting salary (£37,338 to £44,962) which can rise to band 8 salary (£53,755 to £101,677) depending on experience.[1,3] The majority of PAs are women and under 30 years of age.[4] There is no defined career pathway for PAs: they often move between specialities, especially in their first few years of entering the workforce.[4]

Several initiatives introduced by the UK government indicate a commitment to expanding the number and role of PAs. The NHS Long Term Plan and the NHS People Plan (2020) both support the expansion of PAs, highlighting the potential to address workforce shortages and enhance patient care.[5,6] In December 2023, the Department of Health and Social Care (DHSC) produced a consultation process that gave the General Medical Council (GMC) a framework for regulation of PAs.[7]

However, the planned expansion of PAs in the NHS has proven to be a highly contentious and ongoing topic of debate. It has prompted several professional societies to release statements opposing the initiative. Frequently cited concerns relate to patient safety, questionable standards, scope of practice and negative impact on medical trainees.[8] The British Medical Association (BMA) went as far as to call for an immediate halt to PA recruitment,[9] and in June 2024 launched legal action against the GMC over its plans to regulate PAs and anaesthesia associates (AAs).[10]

The Vascular Society of Great Britain and Ireland (VSGBI) is engaged with the Surgical Royal Colleges and the Federation of Specialist Surgical Associations (FSSA) to define an appropriate scope of practice for PAs working within vascular services in the UK and Ireland. Before releasing an official position statement, the VSGBI in collaboration with The Rouleaux Club, who represent vascular surgical trainees, sought to gather input from their membership to ensure their position is representative. The aims of this survey were to explore how PAs are currently working in vascular surgery and to understand the opinions of VSGBI and Rouleaux Club members regarding the role of PAs in vascular surgery. These findings, along with further discussions, will help guide the VSGBI and The Rouleaux Club in shaping an informed position on the role of PAs within vascular surgery.

Methods

Survey design

This report adheres to the reporting recommendations from the Checklist for Reporting Results of Internet E-Surveys (CHERRIES).[11] The survey was developed by a sub-group of members from the VSGBI and Rouleaux Club committees, aiming to capture the perspectives of vascular surgeons and trainees on several key areas. Specifically, it sought to: 1) examine the roles and tasks that PAs are currently undertaking within their units, and determine which roles are considered suitable or unsuitable; 2) assess the supervision, training and accountability mechanisms for PAs; 3) collect opinions on PA impact on patient care and safety; and 4) evaluate the impact of PAs on doctor workloads and training opportunities for vascular trainees. Questions in the second section of the survey were adapted from the BMA's Medical Associate Professionals survey.[12]

Pilot round one

In April 2024 an initial survey was drafted by a subgroup of the VSGBI committee, consisting of two vascular consultants and a project manager, each with experience in administering national surveys. The survey was generated using Qualtrics online survey tool (Qualtrics, Provo, UT) and was distributed to the VSGBI elected council members for the first round of feedback. Following review, several modifications were made to enhance clarity and comprehensiveness.

The modifications included inclusion of the Royal College of Physicians Faculty of Physician Associates (RCP FPA) definition of a PA to the introduction, to help respondents understand the specific role being addressed. The inclusion of vascular unit identifiers was debated but ultimately retained to assess representation from the responses. Additional options were incorporated to the questions that cover potential procedures undertaken by PAs, in addition to procedures referenced on the FPA website.

To understand the quantitative results of the survey, free text comment boxes were introduced in the later sections, giving respondents the opportunity to provide detailed feedback on their views about PAs. Although it was recognised that the inclusion of free text would significantly lengthen the survey and subsequent analysis, it was considered vital to allow respondents the chance to expand on their answers.

Pilot round two

A second draft was recirculated to the VSGBI council in May 2024 and, following feedback, minor clarifications were made. This included adding options for respondents to indicate whether their units did not currently employ PAs, while still allowing them to share their views where applicable. Demographic questions were also expanded to enhance inclusivity, ensuring that all membership levels – not just consultants – could be identified. This adjustment enables a more detailed analysis, allowing for a comparison of perspectives between consultants and trainees.

The final survey was circulated by email to vascular surgeons and trainees via their societies (see Appendix 1 online at www.jvsgbi.com). The survey was open between 7th and 25th June, 2024 with a reminder email on 14th June, supported by social media promotion throughout. The survey consisted of 30 questions and the response types included a selection of options from a pre-defined list, Likert matrix questions and free text comments. Where the option of 'other' was provided, space to give further detail was included. At the end of the survey, respondents were invited to volunteer their contact information if they expressed an interest in being part of a working group on the role of PAs in the vascular specialty.

Data management

Access to data within Qualtrics was restricted to authorised survey administrators, who were Good Clinical Practice (GCP) trained. Data were securely downloaded into a password-protected file and held on NHS computers. Any blank data sessions were excluded from the analysis. Analysis was led by a vascular research fellow at ST3 level (LH) and a project manager at MA level with significant experience of reporting survey results (JL). The process was overseen by the subgroup of the VSGBI council.

Data analysis

Numerical and Likert-scale data from the questionnaire were collated and presented descriptively, with results stratified by respondent type where relevant.

For the qualitative analysis, content analysis was conducted on more than 600 free-text responses. Two authors (LH, JL) independently coded responses. Afterwards, they reconvened to compare codes, utilising research triangulation to combine and refine them. For responses with ambiguous or unclear meanings, discussion and consensus were used to assign appropriate codes. Following this coding process, categories were created through collaborative discussion and reflection. Responses were then assigned to these categories using a consensus approach. After reviewing the categories and subcategories, themes were generated, which were further refined through discussion, with each category ultimately assigned to an overarching theme.

The data were analysed using Qualtrics and Microsoft Excel (2021; WA, USA).

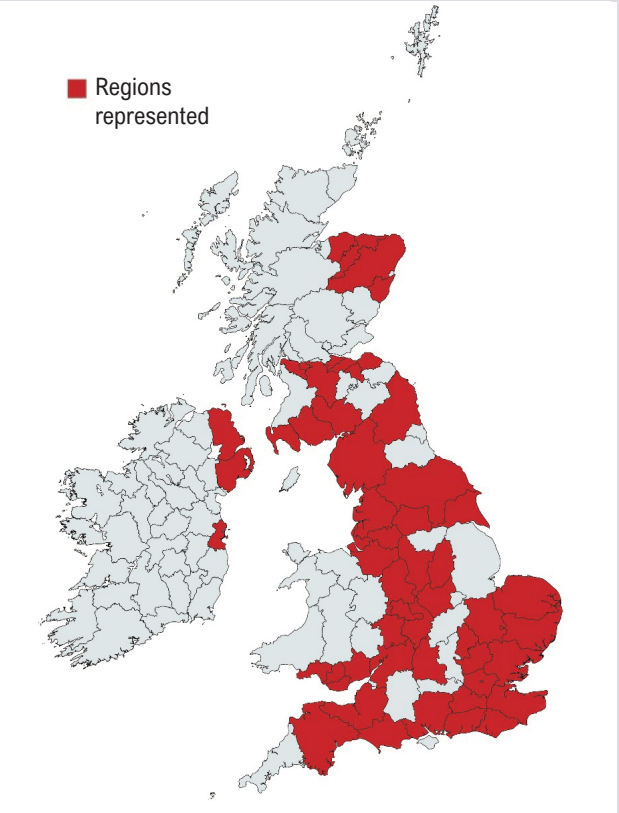
Ethical consideration

The survey was completed voluntarily by vascular surgeons and vascular specialty trainees. The voluntarily completion of the survey was considered consent for participation. No patient data were collected and the results are not presented by unit or respondent, to ensure anonymity.

Results

The survey received 194 responses from 59 NHS Trusts in the UK and two vascular units in the Republic of Ireland (Figure 1). Three

Figure 1 Location of survey respondents.



respondents did not wish to disclose their location, one respondent reported they were retired, one respondent worked overseas and one respondent worked exclusively in private practice. The survey was completed by 98 (51%) vascular surgery consultants, 70 (36%) trainees, 12 (6%) associate specialists, four (2%) senior VSGBI members, one (0.5%) honorary VSASM member, two (1%) overseas vascular surgeons and seven (4%) who identified as 'other', but did not specify their job role. 52 (27.5%) respondents reported that PAs were employed by their vascular unit.

Overall, only 30.9% (60/194) of respondents supported the presence or introduction of PAs in vascular surgery. Support was higher from respondents in vascular units who currently employ PAs (29/52, 55.8%) than from those in vascular units without PAs (31/137, 22.6%). In vascular units with PAs, 40.5% (21/52) of respondents were involved in the decision to recruit PAs, 25.0% (13/52) were involved in writing the PA job description and 23.1% (12/52) were involved in interviewing potential candidates. Four (7.7%) respondents reported that their vascular unit had no involvement in the recruitment of PAs. The majority of respondents (132/194; 68%) felt the public did not understand or were unsure about the difference between a PA and a doctor.

1. Scope of practice

In vascular units with PAs tasks frequently performed by PAs included taking a medical history/writing in the medical notes (45/52; 86.5%), carrying out physical examinations (40/52; 76.9%), requesting diagnostic investigations (excluding ionising radiation) (37/52; 71.2%), maintenance of clinical records (34/52; 65.4%), providing health promotion and disease prevention (27/52; 51.9%), and formulating differential diagnoses (23/52; 44.2%). Other tasks include assisting in the operating theatre (19/52; 36.5%), developing patient management plans (19/52; 36.5%), teaching and examining medical students (17/52; 32.7%), interpreting diagnostic studies (17/52; 32.7%), undertaking research (16/52; 30.8%), requesting ionising radiation (16/52; 30.8%), wound closure (including suturing) and wound care (including applying dressings) (14/52; 26.9%), performing procedures while supervised (14/52; 26.9%), training and assessing resident doctors (13/52; 25.0%), prescribing (8/52; 15.4%), giving prescribed medications (7/52; 13.5%), and performing procedures unsupervised (4/52; 7.7%).

Tasks respondents felt that PAs should not undertake include performing procedures without supervision (43/52; 82.7%), performing procedures supervised (35/52; 67.3%), prescribing (33/52; 63.5%), training and assessing resident doctors (31/52; 59.6%), interpreting diagnostic studies (28/52; 53.8%), requesting ionising radiation (28/52; 53.8%), assisting in the operating theatre (27/52; 51.9%), developing patient management plans (27/52; 51.9%), teaching and examining medical students (26/52; 50.0%), and performing wound closure and wound care (25/52; 48.1%).

In vascular units without PAs, respondents reported they would not support PAs performing procedures unsupervised (114/142; 80.3%), training and assessing resident doctors (95/142; 66.9%), teaching and examining medical students (93/142; 65.5%), interpreting diagnostic imaging (93/142; 65.5%), performing procedures under supervision (91/142; 64.1%), developing patient management plans (84/142; 59.2%), requesting diagnostic investigations (including ionising radiation) (80/142; 56.3%), assisting in the operating theatre (71/142; 50.4%), prescribing (70/142; 49.3%), and wound closure and care (70/142; 49.3%). Other tasks respondents would not support PAs undertaking include formulating differential diagnoses (60/142; 42.3%;), administering medication (54/142; 38.0%), requesting diagnostic investigations (excluding ionising radiation) (50/141; 35.2%), carrying out physical examinations (41/142; 28.9%), taking medical histories and writing in patient notes (34/142; 23.9%), research (27/142; 19.0%), providing health promotion and disease prevention advice (22/142; 15.5%), and maintaining clinical records (21/142; 14.8%;).

2. Training and governance

Respondents reported that PAs had received specific training to undertake the following tasks in their vascular unit: phlebotomy (34/52; 65.4%), peripheral venous cannulation (31/52; 59.6%), urinary catheterisation (26/52; 50.0%), measuring ankle brachial pressure indices (26/52; 50.0%), assisting in the operating theatre

Figure 2 Responses to "Do you believe the ways that PAs currently work within the NHS is a patient safety risk", by units who employ (blue) and do not employ (red) PAs.

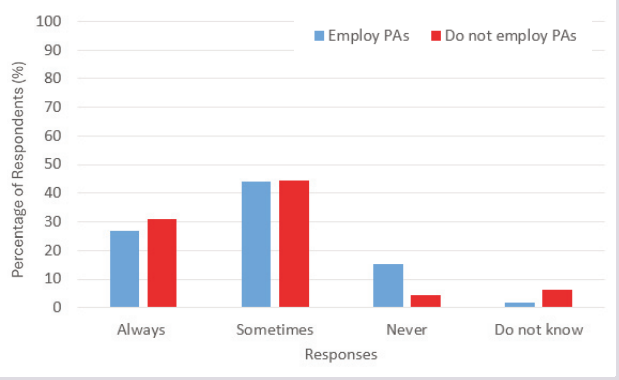
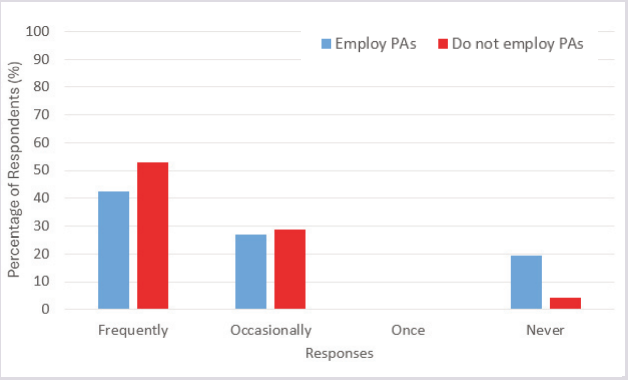


Figure 3 Responses to "Are you concerned that PAs undertake work beyond their competence?", by units who employ (blue) and do not employ (red) PAs.



(15/52; 28.8%), performing wound closure and wound care (13/52; 25.0%), radiation protection (5/52; 9.6%), administering medication (5/52; 9.6%), performing endovenous therapy (5/52; 9.6%), and performing ultrasound assessments (5/52; 9.6%).

PAs were most frequently supervised by a named consultant (21/52; 40.4%) or a supervisory consultant group (20/52; 38.5%). Other respondents reported that trainees (8/52; 15.4%) and senior nurses (3/52; 5.8%) also supervised PAs. Respondents reported that PAs were accountable to the supervisory consultant group (17/52; 32.7%), a named consultant (17/52; 32.7%), senior nurses (3/52; 5.8%) and trainees (1/52; 1.9%). Supervision was often not accounted for in consultant surgeons' job plans, with only 5 (9.6%) respondents reporting the named supervising consultant had time allocated to supervise PAs.

Twenty-three (44.2%) respondents reported that the hospital provided PAs with an annual appraisal. 46.2% (24/52) of respondents reported they did not know whether PAs were appraised annually by the hospital and one (1.9%) respondent reported PAs did not have an annual appraisal at their hospital.

Fifteen (28.8%) respondents reported that the hospital provided continued professional development (CPD) for PAs. CPD activities included audits (10/52; 19.2%;), teaching (10/52; 19.2%), conference attendance (10/52; 19.2%), course attendance (9/52; 17.3%), reflective diaries (4/52; 7.7%) and research (4/52; 7.7%).

3. Patient care and safety

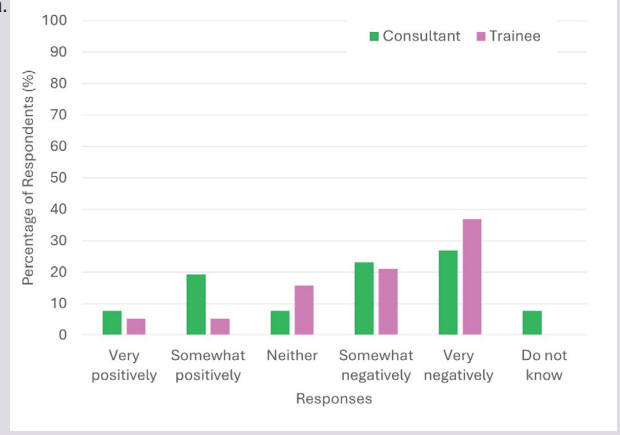
Improvement in patient care associated with the introduction of PAs was reported by 25/52 (48.1%) respondents who currently work alongside PAs and 9/142 (6.3%) of respondents who don't. The majority of respondents felt the way PAs currently work within the NHS is a patient safety risk (Figure 2) and that PAs worked beyond their competency (Figure 3). These findings were evident whether or not the respondent was working alongside PAs.

4. Impact on medical training, recruitment & retention and workload

Respondents felt that PAs have negatively impacted resident doctor and medical student training (Figure 4) and have had a negative

Figure 4 Responses to "Do you think PA have an impact on doctors and medical students training?", by units who employ (a) and do not employ PAs (b) and by consultants (green) and trainees (pink).

a.



b.

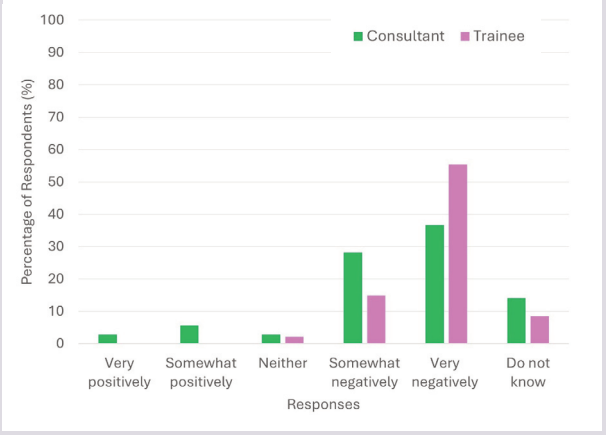
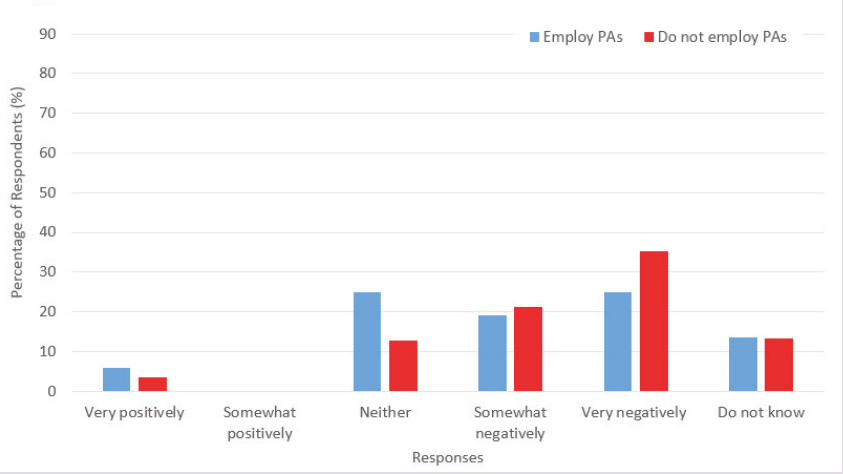


Figure 5 Responses to "Do you think PAs will have an impact on recruitment and retention of the vascular surgical workforce in the UK?", by units who employ (blue) and do not employ (red) PAs.



impact on recruitment and retention to vascular surgery (Figure 5). These findings were evident whether or not the respondent was working alongside PAs. The impact on workload was variable but relatively limited in magnitude (Figure 6).

Qualitative results

Four hundred and sixty codes were analysed into 10 categories. The 10 categories were formed into three overarching themes (Table 1).

Potential positives of PAs

Respondents felt that PAs could offer a positive impact to the NHS with clear role definition and appropriate supervision. Specific positives included providing continuity of patient care and supporting new staff induction. Respondents felt the permanent nature of PAs (who do not rotate) would aid in administrative tasks, such as ward round documentation and organisation, due to familiarisation with hospital systems and protocols.

The presence of PAs could also alleviate the pressures of service provision for resident doctors if they performed ward-based tasks that do not require a doctor, such as phlebotomy and peripheral venous cannulation. Respondents felt that this would allow resident doctors to attend more training opportunities and therefore improve medical training.

Some respondents felt the introduction of PAs might also increase patients' access to doctors. Patient triage performed by a PA could help to identify and escalate patients with pathology who require input from a doctor. This could reduce delays in care and help to reduce health inequalities in understaffed regions.

Organisational flaws

Organisational flaws describe problems respondents felt were associated with the introduction of PAs. This encompasses the lack of regulation of PAs, NHS pressures, ambiguous identification of PAs and the unclear role of the PA in the vascular multidisciplinary team (MDT).

Increasing NHS pressures due to staff shortages led respondents to speculate whether the introduction of PAs was to increase the number of staff on the ward without considering quality of care or cost-effectiveness. A particular concern was PAs filling doctor vacancies, especially for international medical graduates, as a cheaper alternative. This was evidenced by the presence of PAs on resident doctor on-call rotas. Respondents felt that the NHS

Figure 6 Responses to "Has the employment of PAs in places you have worked reduced or increased your workload?", by units who employ (a) and do not employ (b) PAs and by consultants (green) and trainees (pink).

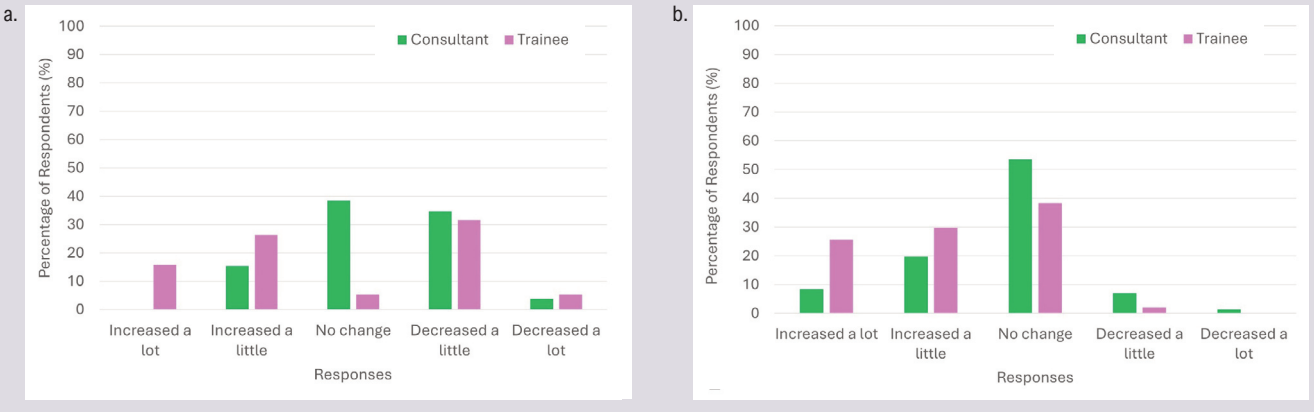


Table 1 Themes, categories and respondents' quotations

Theme	Category	Quotes
Potential positives of PAs	-	"If working within scope of practice then they should be a safe member of the MDT"
Organisational flaws	MDT	"They don't have any roles that contribute to the MDT over and above any other member of the MDT"
	Regulation	"In addition, given there is no standardised training or regulation of their training, it is impossible to know whether their assessment is valid or not & therefore the patient must be seen irrespective of the referral details."
	NHS pressures	"The current deployment of PAs, trained in the medical models, has placed untrained but often willing people (who often have wanted to be doctors & do medical tasks) into areas of high need where people have been willing to accept a reduction in the quality of the care provided as there has not been enough investment in the medical workforce"
	Identification	"Many do not introduce by their role and give vague 'I'm a clinician' answer. Do not seem to understand their limits - the 'I'm a registrar equivalent' phrase is not uncommon"
Negative impact of PAs	Safety	"On multiple occasions PAs have asked for wrong prescriptions to be done by F1s, made dangerous misdiagnoses, and nearly sent home patients who were clearly unwell and required intervention immediately."
	Increased workload	"As above, not only checking work by PAs but also correcting things that PAs have instructed naive Foundation Doctors to undertake on their behalf. Referrals from PAs whilst on call are often incomprehensible and don't stand up to basic questioning, this makes giving advice dangerous as you cannot rely on the information you are being given."
	Inappropriate practices	"PAs essentially do the role of an FY1, but cannot do basic tasks like request scans and prescribe. It requires supervision or help from another doctor, which is often an F1" "Additionally, PAs routinely attending theatres and completing operations as first operator with consultant unscrubbed or in another theatre for minor amputations when the patient was certainly not consented for a non-surgeon to be completing their operation. First assisting in operations and directly taking opportunities from trainees. Giving advice on the registrar on call rota in tertiary referral service completely inappropriately."
	Medical training	"Why do they get reduced price courses (despite earning more than FYs who have to pay the full price)?" "I've had PAs scrub in with me before which is fine, but then when the SHO comes to theatre after being busy in the ward sorting jobs there is no space for them to join. This is completely unfair for the younger surgical trainees"
	Recruitment and retention	"I only became a surgeon because I was treated well during my foundation years and encouraged to come to theatre. If we lose that, surgery may have a real retention crisis on its hands"

should be investing in doctors and advanced practitioners instead of PAs.

At the time of this survey PAs were not regulated and this was an area of major concern for respondents. The lack of regulation means that PAs currently do not have a nationally defined scope of practice. Respondents interpreted lack of scope as PAs having no role, a limited role or an unclear role in vascular surgery. Without a scope of practice respondents were concerned about 'scope creep' and the impact on doctors, especially doctors in training. This relates to some responders feeling that PAs are working beyond their competency. The lack of regulation also led to respondents' apprehensions about the rigour of the PA qualification. There was a lack of clarity on PA postgraduate training and therefore career pathway. This uncertainty resulted in respondents questioning the role PAs should fill in vascular surgery. To address these concerns respondents felt regulation is necessary to define the scope of PAs and ensure accountability, responsibility, accreditation and ethics of PA practice. This would also address respondents' concerns about the PA professionalism and curb inappropriate PA behaviour on social media, PAs comparing themselves to training grade doctors, and ensure PAs were aware of their level of competence.

The lack of regulation is related to the confusion in identifying a PA. Respondents reported interactions where PAs appeared to be masquerading as doctors. To healthcare professionals this was by either identifying themselves as an equivalent to a training grade doctor or giving an unclear role e.g. one of the surgical team. To patients this was failing to correct a patient who assumed them to be a doctor. Respondents also felt the use of the word 'physician' in the title led to confusion about whether a PA was a doctor or not.

Respondents felt the vascular multidisciplinary team included a wide range of healthcare professionals, appropriately regulated through governing bodies with a well defined scope of practice. PAs were thought to be surplus and to bring no additional benefit to the vascular MDT. There was a feeling that development of the current vascular multidisciplinary healthcare professionals would be a more productive use of resources.

Negative impact of PAs

This theme describes how respondents felt PAs have a negative

impact in the NHS. Specific areas include inappropriate PA practices leading to an increased risk of harm to patients and reduced quality of medical training, increase in doctors' workload and reduction in recruitment and retention to vascular surgery.

Respondents believed some of the tasks performed by PAs are inappropriate as PAs do not have a medical qualification or structured postgraduate training. Specific tasks include assisting and operating in the operating theatre and working on doctor on-call rotas. Respondents reported PAs performed (supervised or unsupervised) major lower limb amputations, vascular interventional radiology procedures and venous procedures. Respondents felt that PAs either assisting or operating was inappropriate. This was due to issues with patient consent, ability to demonstrate competency to undertake the procedure and ability to manage the patient as a whole (e.g. prescribing and decision-making). Inclusion of PAs on vascular registrar rotas was felt to be inappropriate because PAs did not hold the knowledge to be able to assess and manage unselected patient referrals. Potential consequences included PAs giving incorrect medical advice, missed diagnoses and delays in patient care. Respondents reported that inclusion of PAs on vascular registrar rotas also led to some PAs equating themselves to speciality registrar equivalent. Inclusion of PAs on foundation and core level doctor rotas was also felt to be inappropriate as PAs are unable to perform the tasks required (e.g. prescribing medication and requesting ionising radiation investigations). This resulted in PAs prescribing using doctors' log-in details and pressuring the foundation level doctors to prescribe on their behalf.

Respondents raised concerns about the impact of PAs on surgical training. Some respondents felt consultants had a competing interest when delivering training. Resident doctors felt PAs would receive preferential training as they did not rotate, only work during the day and have more opportunity to build relationships with consultants. The presence of PAs was felt to increase competition for training, especially to attend the operating theatre and clinics. For registrar level doctors this increased competition to access to vascular interventional radiology and venous operative training. For core trainee level doctors PAs reduced their exposure to the vascular operating theatre and clinics. For foundation years PAs were felt to be taking opportunities for them to learn on the ward. Respondents felt PAs reduced their exposure to vascular surgery, with an associated detrimental effect on recruitment. As well as increasing the competition for training, trainees were disgruntled over reduced or fully funded course fees for PAs (e.g. basic surgical skills) and prescribing on behalf of PAs who have a higher salary than they do. Trainees felt consultants viewed trainees' and PAs' training requirements to be equivalent.

PAs were felt to increase doctors' workload. This is because their work needed to be duplicated as respondents did not think PAs were able to assess patients accurately or initiate appropriate management. Poor quality and inappropriate referrals, along with the inability to hold a medical discussion, resulted in increased workloads for doctors when a PA was involved. There were also pressures from PAs to prescribe medications and ionising radiation for patients they had reviewed. This leads to increased doctor workload due to the need to review and request investigations and prescriptions suggested by PAs. As well as duplicating and increasing clinical work, consultants reported that PAs required more supervision than resident doctors. The increased workload could contribute to burnout of doctors. The workload was felt to increase particularly if PAs were on doctors' rotas.

Respondents felt the widespread introduction of PAs could reduce recruitment and retention to vascular surgery. Reduced exposure due to increased competition for foundation and core level doctors could lead to a decrease in applications to vascular surgery. For vascular surgery trainees increased competition for operative training could lead to trainees feeling disenfranchised and leaving training programmes. Consultants reported they might avoid units that employ PAs, and others reported it would be a reason not to work in the NHS.

Patient safety was thought to be negatively affected by PAs working without a scope, leading to patient harm and inferior quality of care. This could lead to an increase in litigation cases.

Discussion

The survey found the minority of respondents were supportive of the inclusion and introduction of PAs into vascular services. Reasons for this included the poorly defined role of PAs in vascular surgery, the lack of PA regulation, perceived negative impact on patient safety and concerns about medical training capacity.

Professional societies and Royal Colleges have struggled to define the gap in the allied medical workforce that the introduction of physician associate addresses. Surveys conducted by the Royal College of General Practitioners (RCGP) and the Association of Surgeons in Training (ASiT) reported that currently PAs have a very limited role but they could be useful in supporting efficient ward work and delivering advice on lifestyle modification to patients.[8,13] Respondents to this survey shared a similar view, acknowledging the wide range of existing disciplines within the vascular profession who deliver the breadth of care required. Support and development of existing roles within the vascular MDT were considered to be more efficient rather than trying to find a role for PAs.

One of the major issues raised in this survey was the lack of regulation of PAs and therefore the lack of accountability, professional standards and nationally recognised continued professional development. Currently the GMC are posed to regulate PAs. This has been met with legal challenges, supported by the BMA, who believe a joint regulator is inappropriate as this would further the misunderstanding held by the public on the difference between a PA and a medical doctor.[8,14] The lack of regulation, and therefore postgraduate training and accountability, has recently been raised in the UK courts by a Coroner's report. The Coroner advised that future deaths could be prevented by the registration and regulation of PAs, and introduction of a national framework on

KEY MESSAGES

- Introduction of PAs to the vascular workforce does not have significant support at the present time
- The scope of practice of existing PAs needs to be precisely defined and distinct from those of the current medical workforce
- Clinicians in units that currently employ PAs are no more supportive of the current position than those that have no experience of working with PAs

how PAs are trained, supervised and deemed competent. The report also advised cautious use of the word 'physician' in PAs' titles.[15]

Patient safety concerns raised by respondents in this survey echo results of other surveys and Coroner reports.[8,13,15,16] This was driven by their performing procedures without adequate supervision or competency, making inappropriate clinical decisions and lack of appropriate supervision.[8,17] Respondents in this survey felt that PAs undertaking procedures, supervised or unsupervised, was an unacceptable practice. Respondents in this survey reported PAs are able to perform more procedural skills compared to a report published by the RCP FPA in 2019.[18] This could reflect that this survey was undertaken in vascular surgery and the evolving role of PAs over time.

Respondents also felt the impact of PAs could negatively influence the medical workforce. The VSGBI acknowledge the shortage of consultant vascular surgeons and the need to train significantly more vascular surgeons to maintain a safe 24 hours, 7 days a week service to meet the demands of the growing and ageing population.[19] Along with results from this survey, ASiT identified that the presence of PAs negatively impacts foundation and core level trainee doctors disproportionately, which could deter them from applying to the speciality.[8] For higher surgical vascular trainees there is a pressure to meet certification requirements, especially with regards to competency in performing open aortic aneurysm repairs and varicose veins procedures.[20] Diverting training opportunities to a group who will not address the challenges of a decreasing consultant workforce was a major concern for respondents. The potential negative impact on medical training was also a contributing factor to the RCP's and Royal College of Anaesthetists' stance on halting the expansion of PAs.[21]

To address the concerns raised by professional medical bodies and other stakeholders the UK government have commissioned a report on the independent review on PAs and AAs, led by Professor Gillian Leng. The review aims to consider the scope of PAs, the role of PAs, the support PAs offer the wider health teams, their role in providing good quality and efficient care, and the future of this role in the NHS, to inform the future debate on this topic.[22]

This survey has limitations. The survey was open for a short period of time, which could have resulted in selection bias. However, the survey received a good response rate, wide geographical spread in England and data saturation was reached in the qualitative responses. The survey aimed to structure questions in a non-leading way and provided a definition of the role of a PA at the beginning of the questionnaire. This aimed to reduce response bias.

Conclusion

This survey reports that patient safety concerns, governance issues, negative impact on medical training, potential impact on recruitment and retention associated with the introduction of PAs currently outweighs any potential benefits. These concerns persist in respondents with experience of working alongside PAs and therefore cannot be accounted for by lack of experience or exposure to working with PAs. The VSGBI and Rouleaux Club therefore cannot support the expansion of PA numbers and scope within vascular surgery. We would urge politicians and health service leaders to find alternative solutions to workforce problems whilst working with specialist organisations and Royal Colleges to define roles for colleagues within the current services.

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ORIGINAL RESEARCH

What's the denominator? An 8-year audit of ruptured abdominal aortic aneurysm outcomes, including rates of conservative and palliative management

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Plain English Summary

Why we undertook the work: A ruptured abdominal aortic aneurysm (rAAA) happens when the main blood vessel in the body bursts. It is a life-threatening emergency. Surgery is in almost all cases the only treatment. Not everyone is able to survive surgery. Doctors often need to make quick decisions with little time. There are two main types of repairs – open repair and a less invasive method called endovascular repair (EVAR). Many studies compare these treatments. However, there is less focus on those who are too unwell and instead receive comfort care (those who do not have surgery). We wanted to learn more about these patients and their outcomes.

What we did: We looked at hospital records for all cases of rAAA treated at Addenbrooke's hospital between January 2015 and November 2022. We looked at how patients were treated (open repair, EVAR or no repair), their outcomes, and other factors like scans, blood transfusions, and how long they stayed in hospital.

What we found: We found 209 cases of rAAA. About 44% of patients had open surgery, 36% had EVAR, and 20% received no repair. Open repair had higher risks, with more deaths, longer hospital stays, and a greater need for blood transfusions compared to EVAR. Open repair was associated with more surgeries in the short term, while EVAR often required more surgeries in the long term. Some patients who were treated without repair survived for over a year, though this was rare, and most died.

What this means: The patients that underwent EVAR, based on suitability, had better results in the short term. Most studies focus on surgery, but our findings highlight that around 1 in 5 patients are treated without any repair. Including this group in reports can help to ensure that doctors make better decisions about treatment and set clearer standards for the rate of intervention.

Abstract

Background: A ruptured aortic aneurysm (rAAA) is a surgical emergency with rapid onset and poor survival. Expedited diagnosis and surgical repair are required to prevent exsanguination. Extensive literature compares outcomes of endovascular and open repair but there is little discussion of the denominator – the patients undergoing non-operative palliative management. Without this, all reported outcomes are confounded by case selection. We carried out this review to learn more about those operated on and to include the rate of palliation to learn more about overall outcomes.

Methods: A retrospective note review of the electronic patient record identified all rAAAs treated at Addenbrooke's hospital between January 2015 and November 2022. Demographics, treatment strategy, mortality, pre-operative imaging, transfusion requirement and inpatient stay were interrogated.

Results: There were 209 rAAAs identified. Management was with open surgery (44%), endovascular surgery (36%) and palliation (20%). Open repair was associated with higher mortality, longer inpatient and ITU stay, and larger transfusion requirements than endovascular repair. Open repair was associated with a higher rate of return to theatre in the short term, while endovascular repair (EVAR) had a higher rate in the long term. 7% of palliative rAAAs remained alive at one year.

Conclusions: An EVAR-first approach results in lower mortality rates and better short-term outcomes. Although interventional outcomes are widely reported, approximately 20% of the

caseload is palliated. This denominator should be reported alongside conventional outcomes to address the bias of case selection and resource allocation and to provide a more comprehensive picture of overall outcomes.

Key words: ruptured aortic aneurysm, endovascular repair, open repair, palliative management

Introduction

In the UK, more than 4,900 deaths annually are attributed to aortic pathologies,[1] with aneurysms and dissections being the leading causes, particularly in men over 65. Aneurysms, often undetectable until rupture, are at higher risk of rupturing if they exhibit pain, increase in size by more than 1 cm/year or have diameters larger than 5.5 cm, prompting elective surgical repair. Surgical intervention, either through open surgery or endovascular approaches, is the primary treatment for ruptured abdominal aortic aneurysms (rAAAs). The shift towards endovascular repair (EVAR), supported by the IMPROVE study, reflects its short-term benefits over open repair, such as fewer complications and shorter hospital stays, despite long-term risks like endoleaks and the necessity for revision surgery.[2,3,4] Addenbrooke's hospital follows an 'EVAR first' strategy, being able to provide EVAR 24 hours a day, seven days a week in a dedicated hybrid operating suite, with round-the-clock vascular and interventional radiology coverage, adequately supported by a high-power ITU.

Literature often focuses on the effectiveness of interventions, with the intervention decision being complex and reliant on consensus among the patient, surgeon and anaesthetist. The variance in intervention strategies among centres could lead to perceived outcome disparities, suggesting potential selection bias in reported outcomes.

This report presents an 8-year overview of rAAAs at a tertiary centre, providing data on both palliated and treated patients to provide a comprehensive evaluation of the unit's outcomes.

Methods

Local service evaluation and audit approval were sought through the Cambridge University Hospitals NHS Foundation Trust Research and Development department (Registration number PRN10943). Cambridge Vascular Unit, based at Addenbrooke's Hospital, Cambridge is a tertiary vascular referral centre serving an immediate population of approximately 1.8 million and regional complex services for 4 million. Hospitals included in this region are Peterborough Hospital, West Suffolk Hospital, Bedford Hospital and Hinchingbrooke Hospital. The distribution of the population in these spoke hospitals is shown in Figure S1 (see Appendix online at www.jvsgbi.com).

A retrospective case note review was performed via the EPIC – Hyperspace patient management platform (Epic Systems Corporation, Verona WI, US) to elicit all patients with ruptured aortic aneurysms at Addenbrooke's hospital (according to the International Statistical Classification of Diseases, ICD-10), discharged between 01/01/2015 and 30/11/2022. Patients with a previous aortic aneurysm were excluded to analyse primary ruptured aortic aneurysms only. Data were collected from 01/03/2023 to 30/04/2023. Baseline patient demographics including postcode, date of birth (DoB), gender and age were recorded.

Mortality status was interrogated for all patients to determine the date of death (DoD), post-procedure days to death and the 30-day, 90-day and 1-year mortality status. Where mortality data were missing, the NHS inter-hospital data spine, connected to all local hospitals and GP practices, was interrogated to provide mortality data for non-hospital registered patients. When available, the cause of mortality was analysed from registered death certificates.

Pre-specified group analysis was done analysing individual outcomes for open and EVAR surgeries, including the amount of blood transfused intra-operatively and the recovery time and level of care required. The rate of and reason for return to theatre due to complications in the short and long term were inspected. Previous interventions, co-morbidities and average aneurysm size were examined.

All statistics and graphical representations were produced on Microsoft Excel (V16.79.1 Microsoft, Redmond, WA, USA), the SPSS platform (V29.0.1.0, Armonk, NY, USA), and GraphPad Prism (V10.1.2, Boston, MA, USA). Statistical methods involved normality assessment, Chi-squared test for comparison of all groups, unpaired t-test (if parametric data) and Welch's unpaired t-test (if non-parametric data) to compare open vs EVAR, and one-way ANOVA to compare all groups. ArcGIS (V10.6.1 Redlands, CA, USA) was used to plot geographical spread.

Results

Study cohort

209 cases of ruptured AAAs were identified over the 8-year period (approximately 26 cases per year). There were 91 (44%) and 76 (36%) cases of open and EVAR surgery, respectively. 42 patients (20%) were palliated with no surgical intervention. 77 cases presented to Addenbrooke's hospital first. Of these cases, 32 (41.6%) underwent open repair and 18 (23.4%) underwent EVAR. A total of 27 patients were palliated (35.1%). A total of 132 cases presented to a 'spoke' site first, of which 82 were from Peterborough and Hinchingbrooke Hospitals, 27 from West Suffolk Hospital, 8 from Colchester Hospital, and 14 from other areas.

Table 1 Cohort demographics with respect to the pathway of care for patients with a ruptured abdominal aortic aneurysm

Care type	Open	EVAR	Palliative	Total	p value
Number of patients	91 (43.5)	76 (36.4)	42 (20.1)	209 (100)	
Age (years)	75 (7)	77.5 (10)	86 (10.8)	78 (10)	<.001
Males	83 (91.2)	71 (93.4)	29 (69.0)	183 (87.6)	<.001
Hypertension	54 (59.3)	54 (71.1)	26 (42.9)	126 (60.3)	.28
COPD	18 (19.8)	17 (22.4)	12 (28.6)	47 (22.5)	.53
Myocardial infarction	7 (7.7)	11 (14.5)	6 (14.3)	24 (11.5)	.32
Ischaemic heart disease	8 (8.8)	7 (9.2)	3 (7.1)	18 (8.6)	.92

Data are presented as n (%), or median (interquartile range).

Figure 1 Mortality rates of patients with ruptured abdominal aortic aneurysms, divided by their management option of open repair, EVAR or palliation

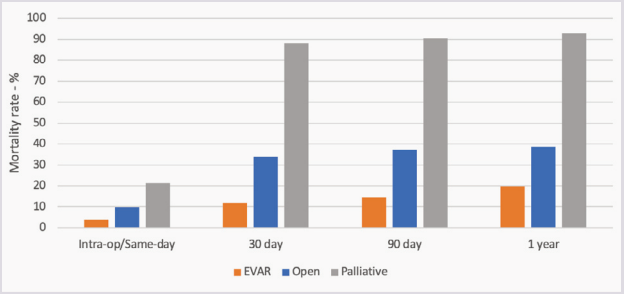
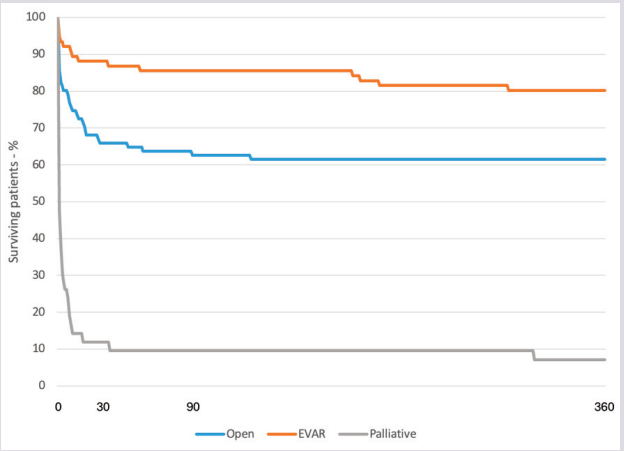


Figure 2 Cumulative Kaplan-Meier estimate of patient survival over 360 days in the entire study population with ruptured abdominal aortic aneurysms. Mortality was significantly different for all three groups at 360 days (p<.001)



Numbers at risk

Days	0	30	90	360
Open	91	60	57	56
EVAR	76	67	63	61
Intervention (open or EVAR)	167	127	120	117
Palliated	42	5	4	3

Cohort analysis

Demographics

Gender and average age, given in Table 1, were both significantly different between the groups (gender p<.001, age p<.001). The median age was 75 years (7 [IQR]) and 77.5 years (10 [IQR]) for open surgery and EVAR, respectively. However, the average age of palliated individuals was 86 years (10.8 [IQR]). Of those undergoing open repair, 8.8% were female, while EVAR was 6.6%. 31.0% of palliated patients were female. The geographical spread of referrals within the East of England is demonstrated in Figure S1 (see Appendix online at www.jvsgbi.com).

The decision for surgery is a multidisciplinary team decision involving the surgeons, anaesthetists and critical care team, taking into account the chance of surviving surgery, the chance of long-term recovery, and the perceived quality of life benefit. The main reason for palliation in 33 (78.6%) cases was unsuitability for surgery. In seven cases, it was due to patient choice. Lastly, two patients, who had already been admitted to hospital, had point of care ultrasound (POCUS) but were too unstable and died on the ward. 22 (53.4%) of the palliated patients were known to have an AAA and had previously declined surgery.

Co-morbidities

The three most common co-morbidities were hypertension (HTN), chronic obstructive pulmonary disease (COPD) and myocardial infarction (MI), as shown in Table 1. Some 59.3%, 71.1% and 42.9% of open, EVAR and palliated patients had HTN registered as a co-morbidity. For the same groups, 19.8%, 22.4% and 28.6% had COPD. The prevalence of remaining comorbidities is shown in Table 1. The only significant risk factors were chronic kidney disease (p<.001) and female gender (p=<.001).

Mortality

Mortality for all patients with a ruptured AAA, for intra-operative (intra-op) or same-day, 30-day, 90-day and 1-year timescales was 10%, 37%, 40% and 43%, respectively. Open repair carried a mortality risk of 10%, 34%, 37% and 38%, while EVAR had a mortality risk of 3%, 12%, 15% and 20%. Mortality for palliated patients was 21%, 88%, 90% and 93%. This is shown in Figure 1. Of the three palliated patients that survived over a year, one was noted to have a contained rupture, while the reason for survival for the other two patients cannot be ascertained. Mortality of open repair vs EVAR vs palliated patients was significantly different (p<.001) at 30 days, 90 days, and 1 year, as shown in Figure 2.

Table 2 Temporal trends for the number of cases of open, EVAR and palliated patients each year, and their respective 30 day mortality rates.

	2015	2016	2017	2018	2019	2020	2021	2022*
Open	9	17	13	6	16	11	13	3
Open mortality	4 (44.4)	2 (11.8)	4 (30.8)	2 (33.3)	8 (50)	6 (54.5)	3 (23.1)	1 (33.3)
EVAR	12	11	10	12	11	7	4	8
EVAR mortality	1 (8.3)	2 (18.2)	1 (10)	1 (8.3)	1 (9.1)	0 (0)	0 (0)	2 (25)
Palliative	5	4	1	9	6	7	7	3
Palliative mortality	3 (60)	4 (100)	1 (100)	9 (100)	5 (83.3)	7 (100)	6 (85.7)	2 (66.7)
Total	26	32	24	27	33	25	24	14

Data are presented as n or n (%).

Temporal trends

Caseload

The overall trendline of cases appears to be decreasing, though the number of cases is variable, as shown in Figure S2 (see Appendix online at www.jvsgbi.com) and Table 2. The number of cases operated on appears to follow the trend of the caseload. Open operations were more frequent overall, with 91 carried out compared to the 76 EVAR surgeries. In 5 out of 8 years, open surgery was more frequent.

Mortality

Temporal trends in mortality were analysed over the 8-year period. Table 2 and Figure S3 (see Appendix online at www.jvsgbi.com) show the temporal trends for 30-day mortality. The overall mortality of open repair appears to be slightly increasing, though it is highly variable due to the low number of cases each year. For EVAR the overall mortality rate is again variable.

Pre-operative imaging

All patients with a suspected rAAA will first have a POCUS to confirm the diagnosis. All patients who underwent EVAR had a CT scan before the operation. 15 (16.5%) of the patients who underwent open repair were too unstable and only had POCUS before surgery. In one case, aneurysm size identified by POCUS contraindicated EVAR.

EVAR is the first-line option in our unit, and therefore the reason for open repair was analysed. Twenty-four (26.4%) of the patients undergoing open repair were deemed too haemodynamically unstable for EVAR, 10 of whom had a CT scan, with the other 14 only receiving POCUS. A further 49 (53.8%) patients were deemed to have unsuitable aneurysm anatomy for EVAR, mainly determined by its location and the structure of the neck. Six cases were initially planned for EVAR, though were changed to open repair before the operation started as the patient became more unstable. Two cases received open repair due to patient choice. For 10 cases the reason for open repair could not be ascertained.

For EVAR, open and palliated patients, the average aneurysm size was 73.8mm ± 22.6 (SD), 84.7mm ± 20.4 (SD), and 81.0mm ± 19.5 (SD), respectively (p=.017).

Table 3 The number and reason of the return to theatre following open surgery or EVAR for patients with a ruptured abdominal aortic aneurysm.

	Open (n=91)			EVAR (n=76)
	1st return	2nd return	3rd return	1st return
Laparotomies, relook for bowel ischaemia and laparotomy closure	11	3	2	2
Lower limb revascularisation (embolectomies and crossover bypasses)	7	1	0	3
Bowel ischaemia	4	5	2	0
Fasciotomy	2	3	0	0
Access complication (pseudoaneurysm)	0	0	0	1
Amputation	0	1	1	0
Other	3	0	0	2

Data are presented as n.

Return to theatre

Owing to the complexity of the operations, return to theatre is relatively common. Open operations have a rate of return to theatre in-hospital of 25.3%, of which 5.5%, 14.3% and 5.5% required 1, 2 and 3 returns to theatre, respectively. EVAR had a significantly lower in-hospital return rate of 10.5% (p=.012), with no patients having to return to theatre more than once. Overall, 52 additional surgeries were done, 43 for open repair and nine for EVAR. The reasons for return to theatre are shown in Table 3.

Long-term re-intervention rates which occurred post-discharge were also analysed. Three (3.3%) cases of open repair required re-intervention related to vascular issues. However, 15 (19.7%) cases of EVAR required later intervention (p=<.001). Following open repair, long-term re-interventions included EVAR relining of the graft (n=1), thoracic EVAR (n=1) and revascularisation operations (n=1). No midline hernia repair surgeries were recorded. For EVAR, three patients required two interventions though none required three.

The reasons for re-intervention were another EVAR (n=2) or EVAR relining (n=3), revascularisation (n=7) pseudoaneurysm repair (n=3), wound explorations (n=2) and amputation (n=1).

Recovery

The average time spent in the hospital was 15 (21.25 [IQR]) and 8 (9.5 [IQR]) days for open and EVAR surgery, respectively (p<.001). All patients first began in level 2 or 3 care after surgery, before they were either discharged from the hospital or de-escalated to a lower level of care. 17% and 83% of open surgery patients entered level 2 and 3 care, respectively, while for EVAR this was 19% and 81%.

The total time spent on wards is shown in Figures S4 and S5 (see Appendix online at www.jvsgbi.com), according to whether patients initially entered level 2 or 3 care post-operatively, respectively. This excludes patients who died on the ward. If a patient post open repair initially entered level 2 care post-operatively, they would spend on average 6.5 (10.5 [IQR]) days on level 2, and a further 9.5 (7.25 [IQR]) days in hospital in level 1 care. EVAR patients initially spent on average 4 (6 [IQR]) days in level 2 care, often being discharged straight from level 2 care. Following open repair, a patient entering level 3 care would spend on average 5 (7.25 [IQR]) days, and a further 9 (11.5 [IQR]) days in lower level care. EVAR patients entering level 3 care would spend on average 1.5 (3 [IQR]) days, and a further 6 (8.75 [IQR]) days in a lower intensity of care. The total time spent on wards was significantly different between open and EVAR for those entering level 3 care (p<.001) and level 2 care (p=.002). Two cases of open repair and one case of EVAR had to be re-escalated from level 2 to level 3 care.

Blood transfusion

Open repair required a significantly higher number of units of RBCs, FFP, platelets and cryoprecipitate, as shown in Figure S6 (see Appendix online at www.jvsgbi.com) (p<.001).

Discussion

These data describe the outcome of all ruptured abdominal aortic aneurysms in a large vascular unit serving a sizeable population.

Mortality

Mortality rates for ruptured abdominal aortic aneurysms (rAAAs) highlight the first 30 days post-surgery as critical, with open repair showing a 30-day mortality of 34%, rising to 37% after 90 days. EVAR outcomes are better, with a 30-day mortality of 12%, increasing slightly to 15%. Survivors of open repair past 30 days have a good chance of reaching one year. Compared to the IMPROVE study's 90-day mortality rates of 35.1% for EVAR and 38.3% for open surgery,[4] this study aligns with open surgery rates but shows a significantly lower mortality for EVAR, by 20.1%. The Cambridge Vascular Unit's EVAR-first policy, influenced by IMPROVE and similar studies, means patients with suitable anatomy for EVAR, who generally have better survival outcomes,[5-7] are preferentially selected, leaving more challenging cases for open surgery. In effect, the patients undergoing EVAR tend to be a self-selecting group due to their haemodynamic stability.

Palliation rates can affect perceived mortality rates, but this study found 20% of patients were palliated from the entire cohort. When only analysing the patients that presented originally to Addenbrooke's, the palliation rate was 34.3%, lower than the national average of 39.3%,[8] indicating a successful intervention strategy at the Cambridge Vascular Unit.

Demographics

The average age of individuals receiving palliative care was notably higher than those undergoing surgery, which aligns with expectations since older people often have more co-morbidities and less physiological reserve. Abdominal aortic aneurysms (AAAs) occur predominantly in men, yet a higher percentage of palliated individuals were women. These women tend to present with AAAs later, with less favourable anatomy and a greater risk of rupture.[9]

Temporal trends

The overall caseload is decreasing, a trend matched by overall AAA repair rates, likely due to fewer smokers, better medical therapy and increased screening and non-screening pick-up rates. In 2014, 18.1% of UK adults smoked; by 2021 this dropped to 13.3%.[10] Interestingly caseload dropped noticeably in 2022. By November 2022, 14 cases were recorded, lower than the previous average of 25. Further evaluation cycles are needed to confirm this trend.

Ruptured AAAs present with varying stabilities so the reported mortality rate may simply show natural variation. Cambridge Vascular Unit operated on an average 26 cases of rAAAs per year, a large number compared to the average UK vascular unit (1,458 rAAA repairs were reported from 2020-2022 – an average of 8 per centre per year).[11] Given the relatively low frequency of these complex surgeries, other centres may need to look towards novel methods to keep skill sets current.[12,13]

Despite COVID-19, there was not an increased tendency to palliate patients. However, mortality rates did see a drop during the pandemic. More patients may have deteriorated at home, reducing diagnoses. However, the pandemic's impacts may have been more nuanced and over-arching effects have since reduced the rupture rate, though future research is needed to confirm this.[14,15]

Pre-operative imaging

POCUS can be done at the bedside to help confirm a rAAA diagnosis, though it is unsuitable in determining whether anatomy is EVAR-suitable, which requires CT. The two most common reasons for EVAR unsuitability were being too unstable and having inappropriate and complex anatomy. These patients are already more likely to have worse outcomes from their pre-morbid state, perhaps explaining why the short-term outcomes for open repair are worse than EVAR.

Return to theatre

Open repair had a much higher early return to theatre than EVAR (p=.012). Patients often required multiple returns to theatre due to complications in open repair, while no patients returned more than once to theatre after EVAR. Laparotomy was the most common reason for returning to theatre in open surgeries. Open surgery was associated with more complex procedures during return to theatre, including amputations and bowel ischaemia operations, likely due to greater patient instability.

Long-term re-intervention rates were significantly higher for EVAR compared to open repair. No midline hernia repairs were recorded following open repair, possibly because these cases occurred in the patient's local hospital. This is consistent with the literature, that those with EVAR are more likely to require reintervention in the long term.[16] While EVAR requires further re-intervention in the long term, open surgeries require more in-hospital re-interventions.

Care requirements

Open-repair patients consistently spend significantly more time on level 3 and level 2 wards compared to EVAR patients. Similarly, open-repair patients used significantly more blood cells and products.

Limitations

This paper reports the palliation rate for a large tertiary hospital, something not often reported in the literature. Still, there are some important limitations which would have affected the calculated palliation rate, particularly regarding the number of palliated patients recorded. Cases may not be logged on the system when patients die at home, before they contact the hospital or in the ambulance. Even for patients that may die from a rAAA, it may be that the cause of death is not recorded, especially if they are frail. Secondly, cases are referred to the Vascular Hub from external hospitals. Some cases which are deemed unsuitable for transfer due to inoperability may not reach the arterial centre, therefore reducing the relative palliation rate, which is not captured by this dataset. In the spoke hospitals, there are consultants in satellite areas who document cases which should capture most decisions. Therefore, due to centralisation, such palliation without review is rare in modern clinical practice and so it would be rare for cases from spoke hospitals to not be included in this report.

While these limitations have been presented, this estimated palliation rate is the best that can be done currently with the resources given. The number operated on is relatively certain from the EPIC hyperspace system. However, the limitations given will likely mean that some palliated patients were missed. This would mean that the calculated palliation rate is probably an underestimation of the true value. Even acknowledging these limitations, the palliation rate is still 35.1% for just the Cambridge population, below the national average. For improvement, death certificates of the entire population would need to be analysed to find some of the missed cases which have been highlighted, though this would require many more resources.

KEY MESSAGES

- EVAR had lower short-term mortality and fewer complications than open surgery, though open repair is essential for complex cases of ruptured aneurysms.
- The reported palliation rate was 20% for the entire unit, and 35.1% for just the Cambridge population.
- Future studies should report palliation rates to give a full picture of outcomes and guide treatment decisions.

Conclusion

This study reports on outcomes for patients with ruptured abdominal aortic aneurysms at a tertiary vascular centre, importantly including the denominator – the number of palliated patients. Though acknowledging the limitations of the study, this estimate is the best estimate with the data available. Our mortality rates are below those generally reported in the literature.[2] Adopting an EVAR-first approach results in favourable mortality rates and short-term outcomes, including shorter hospital stays and reduced post-operative complications. Even so, open repair also shows promising results for patients with complex anatomies not suitable for EVAR. Future research on ruptured AAAs should aim to include palliation rates to enhance understanding of surgical success. This study highlights the need for paired reporting of surgeries and palliation rates to put success rates into perspective. A unit's palliation rate does not necessarily need to change practice, but can theoretically confound outcome reporting if not reported, and could therefore contribute to setting an intervention target.

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ORIGINAL RESEARCH

Management of VTE following superficial endovenous treatment: a global survey

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Plain English Summary

Why we undertook the work: Varicose veins can be treated with procedures inside the veins near the skin, which can sometimes lead to blood clots in the deeper veins (deep vein thrombosis, DVT). To reduce the risk of DVT, some patients are given blood-thinning medications. However, there is not clear agreement on whether these medications help, what the risks of giving them are or how long to use them. We wanted to understand how healthcare professionals around the world manage the risk of DVT and how they use these medications when they perform varicose vein procedures.

What we did: We created an online questionnaire for healthcare professionals who treat varicose veins. The questionnaire asked about the types of treatments they offer, when they prescribe blood-thinning medications and which ones they use. After collecting responses, we looked at the data to find patterns and see how practices vary in different countries.

What we found: We received 263 responses, mostly from vascular surgeons. The results showed wide variation in the use of blood-thinning medications when treating varicose veins. For example, healthcare professionals in North America were less likely to prescribe these medications than those in other regions. The type of treatment also made a difference – procedures that use heat were more likely to lead to the use of blood-thinning medications, while non-heat treatments were less likely to be followed by the use of these drugs, even though they might also pose a risk of DVT.

What this means: Our questionnaire suggests that there is not a standard or common way to give medications to prevent DVT (blood clots) when carrying out varicose vein treatment procedures. The use of these medications varies by region and treatment type, and there is no clear global standard. This highlights the need for more research and better guidelines to make sure that patients receive the most appropriate care.

Abstract

Introduction: Superficial endovenous intervention is the recommended treatment for symptomatic varicose veins. However, venous thromboembolism (VTE) remains a known complication. Guidelines, including those from the National Institute for Health and Care Excellence (NICE) and European Society for Vascular Surgery (ESVS), are largely opinion-based and recommend an individualised approach to pharmacological thromboprophylaxis. However, clinical practices vary: some clinicians routinely prescribe pharmacological thromboprophylaxis while others do not. This survey examined global practices in pharmacological thromboprophylaxis for superficial endovenous interventions and identified regional and treatment trends.

Methods: An online survey was distributed via professional societies and social media platforms to healthcare professionals involved in endovenous interventions. It was piloted before dissemination and included questions on participant demographics, treatment modalities and pharmacological thromboprophylaxis use. Responses were analysed descriptively, summarised as frequencies and percentages, and categorised by region and treatment type.

Results: A total of 263 valid responses were analysed, with vascular surgeons comprising the majority of responders (68%, n=178). Most participants were from Europe (64%, n=170) and North America (18%, n=48), while representation from South America (8%, n=20), Asia (6%, n=15), Africa (3% n=7) and Australasia (1%, n=3) was more limited. Ultrasound-guided foam

sclerotherapy (UGFS) was the most commonly performed procedure, offered by 77% (n=141) of individuals in private, 70% (n=67) in public and 60% (n=41) in academic settings. Geographic variations were observed in pharmacological thromboprophylaxis use, with fewer North American clinicians prescribing it to average- and higher-risk patients compared to other regions. Among respondents prescribing extended direct oral anticoagulant (DOAC) thromboprophylaxis, rivaroxaban was the most common choice for both thermal (77%, n=41) and non-thermal techniques (75%, n=27), followed by apixaban (19%) and edoxaban (4% and 6%, respectively). Most respondents (69%, n=174) reported routinely risk-stratifying patients before treatment, with higher-risk individuals more likely to receive pharmacological thromboprophylaxis. The choice of DOACs for extended thromboprophylaxis showed minimal regional variation.

Conclusions: This survey highlights a global lack of consensus on VTE risk assessment and thromboprophylaxis in superficial endovenous interventions. High-quality evidence is needed to establish standardised guidelines and improve patient outcomes. The generalisability of these findings is limited, particularly in regions where no responses were collected, such as large parts of Africa, the Middle East and areas of Asia and South America. Small sample sizes in certain regions and self-reported data reliance introduce potential selection and reporting bias. These limitations highlight the need for broader, more inclusive research and robust statistical analysis to ensure globally applicable recommendations.

Key words: superficial endovenous treatment, venous thromboembolism,survey

Introduction

Superficial endovenous interventions have become the gold standard for treating symptomatic varicose veins, with multiple guidelines recommending these procedures where appropriate.[1,2] However, venous thromboembolism (VTE) – encompassing deep vein thrombosis (DVT) and pulmonary embolism (PE) - is a recognised complication of these procedures, with reported rates of up to 3.4%.[3] The severity of VTE varies widely, from asymptomatic cases with no clinical consequences to life-threatening PE or debilitating post-thrombotic syndrome (PTS).[4,5] PTS, which manifests as chronic leg pain, swelling and venous skin changes, develops in up to 50% of patients with DVT.[6,7]

To reduce the risk of VTE following superficial endovenous interventions, several professional bodies, including the National Institute for Health and Care Excellence (NICE), the European Society for Vascular Surgery (ESVS) and the UK Royal Society of Medicine (RSM), recommend an individualised approach to pharmacological thromboprophylaxis, particularly for high-risk patients.[1,8,9] In practice, approximately two-thirds of clinicians in the UK and 73% of clinicians in Ireland routinely prescribe pharmacological thromboprophylaxis for these procedures,[10,11] often tailoring their approach based on patient-specific risk factors. A recent systematic review and meta-analysis of non-randomised studies suggests that pharmacological thromboprophylaxis may reduce the rate of DVT in this setting.[3] However, while anticoagulation offers potential benefits, it also carries risks, including an increased risk of bleeding.[12–14] Cost-effectiveness is another key consideration, particularly in resource-limited settings where the economic burden of anticoagulation must be weighed against VTE prevention.[15–17] Despite its clinical significance, the evidence base for pharmacological thromboprophylaxis in superficial endovenous interventions remains limited, with few randomised controlled trials.[3] Much of the current guidance is based on observational data and expert consensus, leading to uncertainty in clinical decision-making.

Despite national and international recommendations, clinical practice regarding pharmacological thromboprophylaxis in superficial endovenous interventions remains highly variable. Some clinicians administer a single dose of low-molecular-weight heparin (LMWH), while others opt for an extended course of LMWH or a direct oral anticoagulant (DOAC).[11] Approximately one third of clinicians in the UK do not routinely prescribe pharmacological thromboprophylaxis.[11] Several factors contribute to this variability, including healthcare infrastructure, institutional guidelines and medicolegal considerations.[18–21] In particular, several high-profile media reports of deaths following varicose vein surgery have heightened concerns over litigation,[22,23] leading some clinicians to adopt more aggressive prophylactic strategies, while others remain cautious due to guideline ambiguity, bleeding risks or resource constraints.[24–26]

This survey aims to explore global practices in pharmacological thromboprophylaxis for superficial endovenous interventions and to identify potential trends related to country of practice and treatment modality.

Methods

Survey development

An online questionnaire was developed using the Qualtrics XM platform (see Appendix 1 online at www.jvsgbi.com).[27] To enhance clarity and validity, the survey underwent internal and external pilot testing with a trial manager and four vascular surgeons.[28–30]

Feedback from the pilot phase was used to refine the survey's wording and structure. The final version contained 26 questions but applied logic ensured that not all participants received every question. Based on the pilot testing, the estimated completion time was approximately four minutes.

Questionnaire structure

The survey consisted of a combination of binary, multiple choice and open-ended questions. It was divided into two main sections:

1. Demographic information. This section collected data on respondents' professional roles and countries of practice. It also examined employment sector (private, public and academic) to explore potential differences in treatment practices, given that resource availability, financial incentives and institutional policies may influence thromboprophylaxis decisions.[31,32]
2. Treatment modalities offered, risk stratification and thromboprophylaxis practices. This section assessed the treatment modalities offered by respondents, whether they routinely risk-stratify patients for VTE risk and their pharmacological thromboprophylaxis practices. Respondents who performed risk stratification were asked about their pharmacological thromboprophylaxis practices for patients they classified as at "average risk" and "higher risk" of VTE. The survey did not define these risk categories, allowing respondents to apply their own clinical judgment and institutional protocols. Respondents who did not routinely risk-stratify patients were asked about their thromboprophylaxis practices without differentiation by risk level.

Questions were tailored using applied logic based on previous responses to ensure relevance, minimise complexity and reduce respondent burden.[30] The pharmacological thromboprophylaxis regimens presented were based on established standard practices.[11,33]

Survey distribution

The survey link and its objectives were disseminated through multiple channels to reach a broad audience of healthcare professionals. It was shared via emails with members of several professional societies, including the American Venous Forum (AVF), American Vein and Lymphatic Society (AVLS), European Venous Forum (EVF) and International Union of Phlebology (UIP). Additionally, the survey was promoted via social media platforms such as Twitter, and a QR code linking to the survey was displayed at the Vascular and Endovascular Issues, Techniques and Horizons (VEITH) symposium in November 2023. Survey reach was assessed through engagement metrics such as click-through rates and completion rates.

Ethics and governance

As the survey targeted healthcare professionals and did not involve patient data, formal ethical approval was not required.[34] This exemption aligns with the ethical principles outlined in the Declaration of Helsinki.[35] Participation was voluntary, and informed consent was implied through survey completion. To maintain respondent confidentiality, all responses were anonymised, and any potentially identifiable information was protected securely.

Questionnaire analysis

Responses were collected over a three-month period (November 2023 to January 2024) and compiled using the Qualtrics XM platform before being exported to Microsoft Excel for analysis. Only descriptive statistics were applied. Multiple-choice responses were summarised as frequencies and percentages, with regional differences and associations between treatment modalities and thromboprophylaxis use described based on respondent distribution by continent. No formal statistical analyses were performed. Open-ended responses were grouped into common themes for qualitative analysis.

Results

Survey participation

As the survey was disseminated via social media platforms, a formal response rate could not be calculated. However, the QR code was scanned 124 times, and 307 participants opened the survey, with 306 attempting to respond. After excluding incomplete submissions (n=43), a total of 263 unique and valid responses were available for analysis, yielding an approximate completion rate of 86%. This rate is considerably higher than similar online surveys in the literature,[10,36] likely because the rate was calculated based on those who opened the survey rather than the total number of individuals who received the link. The number of responses varied across questions, with response counts provided accordingly.

Respondent demographics

The baseline characteristics of respondents are summarised in Table 1. The majority were vascular surgeons (68%, n=178), followed by phlebologists (16%, n=42) and interventional radiologists (1%, n=4). Other professions are also detailed in Table 1. The geographic distribution of respondents is illustrated in Figure 1, with notable representation from Europe and North America but limited participation from Africa, the Middle East and areas of Asia and South America.

Practice setting and treatment modalities

Of the 263 respondents, 70% (n=183) practised in the private sector, 37% (n=97) in public hospitals and 26% (n=68) in academic institutions. As multiple selections were allowed, many respondents reported working across more than one setting (Figure 2). Across all sectors, ultrasound-guided foam sclerotherapy (UGFS) was the most commonly offered treatment modality, reported by 77% (n=141) of private sector respondents and 70% (n=67) in the public sector (Figure 3). In academic settings, UGFS (60%, n=41) and radiofrequency ablation (RFA) (60%, n=41) were the most frequently offered modalities.

Table 1 Baseline characteristics of respondents and areas of practice.

Baseline characteristics	n (%)
Clinician type	n=263
Vascular surgeon	178 (68%)
Phlebologist	42 (16%)
Interventional radiologist	4 (1%)
Other†	39 (15%)
Continent of practice§	n=263
United Kingdom	11 (4%)
Europe (excluding United Kingdom)	159 (60%)
North America	48 (18%)
South America	20 (8%)
Australasia	3 (1%)
Africa	7 (3%)
Asia	15 (6%)

† Free text responses: Angiologist (n=2), Cardiothoracic surgeon (n=1), Cardiovascular products specialist (n=1), Dermatologist (n=11), Dermatologist/phlebologist (n=2), Dermatovenereologist (n=1), Family doctor (n=1), General surgeon (n=10), PhD student (n=2), Physician assistant (n=2), Specialist in vascular medicine (n=1), Surgeon (n=1), Vascular and general surgeon (n=1), Vascular doctor (n=2), Vascular peripheral echo Doppler specialist (n=1).

§ Albania (n=2), Argentina (n=10), Australia (n=3), Austria (n=3), Azerbaijan (n=1), Belgium (n=10), Bosnia and Herzegovina (n=1), Brazil (n=3), Bulgaria (n=1), El Salvador (n=2), Colombia (n=2), Czech Republic (n=2), Egypt (n=3), England (n=3), Estonia (n=1), Finland (n=2), France (n=7), Germany (n=2), Greece (n=5), Guatemala (n=2), Hungary (n=2), India (n=5), Iran (n=3), Iraq (n=1), Israel (n=1), Italy (n=17), Japan (n=1), Kazakhstan (n=2), Kosovo (n=1), Latvia (n=1), Lithuania (n=1), Mexico (n=9), Netherlands (n=30), Paraguay (n=1), Poland (n=2), Portugal (n=16), Romania (n=8), Russia (n=9), Saint Lucia (n=1), Scotland (n=2), Serbia (n=1), Slovakia (n=2), Slovenia (n=5), South Africa (n=4), Spain (n=4), Sweden (n=8), Switzerland (n=4), Trinidad (n=1), Turkey (n=2), United Arab Emirates (n=1), Ukraine (n=1), USA (n=34), Blank (n=18).

Figure 1 Distribution by country of practice.

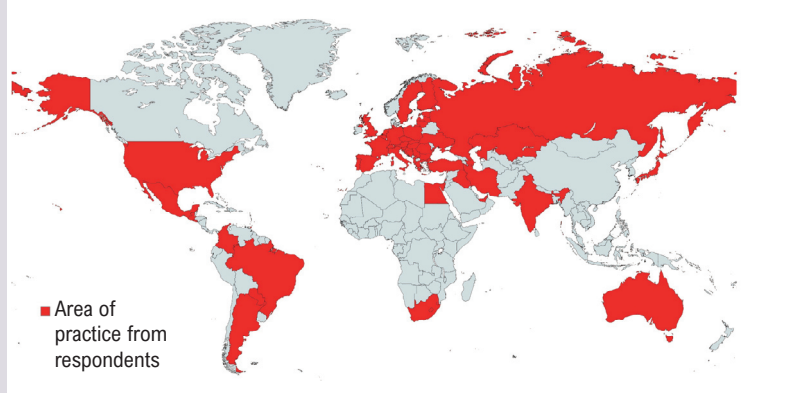
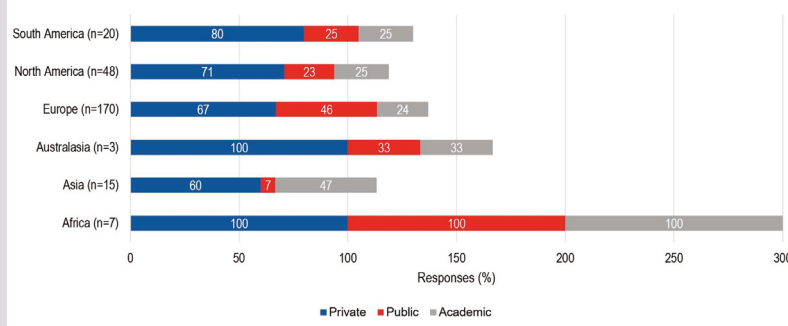


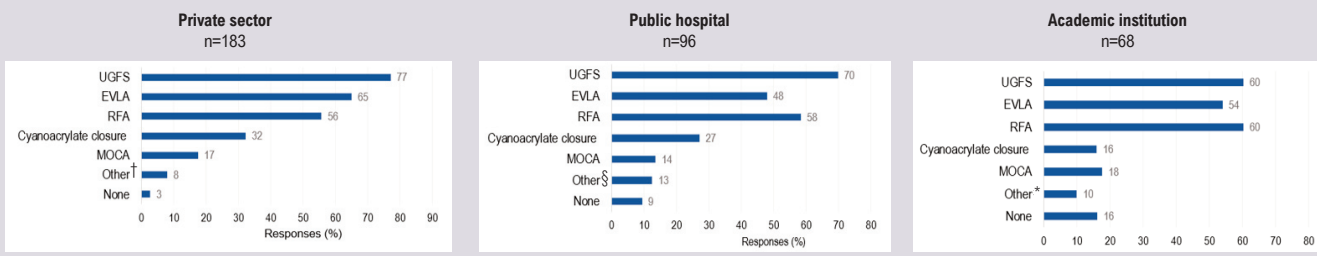
Figure 2 Employment sector distribution among respondents.



Regional variations in treatment modalities

The distribution of treatment modalities by continent is depicted in Figure 4. While UGFS was the most common intervention in most regions, endovenous laser ablation (EVLA) was predominant in Asia (80%, n=12). RFA was most widely used in North America (79%, n=38), while cyanoacrylate closure was also most common in this region (54%, n=26). Mechanochemical ablation (MOCA) and other treatments were reported less frequently across all continents.

Figure 3 Treatment modalities offered versus healthcare sector.



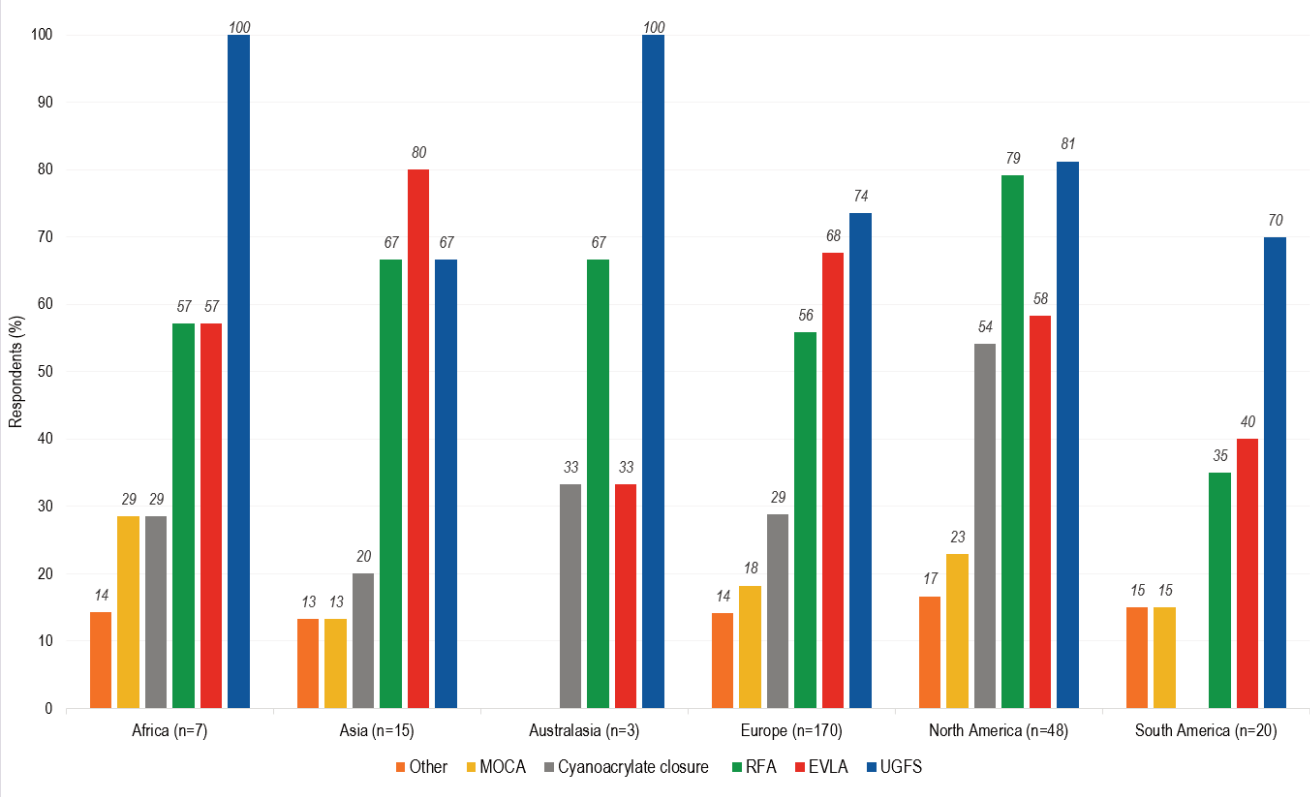
† CLaCS (Cryo-Laser and Cryo-Sclerotherapy) (n=1), FleboGrif (n=2). High-intensity focused ultrasound (HIFU, n=2). Miniphlebectomy (n=1). Microphlebectomies (n=1). Non-ultrasound guided foam (n=1), Open Surgery (n=1), PEM - Varithena (n=1), Sclerotherapy (n=1), Stab avulsion (n=1), Stripping (n=1), Varithena (n=2).

§ Compression therapy (n=1), Microwave (n=2), MOCA with Flebogrif (n=1), No ultrasound guided foam (n=1), Open surgery (n=3), Sclerotherapy (n=2), Stab avulsion (n=1), Stripping (n=1).

* Compression therapy (n=1), High-intensity focused ultrasound (HIFU, n=1), Microwave (n=1), Miniphlebectomy (n=1), Open surgery (n=2), Phlebectomies (n=1)

EVLA, endovenous laser ablation; MOCA, mechanochemical ablation; RFA, radiofrequency ablation; UGFS, ultrasound-guided foam sclerotherapy.

Figure 4 Treatment modalities offered globally.



EVLA, endovenous laser ablation; MOCA, mechanochemical ablation; RFA, radiofrequency ablation; UGFS, ultrasound-guided foam sclerotherapy.

Other' treatment modalities offered (n=38) include:

Africa (n=1): CLaCS (n=1) ; **Asia (n=2)**: Stab avulsion (n=1). Open surgery (n=1) ; **Europe (n=24)**: Compression therapy (n=3), Conventional surgery (n=1), High-intensity focused ultrasound (HIFU, n=2), Micro phlebectomies (n=1), Microwave (n=3), Mini phlebectomy (n=2), MOCA with FleboGrif (n=4). Open surgery (n=2), Phlebectomies (n=1), Sclerotherapy (n=3), Steam ablation (n=1), Stripping (n=1) ; **North America (n=8)**: Microphlebectomy (n=1), Non-ultrasound guided foam (n=2), Sclerotherapy (n=1), Varithena (n=4) ; **South America (n=3)**: Open surgery (n=1). Stripping (n=2).

Perceptions of compression and VTE risk assessment

Among 257 respondents, 67% (n=172) believed that compression following endovenous varicose vein intervention serves as a prophylactic measure against VTE, while 33% (n=85) did not share this view. Regarding VTE risk assessment, 69% (n=174) of respondents reported routinely performing risk assessments before superficial endovenous interventions, while 31% (n=77) did not. The specific tools used for risk assessment are detailed in Table 2.

Thromboprophylaxis practices among risk-assessing respondents

Pharmacological thromboprophylaxis regimens for different treatment modalities among respondents who routinely perform VTE risk assessments are shown in Figure 5. The data are categorised by continent and further stratified by patient risk level ('average risk' versus 'higher risk'), as defined by each clinician's own assessment. While the survey captured whether extended thromboprophylaxis was used, respondents were not asked to specify its exact duration.

Table 2 Risk assessment tools used to risk-stratify patients.[37–39]

Risk assessment tool	(n=169)
Caprini score	191 (60)
Padua prediction	11 (6)
DHRA tool	10 (6)
Other†	47 (28)

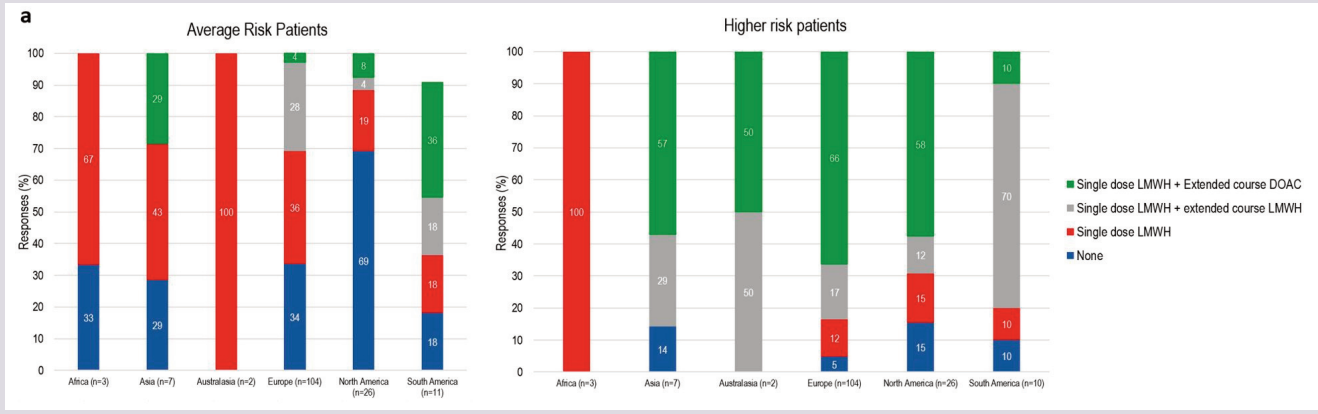
† Free text responses: ACCP risk stratification (n=1), BMI >30 (n=1), History and common risk factors (n=20), IMPROVE risk score (n=1), Local questionnaire / Local modified score (n=4), Personal / individualised risk assessment (n=5), Ultrasound assessment (n=2), Blank / Incomplete responses (n=13).

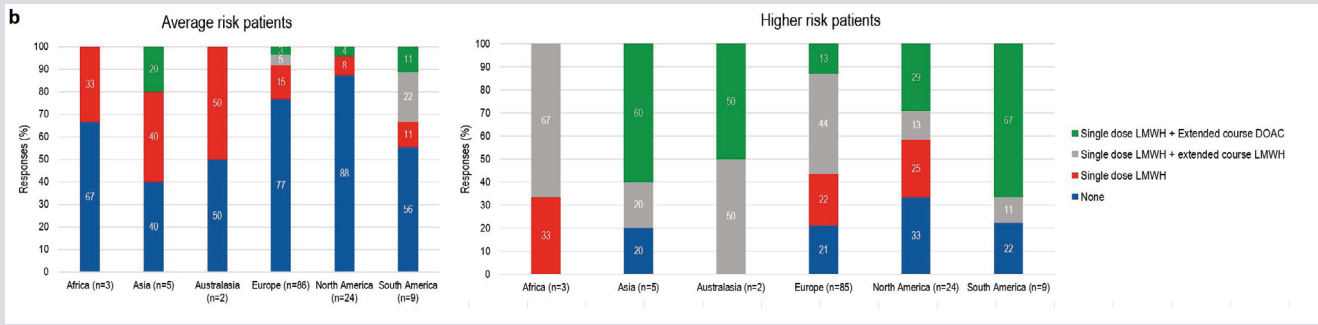
ACCP, American College of Chest Physicians; BMI, Body mass index; DHRA, Department of Health Risk Assessment

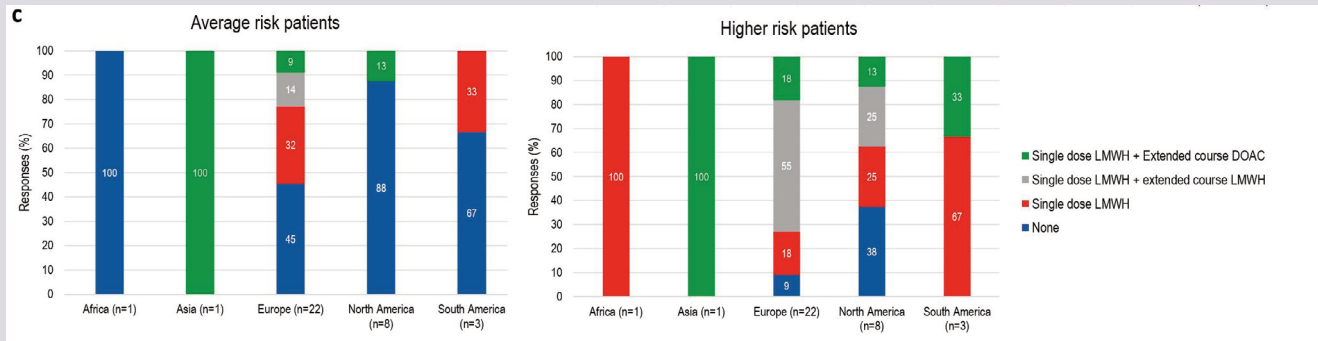
Thermal ablation

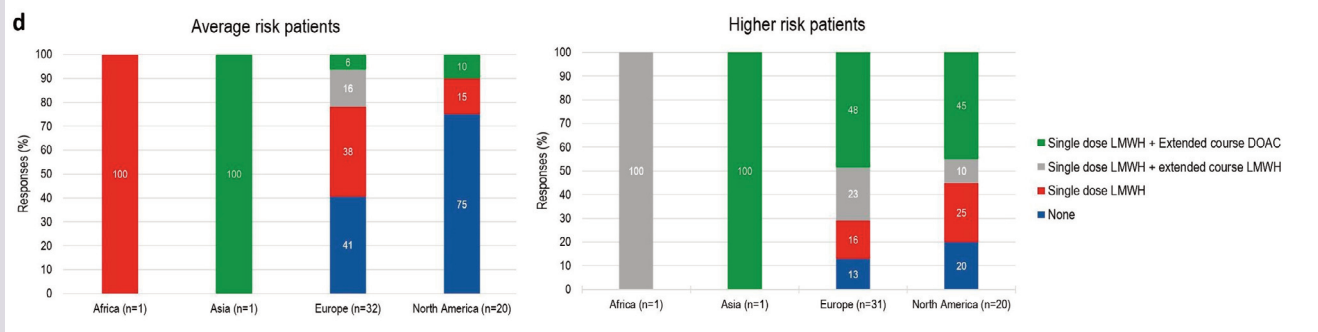
In North America (n=26), 69% (n=18) of respondents did not prescribe pharmacological thromboprophylaxis for average-risk patients, but this decreased to 15% (n= 4) for higher-risk patients.

Figure 5 Standard pharmacological thromboprophylaxis regimes for thermal modalities (a), UGFS (b), mechanochemical ablation (c) and cyanoacrylate closure (d) among respondents who routinely risk assess patients based on their VTE risk prior to superficial endovenous interventions.









DOC, direct oral anticoagulant; LMWH, low-molecular-weight heparin; UGFS, ultrasound-guided foam sclerotherapy.

In Europe (n=104), 34% (n=35) of respondents did not routinely prescribe pharmacological thromboprophylaxis for average-risk patients, decreasing to 5% (n=5) for higher-risk patients. Similar trends were observed across Asia, South America and Africa (Figure 5a).

UGFS
For UGFS, 88% (n=21) of respondents in North America (n=24) did not routinely prescribe pharmacological thromboprophylaxis for average-risk patients, decreasing to 33% (n=8) for higher-risk patients. In Europe (n=86), 77% (n=66) of respondents did not routinely prescribe pharmacological thromboprophylaxis for average-risk patients, with this decreasing to 21% (n=18) for higher-risk patients (Figure 5b).

MOCA
In North America, 88% (n=7) of respondents did not routinely prescribe pharmacological thromboprophylaxis for average-risk patients undergoing MOCA, decreasing to 38% (n=3) for higher-risk patients. In Europe (n=22), 45% (n=10) of respondents did not routinely prescribe pharmacological thromboprophylaxis for average-risk patients, reducing to 9% (n=2) for higher-risk patients. No respondents in Asia reported prescribing pharmacological thromboprophylaxis for either average-risk or higher-risk patients undergoing MOCA (Figure 5c).

Cyanoacrylate closure
In North America, 75% (n=15) of respondents did not routinely prescribe pharmacological thromboprophylaxis for average-risk patients, decreasing to 20% (n=4) for higher-risk patients. In Europe (n=32), 41% (n=13) of respondents did not routinely prescribe pharmacological thromboprophylaxis for average-risk patients, reducing to 13% (n=4) for higher-risk patients. No respondents in Africa reported prescribing pharmacological thromboprophylaxis for either risk category undergoing cyanoacrylate closure (Figure 5d).

Thromboprophylaxis practices among non-risk-assessing respondents

Figure 6 presents the pharmacological thromboprophylaxis regimens used by respondents who did not routinely perform VTE risk assessments prior to intervention. The data are categorised by treatment modality and continent, highlighting variations in prescribing patterns.

Thermal ablation
Among respondents who did not routinely risk assess patients, the likelihood of prescribing pharmacological thromboprophylaxis varied widely by region (Figure 6a). In North America, the majority (94%, n=16) reported not routinely prescribing pharmacological thromboprophylaxis for patients undergoing thermal ablation. In contrast, only 32% (n=12) of European respondents and 33% (n=1) of African respondents reported not routinely prescribing pharmacological thromboprophylaxis. All respondents from Asia (n=7), South America (n=2) and Australasia (n=1) reported routinely prescribing pharmacological thromboprophylaxis. However, the small sample sizes in these regions limits definitive conclusions.

UGFS
Prescribing practices for UGFS also varied considerably across regions (Figure 6b). All respondents from Asia (n=4), Australasia (n=1) and South America (n=4) reported not routinely prescribing any form of pharmacological thromboprophylaxis. Fifty percent (n=2) of African respondents indicated that they routinely prescribed extended thromboprophylaxis with either LMWH or a DOAC.

MOCA
Among the relatively small number of respondents who performed MOCA without prior risk stratification, prescribing patterns were similarly varied (Figure 6c). In both North America (n=3) and Africa (n=1), no respondents reported routinely prescribing pharmacological thromboprophylaxis. In Europe, 37% (n=3) of respondents indicated that they routinely prescribed extended thromboprophylaxis with LMWH.

Cyanoacrylate closure
The use of pharmacological thromboprophylaxis for cyanoacrylate closure was infrequent among non-risk-assessing respondents (Figure 6d). While 58% (n=8) of European respondents reported routinely prescribing pharmacological thromboprophylaxis, no respondents from North America (n=5), Africa (n=1) or Asia (n=1) reported doing so. A single respondent from Australasia indicated that they routinely prescribed a single dose of LMWH for patients undergoing cyanoacrylate closure.

Extended thromboprophylaxis regimens

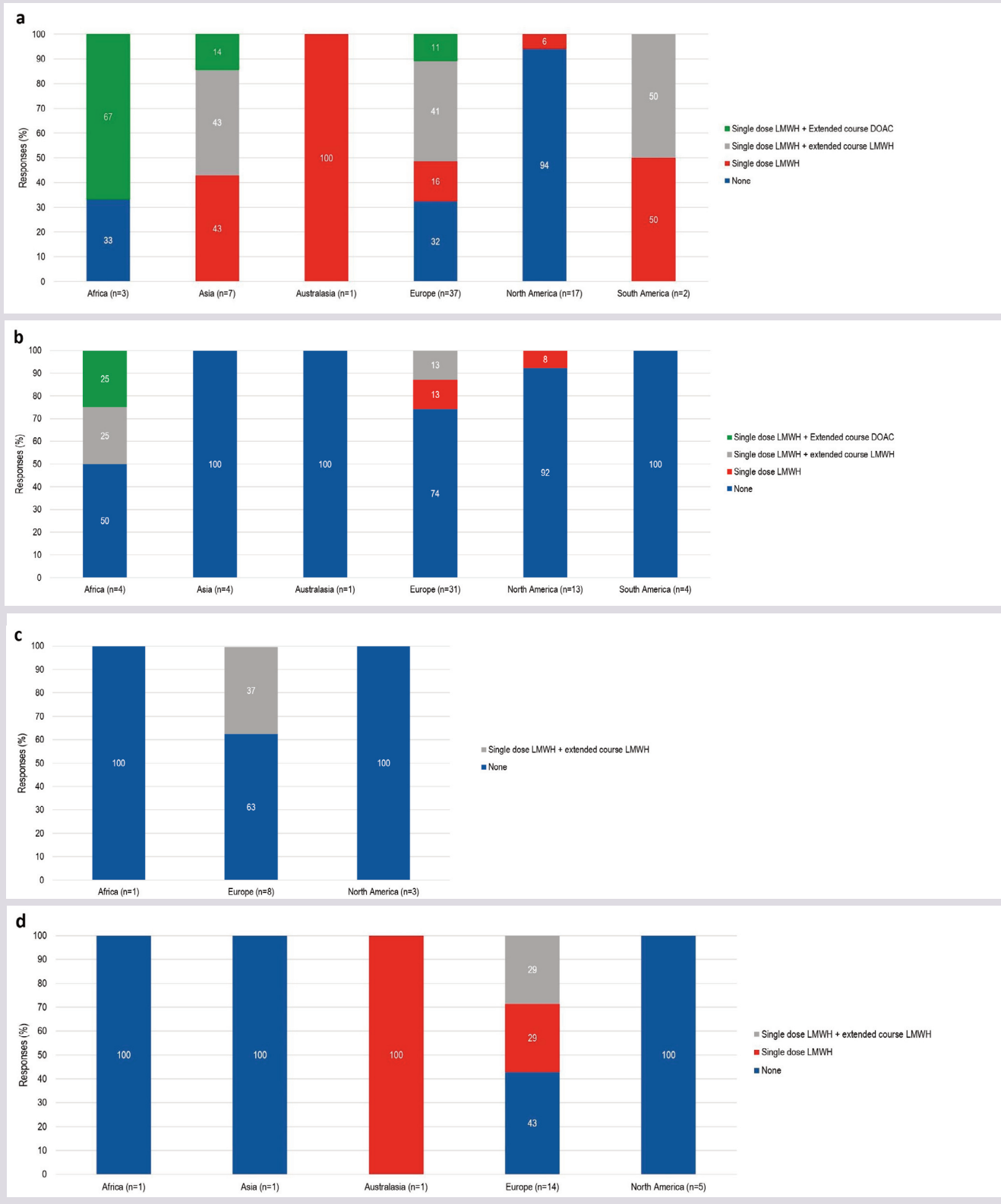
Among respondents who routinely prescribed extended thromboprophylaxis with a DOAC for thermal ablation (n=53), the majority (77%, n=41) used rivaroxaban, followed by apixaban (19%, n=10) and edoxaban (4%, n=2). Similarly, among those prescribing extended DOAC thromboprophylaxis for non-thermal techniques (n=36), rivaroxaban was the most commonly prescribed (75%, n=27), followed by apixaban (19%, n=7) and edoxaban (6%, n=2).

Discussion

Regional differences

This survey provides a global perspective on current thromboprophylaxis practices, with significant contributions from clinicians in North America, Europe and parts of Asia and the Pacific. UGFS was suggested to be the predominant treatment modality across all sectors and was the predominant modality in

Figure 6 Standard pharmacological thromboprophylaxis regimes for thermal modalities (a), UGFS (b), mechanochemical ablation (c) and cyanoacrylate closure (d) among respondents who do not routinely risk assess patients based on their VTE risk prior to superficial endovenous interventions.



DOC, direct oral anticoagulant; LMWH, low-molecular-weight heparin; UGFS, ultrasound-guided foam sclerotherapy.

Africa, Australasia, Europe, North America and South America. This is consistent with a 2015 survey of the Vascular Society of Great Britain and Ireland,[36] which also identified UGFS as the most widely used approach for superficial endovenous treatment. While UGFS is recognised for its safety and efficacy in treating great saphenous incompetence,[40] concerns remain regarding recurrence rates and lower occlusion rates compared to thermal modalities.[41,42] Additionally, studies have questioned its cost-effectiveness within publicly funded healthcare systems such as the UK National Health Service,[43] highlighting the need for further research into its long-term clinical and economic outcomes. UGFS is also associated with complications such as hyperpigmentation, telangiectatic matting and, in rare cases, cutaneous necrosis.[44,45] Notably, larger foam sclerosant volumes have been linked to an increased risk of thrombosis, raising questions about the balance of efficacy and safety in procedures.[46–50]

Economic factors also play a role in thromboprophylaxis practices. The cost differences between DOACs and LMWH, along with variations in healthcare funding structures, likely influence prescribing decisions across different regions.[21,51–53] In countries with limited access to DOACs or where out-of-pocket costs are high, clinicians may be more conservative in their use of pharmacological thromboprophylaxis.[54,55]

Compression therapy

Although the primary focus of this survey was pharmacological thromboprophylaxis, the inclusion of the compression therapy question provides additional insight into clinicians' broader approaches to VTE prevention. The role of postoperative compression in reducing VTE risk remains an area of debate.[8,56–58] In this survey, two thirds of respondents believed that compression lowers VTE risk, suggesting that mechanical measures may influence decisions regarding pharmacological thromboprophylaxis. Current NICE guidelines recommend mechanical prophylaxis for patients who are undergoing varicose vein surgery, who are at an increased risk of VTE and in whom pharmacological thromboprophylaxis is contraindicated.8 However, this recommendation is based on low-quality evidence, including studies with considerable risk of bias, imprecision and methodological limitations.[59–61] Despite this, postoperative compression remains widely used in the UK and other regions following superficial venous interventions,[11,36] not only for VTE prevention but also to reduce bruising, haematoma formation and pain and to improve treatment success.[11,62–65] The 2023 SVS, AVF and AVLS joint guideline recommends at least one week of post-procedural compression following thermal ablation for pain reduction,[58] but does not specifically endorse its use for VTE prophylaxis. The discrepancy between clinical belief and evidence regarding the role of compression in VTE prevention highlights the need for further research. While this survey suggests widespread confidence in its benefits, one third of respondents expressed doubts about the efficacy of compression in VTE prophylaxis. This aligns with prior studies reporting near universal adoption of compression,[10,11] yet an ongoing debate remains about its necessity.

Pharmacological thromboprophylaxis and risk stratification

Pharmacological thromboprophylaxis in superficial endovenous procedures also remains controversial. While guidelines typically advocate an individualised approach to VTE prevention,[1,8,9,58] the evidence supporting this approach in this specific context is limited. Additionally, the absence of a validated risk assessment tool for this specific patient population presents significant challenges. This survey highlights substantial variability in how clinicians define 'average risk' and 'higher risk' patients, suggesting that individual interpretation plays a major role in decision-making.

Existing tools, such as the Caprini score,[39] the Department of Health Risk Assessment tool and the Padua prediction model,37,38 address general thrombotic risk but may not fully account for procedure-specific factors.[10,33] Furthermore, some studies suggest that risk-adjusted anticoagulation may not alter thrombotic outcomes significantly in this setting.[66,67] High-quality evidence is essential to determine the true benefits of individualised thromboprophylaxis and to develop a dedicated risk assessment tool tailored to superficial endovenous procedures. The ongoing THRIVE trial (THRomboprophylaxis in Individuals undergoing superficial endoVENous intervention),[68] a large randomised controlled trial, aims to address this evidence gap. By providing robust Grade A evidence, this trial has the potential to refine thromboprophylaxis practices and offer much needed clarity in this debated area.

Regional variability in pharmacological thromboprophylaxis

This survey highlighted notable regional differences in prescribing practices for pharmacological thromboprophylaxis. Compared to other regions, North American clinicians were less likely to prescribe pharmacological thromboprophylaxis for both average-risk and higher-risk patients. This aligns with the joint guideline from the American SVS, AVF and AVLS,[58] which assigns a Grade 2C recommendation for anticoagulation only in high-risk patients undergoing endovenous ablation. The Grace 2C classification reflects low-quality evidence and significant heterogeneity in existing studies. While the guideline acknowledges potential benefits of pharmacological thromboprophylaxis, it also emphasises its limited generalisability due to small effect sizes, a lack of risk stratification in studies and significant heterogeneity in results.[58] Furthermore, there are insufficient data on the optimal agents, dosing and duration of thromboprophylaxis. As a result, clinicians may feel that even higher-risk patients do not warrant routine anticoagulation. Lower rates of pharmacological thromboprophylaxis in North America may also be influenced by lower detection rates of DVT, which could reinforce the perception that routine anticoagulation is unnecessary. Further research is needed to determine whether differences in DVT surveillance

contribute to regional variations in thromboprophylaxis use.

In contrast, European clinicians were more likely to prescribe pharmacological thromboprophylaxis across all risk categories, particularly for higher-risk patients. This aligns with the ESVS and NICE recommendations,[1,8] which emphasise an individualised approach to VTE prophylaxis with careful consideration for those at greater risk. However, the survey also suggests that many clinicians prescribe pharmacological thromboprophylaxis even for patients who are not at an increased risk of VTE. This may reflect a lack of clear risk stratification guidance in current guidelines or concerns about medicolegal implications.[24,26]

These findings highlight geographical variations in practice patterns, which may be driven by differences in resource availability, clinical guidelines and local expertise.[17,69] Additionally, current pharmacological thromboprophylaxis guidelines rely heavily on retrospective studies of varying quality. For instance, NICE acknowledges that its recommendations are based on very low quality evidence,[70] including studies that used outdated surgical techniques such as open vein surgery, which is no longer routinely performed. These limitations highlight the need for more rigorous prospective trials to inform future guidelines.

Thromboprophylaxis by treatment modality

Treatment modality also played a role in the administration of pharmacological thromboprophylaxis. The survey suggests that patients undergoing thermal ablation were more likely to receive anticoagulation, while non-thermal techniques such as UGFS and MOCA were associated with lower rates of pharmacological thromboprophylaxis. This is interesting given that prior reports link UGFS, particularly higher volumes of foam sclerosant, to increased thromboembolic complications.[46–50]

Choice of pharmacological agent

Rivaroxaban was the most commonly prescribed anticoagulant across all treatment modalities, regardless of risk profile or procedure type. This aligns with a recent meta-analysis ranking rivaroxaban as the preferred anticoagulant for thromboprophylaxis following endovenous ablation due to its lower bleeding risk.[71] However, rivaroxaban is not specifically licensed for post-procedural thromboprophylaxis in varicose vein surgery,[72] raising questions about its off-label use in this context. Clinicians who routinely assess VTE risk were more likely to omit pharmacological thromboprophylaxis for non-thermal techniques, suggesting a more selective approach to anticoagulation based on perceived procedural risk.

Limitations

The generalisability of this survey's results is limited due to the lack of responses from large parts of Africa, the Middle East and areas of Asia and South America. This uneven geographic distribution may be due to factors such as language barriers, varying levels of interest or expertise in the subject or limited access to the survey. These gaps could introduce the possibility of regional bias, potentially limiting the applicability of these findings to under-represented regions. Future surveys could mitigate this issue by offering translations to increase participation.

Small sample sizes in certain regions, such as Australasia, Africa, Asia and the UK, may limit the reliability of regional comparisons. Additionally, the reliance on self-reported data introduces potential selection bias. Vascular surgeons may be over-represented, and respondents may overstate adherence to guidelines. Furthermore, variability in how respondents interpreted "higher risk" patients also suggests inconsistencies in risk stratification.

The survey did not collect information on the use of the CEAP (Clinical-Etiology-Anatomy-Pathophysiology) classification or procedural indication for thromboprophylaxis decisions, despite anecdotal evidence that some clinicians incorporate these factors.[73] This omission may have limited the study's ability to capture the full scope of risk assessment practices.

Finally, while the survey presents descriptive statistics, it does not include statistical analyses to assess the significance of regional differences. The absence of confidence intervals or p values makes it unclear whether observed variations reflect true differences or random variation.

These limitations highlight the need for cautious interpretation of the results. Future research should prioritise broader geographic representation, standardised risk assessment criteria and more robust statistical analysis to strengthen the validity of findings.

Conclusions

This global survey provides valuable insight into current global practices following superficial endovenous interventions, highlighting considerable variability across regions, treatment modalities and patient VTE risk profiles. While most clinicians routinely assess VTE risk prior to these procedures, the absence of a validated risk assessment tool for this specific patient population remains a significant gap. The findings from this survey suggest that pharmacological thromboprophylaxis is more commonly used in thermal modalities than in non-thermal modalities, with rivaroxaban being the most frequently prescribed anticoagulant across regions. These results emphasise the need for clearer, evidence-based guidelines to standardise key aspects of thromboprophylaxis, including risk stratification criteria, the role of pharmacological thromboprophylaxis in this patient population and the selection of appropriate pharmacological agents. Addressing these gaps would help reduce practice variation and promote a more consistent approach to VTE prevention. High-quality randomised controlled trials, such as the ongoing THRIVE study, will be crucial in refining thromboprophylaxis recommendations and addressing current uncertainties in clinical practice. This survey's findings should be interpreted in light of its limitations, including potential selection bias, regional disparities in response rates and reliance on self-reported data.

KEY MESSAGES

- There is considerable variation in the use of pharmacological thromboprophylaxis for superficial endovenous treatment, highlighting the absence of a clear consensus among clinicians
- Pharmacological thromboprophylaxis is largely driven by patient VTE risk but may also be influenced by the treatment modality and regional practices
- The lack of a validated risk assessment tool specific to superficial endovenous interventions contributes to variability in clinician decision-making and highlights the need for tailored, evidence-based guidelines

Conflict of Interest: AHD and DC (co-authors) are the Chief Investigator and Co-Chief Investigator of the THRIVE (THRomboprophylaxis in Individuals undergoing superficial endoVEnous intervention) trial, which has been mentioned in this manuscript.

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PROTOCOL

Optimal treatment strategy for mixed arteriovenous leg ulceration: a systematic review protocol

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Plain English Summary

Why we are undertaking this work: A leg wound which fails to heal within two weeks is called an ulcer. Leg ulcers are a serious health problem which happen to one out of every 67 adults and one in every 20 people over the age of 60. This has a large impact upon quality of life and costs the NHS in England more than £3.1 billion every year. In most people with this condition the underlying cause is a disease in the veins in the leg but, in a quarter of cases, there is also disease affecting the arteries. In this case it is called a 'mixed arteriovenous leg ulcer'. There are a range of treatments available for both the arteries and veins and, in some cases, we do not know which treatments to use and in what order so that wounds heal and stop coming back.

What we will do: We will find the studies that looked at different ways of treating people with this condition and combine the results to produce the strategy that best supports healing while being safe.

What this means: Gathering and combining research findings allows us to paint a clearer picture about the best evidence to treat people with this complex and not very well-researched condition. Specifically, in mixed arteriovenous leg ulcers, we will be able to identify if there is a combination of treatments that speeds up healing or is more likely to prevent ulcers from coming back after healing. If strong enough, this information can be used to pave the way for future research that will lead to better care for this group of patients.

Abstract

Introduction: Chronic leg ulceration is a major health problem affecting 1.5% of adults, increasing to 5% of those over 60 years old. It is associated with significant quality of life (QoL) impairment in addition to high treatment costs, estimated at £3.1 billion annually in England alone. In the majority of patients chronic venous disease is the underlying cause, but in a quarter of patients there is also disease affecting the arteries. This situation is often termed mixed arteriovenous leg ulceration (AVLU). Several treatments may be of benefit including arterial intervention, venous intervention, compression therapy, alone and in combination. It is at present uncertain which is the optimal treatment strategy to offer to patients with this condition. The aim of this review is to identify and analyse the available literature evidence and identify the most effective treatment strategy.

Methods: A systematic review will be conducted on the available literature of treatment strategies used for the management of AVLU in line with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines. A search of online databases including OVID Medline and EMBASE will be carried out for comparative prospective studies of patients undergoing treatment of AVLU. The treatment regimens used will be described in full including the sequence and timing of intervention. The primary outcome will be ulcer healing. Secondary outcomes include ulcer recurrence, generic and disease-specific QoL measures, complications and cost-effectiveness. The Covidence software for systematic reviews will be used to screen and select studies. Study data will be extracted onto a Microsoft Excel® spreadsheet and summarised in tables. Risk of bias will be assessed using the Cochrane Risk of Bias Tool for randomised trials or the modified Downs and Black checklist for non-randomised studies. Meta-analysis will be performed for homogenous data. Data deemed unsuitable for meta-analysis will be summarised in a narrative fashion.

Conclusion: The findings from this review aim to summarise the current literature in the management of AVLU, including different approaches such as treating venous disease alone or combining treatments to optimise wound healing. This will in turn inform further prospective studies on the optimal treatment strategy for this complex condition.

Key words: arteriovenous ulcers, systematic review protocol

Introduction

Chronic leg ulceration is an increasingly common condition affecting 1.5% of all adults and 3–5% over the age of 60. It is a major challenge to healthcare systems due to the high cost of managing patients with this condition.[1] The National Health Service (NHS) in England treats an estimated 700,000 leg ulcers annually, costing £3.1 billion.[2–5] This considerable sum is more than double the combined yearly cost of treating colorectal, lung, breast and prostate cancers,[6] and is additional to the debilitating effect of this condition on patients due to morbidity from pain, immobility and infections.[7–9] Moreover, the disease and its treatment lead to social isolation and restrictions on daily living such as bathing, clothing choice and walking,[7–10] all of which have a significant detrimental effect on quality of life (QoL).[9–11] Indeed, QoL limitation of the physical function of patients with leg ulceration is reported to be similar to those with congestive heart failure.[11] The management of chronic leg wounds has been highlighted in the NHS's Long Term Plan as an important area for improvement.[5] Similarly, this area has been identified as a priority area for research by the James Lind Alliance Priority Setting Partnership in conjunction with the Vascular Research Group.[12,13]

Mixed arteriovenous ulceration (AVLU) accounts for up to 25% of leg ulcers.[14–16] This is characterised by a leg wound which fails to heal within two weeks[17] in the presence of both chronic venous disease and peripheral arterial disease.[14,16,18] A recent National Wound Care Strategy Programme (NWCSP) report identified wide variation in the quality of care received by patients with leg ulcers and that many do not receive effective evidence-based care.[5] The NWCSP report also highlights that this is a prime area for quality improvement to deliver better patient outcomes and secure better value from resources.[5] This is perhaps most true of AVLU, where a combination of venous, arterial and wound care-based treatments may be used and there is little consensus on which should be used, and in what order, to provide the best patient outcomes. This contrasts with the evidence for the management of isolated arterial or venous leg ulcers which are well-researched areas with strong evidence to guide treatment.[18,19]

The optimal management strategy for patients with AVLU remains uncertain. Compression therapy, venous and arterial interventions may all be of benefit, but it is unclear which combinations or sequences lead to optimal wound healing and recurrence prevention. Many clinicians only offer compression therapy after arterial intervention is carried out due to a perception that compression may worsen ischaemia; however, there is good evidence that compression is safe in the presence of a low ankle brachial pressure index.[20,21] Moreover, arterial intervention is associated with a significant risk of harm including 1–2% mortality and morbidity in the form of heart attacks, strokes and limb loss.[22] Additionally, arterial interventions cost significantly more than office-based venous interventions, which are associated with a much lower risk of harm. An inclusive review of available evidence is therefore needed to guide clinicians towards strategies that optimise benefit and reduce harm to patients. The aim of this review is to identify and analyse the current evidence on the optimal treatment strategy, order and timing of interventions for AVLU.

Methods

A systematic review of the literature will be performed in line with the Cochrane recommendation on conducting reviews of interventions.[23] This protocol was written in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA-P) guidance.[24] The main study aim is to identify and synthesise the evidence on different treatment strategies for patients with AVLU. The study protocol has been registered on the International Prospective Register of Systematic Reviews (PROSPERO) database (CRD42024489366).

The study aims to identify the safety, efficacy, effectiveness and cost-effectiveness of treatments for AVLU including compression and intervention for venous and/or arterial disease, alone or in combination. AVLU is defined as the presence of a full-thickness skin defect in the gaiter region with the presence of both clinical class 6 venous disease and an ankle brachial pressure index of <0.9.[25]

Study eligibility criteria

Original English language articles of prospective comparative studies investigating the effect of compression, arterial intervention, venous intervention or any combination thereof in the treatment of adult patients with AVLU are eligible for inclusion. Conference abstracts, book chapters and retrospective studies will be excluded. Studies that include both patients with critical limb-threatening ischaemia and those with AVLU or those that combine venous leg ulcer patients with AVLU patients will also be excluded, unless the data of patients with AVLU can be analysed separately.

All compression methods including hosiery, bandages, boots or intermittent pneumatic devices are eligible for inclusion. Only arterial interventions recommended for the treatment of peripheral arterial disease by international bodies such as the European

Society for Vascular Surgery (ESVS) will be eligible for inclusion.[19] Similarly, only venous interventions recommended by international bodies such as the ESVS for the treatment of venous reflux or obstruction will be considered eligible.[18]

Outcomes

Outcome measures of treatment effect in this review are in line with the US Food and Drug Administration (FDA) recommendation on studies of skin ulceration.[26] The primary outcome measure of this review is the time to ulcer healing. Secondary outcome measures of wound healing are ulcer-free time, rate or risk of ulcer recurrence and reduction in wound size. Other outcomes include wound-specific QoL, generic QoL, major adverse cardiovascular events (MACE), major adverse limb events (MALE), wound infection rate and patient-reported pain. MACE will be defined as death, myocardial infarction or stroke within 90 days of any intervention. MALE will be defined as any amputation of a limb above the ankle within 90 days of any intervention.

Search strategy and study selection

A literature search will be conducted with the support of a qualified medical librarian (TS) with predefined search terms using keywords, equivalent words and Medical Subject Headings (MESH) terms. Databases to be searched include EMBASE, OVID Medline and CINAHL from inception to October 2024. The reference lists of included studies will also be searched for other studies that may meet the inclusion criteria. Finally, a search update will be conducted prior to data analysis and any newly identified studies will be included in the final review to ensure literature saturation. A draft search strategy for OVID Medline is shown in Table 1. This strategy will be adapted for other databases.

Study screening and selection will be carried out by two reviewers independently using the web-based Covidence systematic review software (2024, Veritas Health Innovation, www.covidence.org). Authors of studies that treat AVLU patients but include other cohorts such as venous leg ulcers in the same study will be contacted so that AVLU patient data can be extracted separately. The search results will be uploaded to the software and, where the two do not agree on the inclusion of a study, consensus will be sought and, if necessary, arbitration will be provided by a third reviewer. A PRISMA chart will be used to summarise the study selection process.[24]

Table 1 Draft search strategy for OVID Medline.

1	mixed leg ulcer*.mp.
2	mixed ulcer*.mp.
3	mixed arteriovenous leg ulcer*.mp.
4	arteriovenous leg ulcer*.mp.
5	arteriovenous ulcer*.mp.
6	arterovenous leg ulcer*.mp.
7	artero venous ulcer*.mp.
8	artero-venous ulcer*.mp.
9	arterial leg ulcer*.mp.
10	arterial ulcer.mp.
11	Venous Leg Ulcer*.mp.
12	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13	revasculari?ation.mp.
14	compression.mp.
15	Compression Bandages/
16	venous treatment.mp.
17	venous ablation.mp.
18	13 or 14 or 15 or 16 or 17
19	12 and 18
20	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10
21	18 and 20
22	19
23	limit 22 to (english language and humans)
24	remove duplicates from 23
25	limit 24 to (books or chapter or conference abstract or conference paper or "conference review" or editorial or erratum or letter or note)
26	24 not 25

Data extraction and management

Following this, two independent reviewers will commence data extraction using a dedicated Microsoft Excel spreadsheet (Microsoft ® Corporation, 2022). Again, discrepancies will be resolved through consensus and, where clarification is needed, authors of included studies will be contacted. Data extraction will include study design, sample size, study population demographics, comorbidities, interventions, comparators, follow-up duration and main findings. Conflicts of interest, study funding and other sources of bias will also be reported where available. A summary table of study characteristics will be provided.

Included randomised controlled trials will be reported separately from non-randomised studies and risk assessed using the Cochrane Risk of Bias tool for randomised trials,[27] whereas the methodological quality of non-randomised studies will be assessed using the modified Downs and Black checklist.[28] Clinical heterogeneity of included studies will be considered to assess suitability for meta-analysis including patient demographics, comorbidities, types of interventions, follow-up duration and definitions used to report outcomes. If clinical homogeneity criteria are satisfied, statistical heterogeneity will be assessed using the

KEY MESSAGES

- Mixed arteriovenous ulceration is a complex condition with little evidence regarding its management
- This review aims to analyse available literature and identify the effective treatment strategies for AVLU
- We hope to use the results of this review to inform current practice and future study design

χ^2 and I^2 tests. A fixed effects model meta-analysis will be performed for studies where statistical heterogeneity is ≤60%, and for those >60% a random effects model will be used. There are no planned subgroup analyses. Dichotomous outcomes will be presented in a forest plot with risk ratios and 95% CI, whereas continuous outcomes will be presented as mean difference (MD) or SMD with 95% CI. A hazard ratio with 95% CI will be provided for time-to-event data. Data that cannot be synthesised in meta-analysis will be presented in a narrative summary. The Grading of Recommendations, Assessment, Development and Evaluation (GRADE) Working Group guidelines will be used to assess the quality of synthesised evidence.[29]

Discussion

In AVLU there can be clinical uncertainty of the relative contribution of both arterial and venous pathologies present, whether both require treatment to achieve wound healing, and in what order they should be addressed. This uncertainty leads to delays in diagnosis, treatment and ultimately wound healing and increasing morbidity and treatment costs.[5] The management of chronic leg ulcers currently consumes a considerable amount of resources and this has been identified as an area where patient care can be improved, and better value can be gained from utilised resources. A key aspect of this involves an evidence-based approach to the care of complex patients such as those with AVLU. One review has been conducted previously in this area, although it focused only on the use of compression.[30] The authors identified that reduced compression is safe and promotes ulcer healing in AVLU. They did not, however, comment on the treatment of underlying venous or arterial disease, or indeed the order in which these treatments should be undertaken.[30] Current international guidelines have similarly not identified an optimal strategy to investigative and treat patients with AVLU, although the use of light compression is recommended.[18] This review will identify and synthesise key evidence from the literature on the management of patients with AVLU and help inform future research in this area.

Conclusion

This review will be the first to assess the evidence on the complete management of AVLU, including the benefits of combinations of compression, arterial and venous interventions. The findings will be used to inform current practice, highlight gaps in the literature and guide future research on the subject, including interventional studies.

Conflict of Interest: The authors declare that there are no conflicts of interest.

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Author contributions: All the authors have made substantial contribution to this work including conception, design, acquisition, drafting, revision and approval of the final manuscript.

Ethics and dissemination: This is a systematic review and meta-analysis of published literature data and does not require prior ethical approval. Requests for unpublished data from authors of included studies will comply with the UK General Data Protection Regulation (GDPR). We aim to disseminate the results of this study in peer-reviewed journals and conferences.

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REVIEW

Carotid webs: a review of diagnosis and management strategies in current literature

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Plain English Summary

Why we undertook the work: Carotid webs are small protrusions on the inside of blood vessels in the neck where clots can form and lead to a stroke. They are a rare cause for strokes in young people and can be difficult to diagnose. We undertook this review to look at the current research on how this is being treated globally.

What we did: We evaluated existing evidence in the literature on the diagnosis, management and outcome of carotid webs.

What we found: We found a mix of low- and medium-quality evidence, which suggests there is no clear guideline on the best way to manage carotid webs at present. Options include treating with medication which thins the blood, keyhole surgery to put stents in the blood vessel or open surgery.

What this means: There is no clear evidence about which option is better and when this should be done, and further studies are needed. It would be useful to establish a worldwide registry so that data can be standardised and evidence improved.

Abstract

Introduction: Carotid webs (CaW) are non-atherosclerotic fibrous bands which present as shelf-like linear intraluminal filling defects at the carotid bulb or internal carotid artery. They are a known cause of cryptogenic strokes. Current management includes medical, interventional (stenting) and surgical approaches.

Aims: The aim of this review was to systematically evaluate the existing evidence in the literature on the diagnosis, management and outcomes of carotid webs.

Methods: This review was performed in accordance with the Preferred Reporting for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A combination of the medical subject headings (MeSH) terms “carotid web”, “carotid shelf”, “CaW”, “web vessels”, “Intraluminal web” and “cryptogenic stroke”, “ischaemic stroke”, “embolic stroke of undetermined source” was utilised in the primary search. Basic descriptive statistical analysis was completed using IBM’s Statistical Package for the Social Sciences (SPSS) statistics software, version 29.

Results: 123 articles met the criteria and underwent data extraction. This included two registry reviews, 13 cohort studies, 20 case series and 73 case reports. The articles spanned from 1967 to 2024. A pooled total of 771 patients were included (registry and cohort studies n=559; case series/case reports n=212). A higher prevalence of CaW is reported in young female patients and in patients of Afro-Caribbean origin. Symptom recurrence is reduced following intervention in the form of stenting or open surgery in a subset of patients. There is little evidence on the management of asymptomatic CaW.

Conclusions: Current literature on CaW lacks homogeneity and is mostly anecdotal in nature. Previous studies have focused on diagnosis, with emerging cohort studies in the last decade evaluating management options. Further large-scale studies are needed. Establishing a worldwide registry will allow standardisation of the data collected and evaluated. Improving the quality of evidence available will help to guide management.

Key words: carotid web, carotid artery, cryptogenic stroke, endarterectomy

Introduction

Carotid Webs (CaW) are non-atherosclerotic fibrous bands which present as shelf-like linear intraluminal filling defects, often on the posterior wall of the carotid bulb or the proximal internal carotid artery, causing turbulent flow (Figures 1-5).[1-4]

The condition was first described by Ehrenfeld in 1967 and is often referred to as atypical fibromuscular dysplasia due to the fibrosis and hyperplastic changes seen in the intimal layer on histology.[3,5,6] CaW are difficult to diagnose on imaging and are increasingly being recognised as a source of cryptogenic stroke. The CaW shelf serves as an area for accumulation of thrombus with a risk of subsequent embolisation, resulting in large vessel occlusion and subsequent ischaemic strokes.[7-9] A high index of suspicion should be considered in cases where no other source for the transient ischaemic attack (TIA) or stroke has been identified. CaW are still underdiagnosed due to the imaging challenges and a general lack of awareness of this pathology. Current literature suggests that CaW have a higher prevalence in young individuals (age <60 years), female patients and individuals of African descent.[1,10-15] Current management options may include conservative medical management, carotid artery stenting (CAS) or surgical intervention in the form of carotid endarterectomy (CEA) and web resection with or without patchplasty or segmental resection.[8]

Figure 1 Carotid Web schematic.

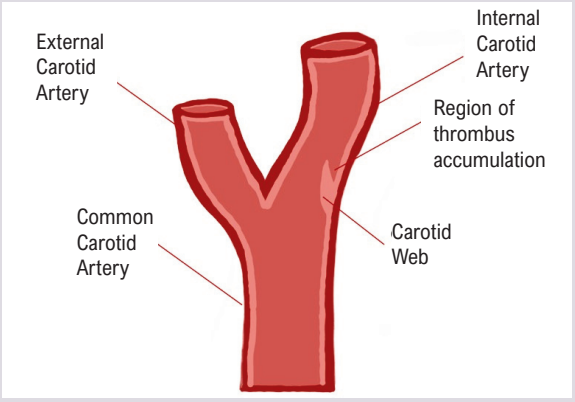


Figure 2 Intraoperative appearance of a Carotid Web.

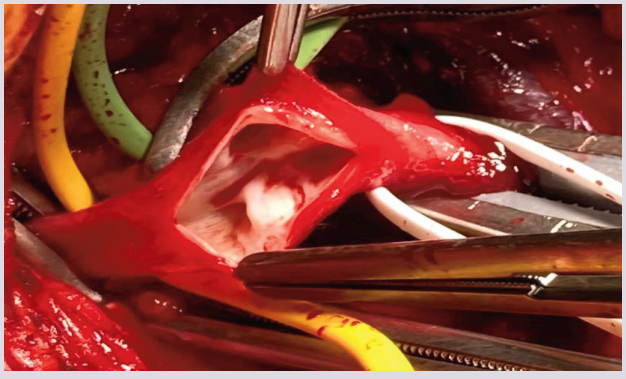


Figure 3 Carotid Web appearance on duplex ultrasonography.

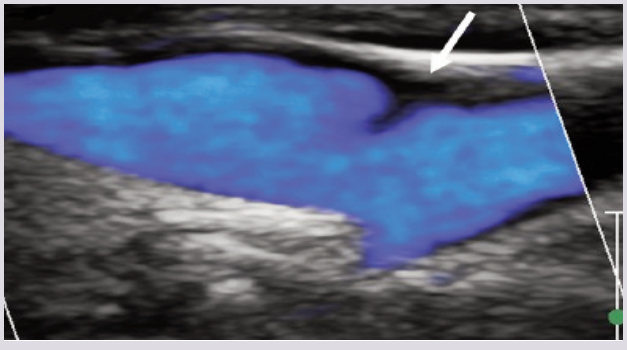


Figure 4 Carotid Web on computed tomography.

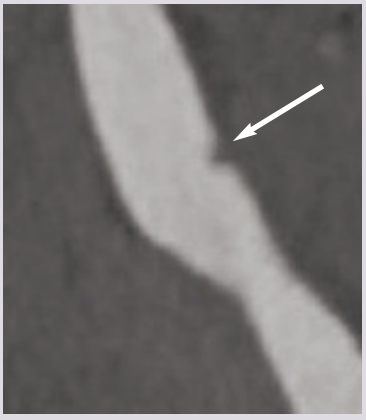
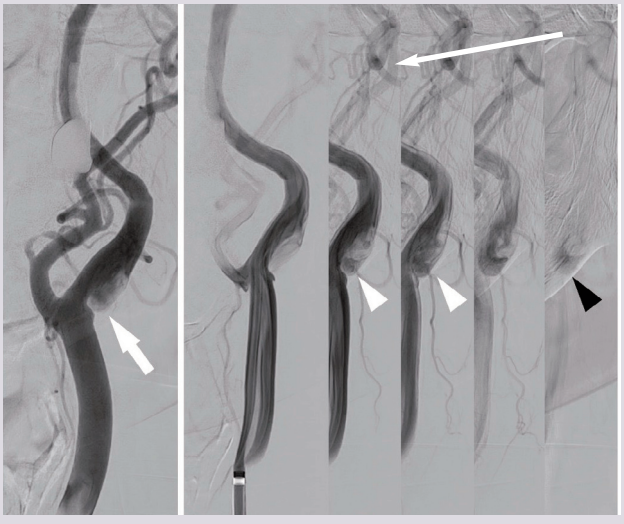


Figure 5 Carotid Web on angiography.



Aim

The aim of this review was to evaluate existing evidence in the literature on the diagnosis, management and outcomes of carotid webs.

Methods

This review was performed in accordance with the Preferred Reporting for Systematic Reviews and Meta-Analyses (PRISMA) statement.[16] The literature was searched using Embase and Medline (via Ovid interface), Web of Science, Scopus and CINAHL databases. A combination of the medical subject headings (MeSH) terms "carotid web", "carotid shelf", "CaW", "web vessels", "Intraluminal web" and "cryptogenic stroke", "ischaemic stroke", "embolic stroke of undetermined source" and "stroke" was utilised in the primary search strategy.

Randomised controlled trials, cohort studies, cross-sectional studies, observational studies, case series and case reports on the subject of CaW were included. Studies were limited to those written in the English language. No time limit was placed for the search and articles up to 2024 were included. The exclusion criteria consisted of studies where only the prevalence or incidence was reported, abstracts, letters and conference papers. The abstract and title screening and full text review was completed using the Covidence software by two reviewers (MAh, KP, MT).

Data extraction was completed by four reviewers (MAh, MT, MAb, FS). The extracted information included the author, year of publication, type of study, number of patients, age, gender, ethnicity, presenting complaint, co-morbidities, initial investigations, investigation findings, territory of stroke/TIA, National Institute of Health Stroke Scale (NIHSS) score, ipsilateral/contralateral disease, acute management, long-term management, histology and outcome. Basic descriptive statistical analysis was completed using IBM's Statistical Package for the Social Sciences (SPSS) statistics software, version 29.

Results

Some 4,017 articles were initially identified and they are summarised in Figure 6. After de-duplication, 3,297 articles underwent title and abstract screening and of these 3,035 were excluded. 261 articles were assessed for eligibility. 123 articles met the criteria and underwent data extraction. They included two registry reviews, 13 cohort studies, 20 case series and 73 case reports. The articles spanned the period from 1967 to 2024.

A pooled total of 771 patients were included (registry and cohort studies n=559; case series/case reports n=212).[3,6,17-105] The findings are summarised in Tables 1-4. Further details of each case series and case report are available to view in Appendix 1 (online at www.jvsgbi.com). There was a higher prevalence of CaW reported in female patients (n=521) compared to male patients (n=295). Forty-four case reports did not describe the gender. The mean age of presentation was 43.7 years (range 29-93 years) across the case series and reports. The mean age range across the pooled registry/cohort studies was between 44-59 years. Fifty-five patients had concurrent bilateral carotid webs.[3,25,38, 42,47,49,67,106-109] Only a third of the articles reported the ethnicity. A higher prevalence was reported in individuals of African descent, who represented 21% of the patient cohort (Afro-Caribbean n=101, African-American n=50, African n=14), followed by 10.5% of Caucasians (n=81). Other reported ethnicities included Asian (1.29%), Middle Eastern (0.52%) and Hispanic (0.52%). Where reported, almost 9% of the 212 patients (n=19) from the case series/case reports had a series of recurring symptoms at the time of presentation and diagnosis, although the time frame for these was not clear. All other reported cases were

Figure 6 PRISMA Flowchart.

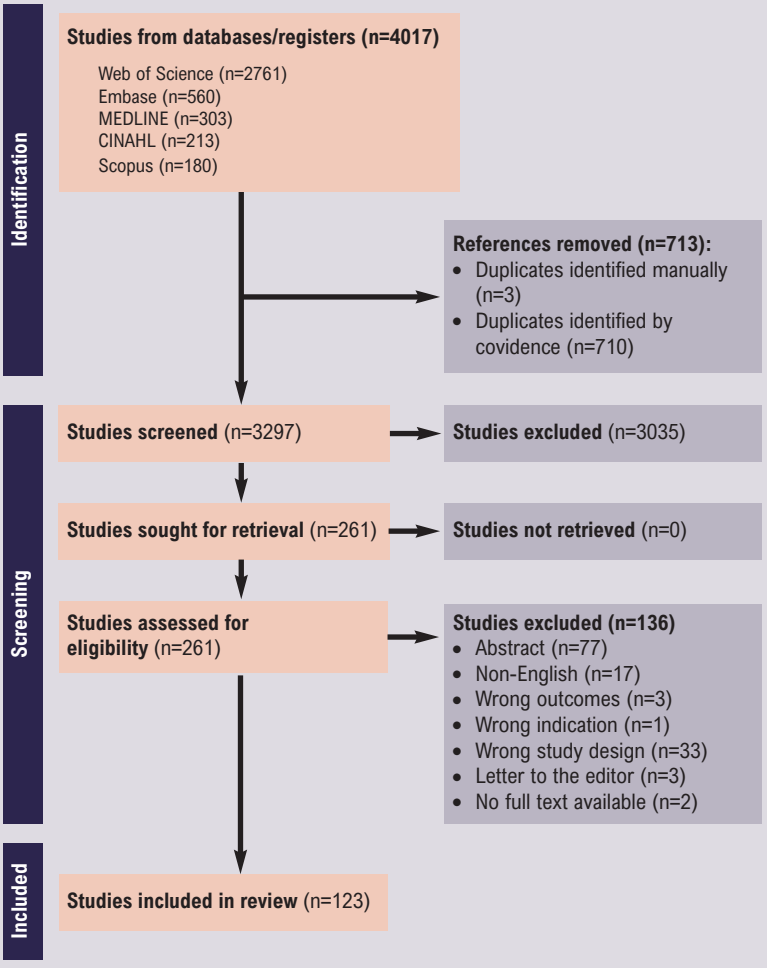


Table 1 Short summary of findings and intervention, where reported

Studies included – cases from 1967-2024

2 Registry reviews 13 Cohort studies	559 patients	Initial acute management • Medical management (n=238) • Thrombolysis (n=41) • Thrombectomy (n=50) • Reperfusion not otherwise specified (n=106) • Decompressive hemicraniectomy (n=7)	Subsequent/Definitive management • Carotid artery stenting (n=228) • Surgical (108)	• 55 patients – Bilateral Carotid Webs • 6 patients – known fibromuscular dysplasia • No recurrence of symptoms after definitive management
20 Case Series 73 Case reports	212 patients	Initial acute management • Medical management (n=103) • Thrombolysis (n=9) • Thrombectomy (n=18) • Thrombolysis and thrombectomy (n=8) • Carotid artery stenting (n=18) and surgical (n=38) • Not reported (n=23 cases)	Subsequent/Definitive management • Unchanged (n=118) • Carotid artery stenting (n=28) • Surgical (n=58) • Further thrombectomy (n=1).	

Table 2 Summary of patient demographics

Age	43.7 years (range 29-93)
Sex	71.66% - Female patients (n= 521) 22.64% - Male patients (n=295) 5.7% - Gender not reported
Ethnicity	21% - African/Afro-Caribbean (n=165) • Afro-Caribbean (n=101) • African-American (n=50) • African - not otherwise specified (n=14) 10.5% - Caucasian (n=81) 1.29% - Asian • Asian – not otherwise specified (n=4) • East Asian (n=4) • South Asian (n=2) 0.52% - Hispanic 0.52% - Middle Eastern Only 1/3 of all studies/cases reported the ethnicity
Co-morbidities	0.77% - Fibromuscular dysplasia 10.6% - Hypertension 5.45% - Hyperlipidaemia 3.3% - Diabetes

Table 3 Short summary of reported management in case series/case reports

Initial management	Medical management *(Dual antiplatelet therapy or high dose single antiplatelet therapy)*	48.5% (n=103)
	Thrombolysis	4.2% (n=9)
	Thrombectomy	8.5% (n=18)
	Thrombolysis + thrombectomy	3.8% (n=8)
	Carotid artery stenting	8.5% (n=18)
	Surgical	17.9% (n=38)
	Not reported	10.8% (n=23)
Definitive/ Subsequent management	Carotid artery stenting	13.2% (n=28)
	Surgical	27.3% (n=58)
	Thrombectomy	0.47% (n=1)
	Unchanged	55.6% (n=118)

emergent or semi-emergent cases presenting with symptoms in the preceding hours or days. From the symptomatic case reports, 79% presented with TIA and 58.9% had stroke symptoms. There were 20% which did not specify the presentation or had atypical symptoms. The NIHSS score at presentation was provided in 54 case reports. The mean score was 7.7 at presentation (range 0-25). Six patients had a known pre-existing diagnosis of fibromuscular dysplasia.[2,17,18,22,26,47,53,110] The most commonly co-morbidities, where reported, were hypertension in 10.6% of the cohort, followed by hyperlipidaemia in 5.45% and diabetes in 3.3%.

All studies and case reports initially managed CaW with medical management or thrombolysis/thrombectomy. [2,106-119] However, further intervention with either stenting or surgery was required in a subset which comprised almost half the patient group who had symptom recurrence or as a means to definitive management of the CW. [2,106,108,109,111,112,115,116,119] Of the 212 cases reported, the initial acute management included medical management with dual antiplatelet therapy or a high-dose single antiplatelet agent in 48.5% of the reported cases (n=103). 4.2% underwent thrombolysis (n=9), 8.5% underwent thrombectomy (n=18), 3.8% had thrombolysis and thrombectomy (n=8), 8.5% had carotid artery stenting (n=18) and 17.9% had surgical intervention (n=38). Initial management was not reported in 23 of the 212 cases. Subsequent, definitive management remained unchanged in more than 55.6% of the patients. However, further interval intervention included carotid artery stenting 13.2% (n=28), surgical 27.3% (n=58) and further thrombectomy 0.47% (n=1). None of the patients reported further symptoms following further definitive management.

Forty-five cases reported the intra-operative histology from the tissue samples sent. These are summarised in Table 5. Common findings included subintimal/intimal fibrosis (n=32) and medial muscular hyperplasia (n=12) and to a lesser degree, adventitial fibrosis (n=2). Associated thrombus was reported in 11 cases and arterioscleosis or plaques were mentioned in seven cases.

Table 4 Summary of studies included

Author	Year	Type of study	Number of patients	Age [in years]	Gender [Female: Male]	Ethnicity	Other patient descriptors	Acute Management	Recurrence	Definitive Management	Outcome
Joux *et al* (111)	2014	Cohort	25	Mean: 45.7±6.5	15F:9M	25 Afro-Caribbean	NR	Medical management (20/25 patients)	3/20- major strokes (NIHSS>10), 2/20 minor strokes (NIHSS<10), 1/20 TIA	1 Recurrent presentation underwent CEA. Surgical removal (7/25 patients)	Median time to recurrence = 12 months (earliest 1 month and all others after ≥6 months). Kaplan–Meier survival analysis: 1-, 2-, and 3-year recurrence rates in medically treated patients were 20% (95% confidence interval, 2.6–37.4), 27.3% (95% confidence interval, 6.3–48.3), and 36.4% (95% CI, 11.7–61.1). No recurrence in CEA patients.
Brinjikji *et al* (112)	2018	Cohort	4	Mean: 44 (range 30-50)	3F:1M	NR	NR	3-5 days of Ticagrelor		CAS	Post-operative bradycardia (n=3)
Haussen *et al* (113)	2018	Cohort	24	Median: 47 [IQR 41-61]	14F: 10M	17 African American; 7 Caucasian	NR	24/24 - Initial medical management; 11/24 - Thrombolysis; 13/24 - Thrombectomy	20 strokes; 4 TIA's (7 recurrent prior to stenting)	All underwent stenting + DAPT for 3 months followed by SAPT	No further symptoms
Pereira *et al* (114)	2018	Cohort	20	Mean: 50 (range 29-82)	10F:9M	NR	NR	13 - Supportive care NOS; 8 Stenting; 2 CEA; Aspirin and ticagrelor for 6 months then SAPT (Aspirin) up to 18 months.			No further symptoms
Haynes *et al* (110)	2020	Cohort	45 (7 had CaW, 15.6%)	Mean: 55 ± SD 12.6 (min 43, max 79)	5F:1M	4 African American; 1 Hispanic; 1 Caucasian	5/6 no significant cardiovascular disease risk factors, 1/6 Hypertension, Hyperlipidaemia, Former smoker, 1/6 Fibromuscular Dysplasia	Medical management - Aspirin	6 CEA 1 CAS		
Guglielmi *et al* (107)	2021	Registry	30	Median: 57 [IQR 46-66]	22F: 8M	NR	NR	28/30 - Medical management (15 on SAPT/ 8 on DAPT/ 4 on Warfarin/ 1 on DOAC)		1/30 - CEA after failining medical management	One death

continued...

Table 4 Summary of studies included (continued 1)

Author	Year	Type of study	Number of patients	Age [in years]	Gender [Female: Male]	Ethnicity	Other patient descriptors	Acute Management	Recurrence	Definitive Management	Outcome
Rzepka *et al* (115)	2021	Cohort	181 (27 had CaW, 14.9%)	Mean: 66.70 years ± SD 14.34	16F:11M	NR	23 (85%) Hypertension, 14 (52%) Dyslipidaemia, 5 (19%) Atrial Fibrillation, 4 (15%) Diabetes Mellitus, 5 (19%) Smokers, 3 (11%) Myocardial Infarction, 8 (30%) ischaemic heart disease)	All patients started on DAPT on diagnosis of ischaemic stroke + anticoagulation in 2 patients	54% CEA (n=27) 46% CAS (n=23)		
Semerano *et al* (108)	2021	Cohort	11	Median: 47 [IQR 38-50]	6F:5M	7 Sub saharan African; 3 North African; 1 Caucasian	NR	7/11Thrombolysis; 4/11 Medical management with antiplatelets;	5/11 CAS 1/11 CEA		Modified Rankin Scale - 4 excellent outcome; 10 good outcome; 1 poor outcome. §§No deaths
Turpinat *et al* (109)	2021	Cohort	21	Mean: 50.6 +/-9.2	11F:10M	1 Asian, 16 Caucasian, 1 African/ Caucasian, 3 Middle eastern	NR	21/21- antiplatelet, 5/21- short term anticoagulation - 4/20 patients had at least one stroke recurrence before CaW stenting or on medical management. The annual recurrence rate on medical therapy was 11.4% (95% CI [8.4–15.1]		14/20- CAS	
Zhu *et al* (106)	2021	Cohort	8 (6 presented with acute ischaemic stroke)	Mean: 50.75 (range 38-65)	2F:6M	NR	NR	x1 Thrombolysis; + Medical management for all patients (Aspirin 100mg + Clopidogrel 75mg + Atorvastatin 40mg)		x2 CAS x1CEA	
Tabibian *et al* (2)	2022	Cross-sectional study	86 patients (all with CW, 14/86 acute ischaemic stroke, 72/86 asympto-matic)	Mean - stroke group 48.3 ± SD 9.9; Mean - asymptomatic group 46.4 ± 14.8	47F:39M (both groups)	NR	25/86 Hypertension 14/86 Hyperlipidaemia 1/86 Atrial Fibrillation 5/86 Diabetes Mellitus 31/86 Smoker 7/86 FMD	4/14 (28.6%) CEA 5/14 (35.7%) CAS 5/14 (35.7%) Aspirin alone			

continued...

Table 4 Summary of studies included (continued 2)

Author	Year	Type of study	Number of patients	Age [in years]	Gender [Female: Male]	Ethnicity	Other patient descriptors	Acute Management	Recurrence	Definitive Management	Outcome
Zhou *et al* (116)	2022	Cohort	17 (all had CaW)	Mean age 59.41 years ±SD 10.86 years	4F:13M	NR	76.5% Hypertension 5.9% Dyslipidaemia 47.1% Diabetes Mellitus 11.8% Coronary artery disease 35.3% Previous stroke	7/17 medical management		9/17 CAS 1/17 CEA	No recurrence at median follow-up of 9 months (Inter quartile range 6-20 months)
Olindo *et al* (1)	2023	Registry	202 (32 with contralateral CaW)	50.8+/-12.2	62.9% F	47.5% Caucasian, 20.3% Afro-Caribbean	NR	106/185 - treatment of reperfusion; 21/185 thrombolysis; 37/185 thombolysis and mechanical thrombectomy; 7/185 decompressive hemicraniectomy		80/110 – CAS 30/110- CEA 4/32 Contralateral CW's underwent Carotid Artery Stenting	33.3% anticoagulation (DOAC 85.7%, vitamin K antagonist 14.3%), 61.9% SAPT, 3.6% DAPT, 1.2% antiplatelet and anticoagulation; 4 patients had no further treatment (patient decision)
Osehobo *et al* (117)	2023	Cohort (2014-2021)	118 (88 athero-sclerotic disease, 30 CaW)	Mean 51.2	73.3% F	NR	NR	Dual antiplatelets		CAS	
Brinster *et al* (118)	2024	Cohort (2016-2022)	52	Mean 49 (range 29-73)	71% F	67% Afro-Caribbean	NR	All patients started on DAPT on diagnosis of ischaemic stroke + anticoagulation in 2 patients; 54% CEA (n=27), 46% CAS (n=23), 2 strokes nil intervention		When managed medically with DAPT + statin +/- anticoagulation for 10 patients, all suffered ipsilateral recurrent strokes; after intervention with a mean duration of 38 months, no post-intervention stroke or death	

CAS – Carotid Artery Stenting; CaW – Carotid Web; CEA – Carotid Artery Stenting; DAPT – Dual Antiplatelet Therapy; DOAC – Direct Oral Anticoagulant; F – Female; IQR – Interquartile range; M – Male; NIHSS – National Institutes of Health Stroke Scale; NR – Not Reported; SAPT – Single antiplatelet therapy; SD- Standard Deviation; TIA – Transient Ischaemic Attack.

Table 5 Summary of histology findings; 45 cases reported histology findings from intra-operative samples sent

Findings	Number of patients
Subintimal/Intimal Fibrosis	32
Medial Muscular Hyperplasia	12
Adventitial Fibrosis	2
Arteriosclerosis or Plaque	7
Thrombus	11
Myxoid degeneration	8
Inflammatory cell infiltration	3
Dissection	3

Other histological findings included myxoid degeneration (n=8), inflammatory cell infiltration (n=3) and dissection (n=3). Myxoid degeneration results in the accumulation of mucin in tendons, ligaments and fibrocartilage and its presence in CaW warrants further research to gain an understanding of the underlying pathology of CaW formation.

A single peri-partum case with bilateral CaW was also reported in a 39-year-old female with a history of ocular symptoms five years prior to presenting with left arm weakness. This was managed successfully with dual antiplatelet therapy, switched to low molecular weight heparin in the late third trimester and six weeks following delivery.[67] Further statistical analysis was not possible owing to missing data as well as the overall heterogeneity of the data available.

Discussion

CaW are increasingly being recognised as a source of stroke for which no other causes may be identified leading to large vessel occlusion, particularly in younger patients.[42,119] Current imaging modalities include duplex ultrasonography, computed tomography angiography and high-resolution magnetic resonance angiography: however, CaW can be difficult to detect.[103,106,116] Barriers to diagnosis include lack of awareness and diagnosis with respect to imaging interpretation. Lesion identification can take up to four and a half months after initial stroke symptoms in as many as a quarter of patients.[1] CT angiography appears to be the most commonly used imaging modality in diagnosing and reporting CaW.[1,106,107] Duplex ultrasonography can be helpful as it provides information on the morphology of the CaW and can highlight haemodynamic changes, especially thrombus formation, but requires experience and expertise.[106] The literature comprises predominantly case reports and case series, with cohort and cross-sectional studies emerging in the last decade.

The true prevalence of CaW remains unknown. Registries such as MR CLEAN in the Netherlands and the CAROWEB in France have helped to shed light on this.[1,15] The CAROWEB registry, comprised of 224 cases, found that CaW were not identified at the time of mechanical thrombectomy in 30 out of the 85 patients.[1] The MR CLEAN registry found a 2.5% prevalence of CaW on the symptomatic side and a 0.5% prevalence on the asymptomatic side in a cohort of 443 cases.[107] Similar to findings from the pooled evidence in this review, CaW were identified primarily on CTA in female patients in a younger age group. In our pooled cohort of cases series/case reports, symptoms recurred in just under half of all patients, requiring further definitive treatment. The MR CLEAN registry reported a recurrence rate of about 17% over a two-year period. The overall true recurrence rate is therefore not entirely clear. The results from these registries have helped to shape the current iteration of the European Society of Vascular Surgeons current guideline on CaW. The overall underdiagnosis of CaW is a possible factor in the recurrence of symptoms which would otherwise not yield any underlying causes for symptoms during initial investigations.

Current management options available include antithrombotic and antiplatelet medication, including aspirin, clopidogrel or a combination of both, and statin use. Immediate management in acute cases where there is evidence of large vessel occlusion with focal neurological changes includes thrombolysis and/or thrombectomy followed by either medical management or intervention. Carotid artery stenting is a minimally invasive option in patients who may otherwise be high risk or who opt for this option. Dual layer stents show positive results without significant complications.[103] Open surgical intervention can include endarterectomy and patchplasty, or web excision and anastomosis, as described in some reports.

In general, there appears to be a higher rate of symptom recurrence in patients managed medically.[11,31,109,111,118,120] The overall time to symptom recurrence varies between 1-97 months, with another study citing a median 12 months to symptom recurrence.[31,111] An annual symptom recurrence rate of up to 11.4% has been reported in patients on medical therapy alone.[109,111] Other studies reported that their cohort of patients with CaW presenting with transient ischaemic attacks progressed to cerebral infarction within three months of medical management in almost two-thirds of the cases.[121]

No further symptoms were reported after definitive intervention in the form of carotid artery stenting or carotid endarterectomy.[106,111-113,115,116,117,120] The risks and side effects associated with intervention also need to be considered and balanced with the frequency of symptom recurrence and future risk of symptom recurrence and risk of stroke. This also needs to be balanced with potential advances in endovascular methodology. The timing of definitive intervention also varies vastly and seems to be dependent on a number of factors, including symptom recurrence and surgeon preferences.

There seems to be a general lack of consensus in managing concurrent contralateral CaW without symptoms. The CAROWEB registry reported invasive intervention (primarily carotid stenting) in four of the 32 patients with contralateral CaW, which appears to show a slightly higher intervention rate for contralateral CaW in the US.[4,120] Consideration must also be given to the management of asymptomatic carotid webs which may be detected incidentally.

KEY MESSAGES

- Carotid webs remain underdiagnosed and should be looked for in cases of stroke of undetermined cause
- The risk of symptom recurrence is generally high when managed medically. Definitive management options include carotid stenting or open surgery
- There is no clear guideline on how asymptomatic and concurrent bilateral carotid webs should be managed
- Establishing a registry will allow further research into this area

Little is known as to when CaW may occur, whether there is an embryological component and why symptoms present in young patients before the age of 60 but not earlier if CaW have been present for a long period. This also prompts the question as to whether these should be expectantly managed medically and whether early intervention could offset any potential risk of stroke in future. The optimal timing of any definitive intervention in asymptomatic patients also warrants further exploration.

The European Society of Vascular Surgeons current guideline on CaW recommends that for "*symptomatic patients with a carotid web in whom no other cause for stroke can be identified after detailed neurovascular work up, carotid endarterectomy or carotid artery stenting may be considered to prevent recurrent stroke*".[8] This is based on Level C evidence, given the lack of consistent and sufficient data, and has been highlighted as an area warranting further research.[8,122] At present, these patients are managed on a case by case basis, with involvement of relevant specialities including radiologists, stroke physicians and vascular surgeons. There are also differing opinions on whether these cases should be managed with stenting or surgery as definitive management.

The current UK National Vascular Registry (NVR) reports data on patients undergoing carotid stenting and carotid endarterectomy and/or patchplasty. However, it does not report data on CaW and this in part may be due to the underdiagnosis or overall prevalence. Perhaps establishing a worldwide registry would allow uniformity in global reporting and help to establish the true incidence as well as allowing follow-up of the management and outcomes in these cases?

Conclusion

Current literature on CaW lacks homogeneity and is mostly anecdotal in nature. Previous studies have focused on diagnosis, with emerging cohort studies in the last decade evaluating management options. Symptom recurrence is reduced following intervention in a subset of patients. However, the literature on the management of asymptomatic CaW is very limited.

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CASE REPORT

Axillary EndoVac procedure: a novel hybrid procedure for an infected axillary-profunda bypass

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Abstract

This paper reports an axillary artery EndoVac procedure for the management of an infected left axillary-profunda polytetrafluoroethylene (PTFE) bypass. Our patient presented with peri-graft infection and dehiscence of the distal anastomosis. Three separate surgical procedures subsequently took place over a seven-day period: day 1 required profunda artery ligation with sub-total explantation of the mid to distal PTFE bypass, day 2 required a left above-knee amputation, and the final operation on day 7 was the left axillary artery EndoVac procedure.

The EndoVac procedure involved endovascular relining of the axillary artery with a covered stent graft, immediately followed by explantation of the remaining proximal PTFE graft and vacuum-assisted closure (VAC) application within the same operative setting. This resulted in successful wound healing within six weeks. It is not recommended currently as first-line management in treating vascular graft and endograft infections of the axillary vessels but the EndoVac approach should be considered in a select cohort of patients.

Key words: EndoVac, axillary artery, graft infection

Introduction

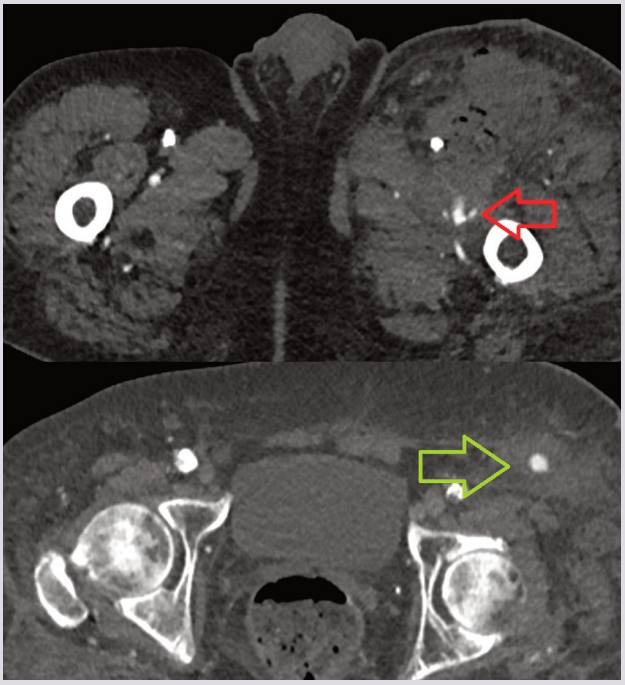
Vascular graft and endograft infections are challenging to manage. They can present insidiously or acutely with sepsis and bleeding. The gold standard approach is complete excision of all infected prosthetic material. Other approaches include covered stent placement with long-term suppressive antibiotics, conservative management with antibiotics alone, or a purely palliative approach. Major challenges in this patient cohort include significant co-morbidities, co-existent sepsis and bleeding. Compromised autologous vein availability may also be an issue. This case report highlights the use of the axillary EndoVac procedure as an innovative management strategy for an infected axillary-profunda polytetrafluoroethylene (PTFE) graft.

Case report

A 78-year-old man was referred with left chronic limb-threatening ischaemia (left foot rest pain but no tissue loss). His past medical history included kissing iliac stents, left common femoral artery (CFA) endarterectomy, hypertension, type 2 diabetes (T2DM), transient ischaemic attack, chronic obstructive pulmonary disease (COPD) and epilepsy. Computed tomography angiography (CTA) revealed a moderately diseased infra-renal aorta, patent but diseased right iliac system with a patent right iliac stent, severely diseased right common femoral artery, left common and external iliac full-length occlusion with collateral vessels filling a patent left CFA endartectomy site, a patent profunda artery, and a long superficial femoral artery (SFA) occlusion with distal crural vessel disease. Multidisciplinary (MDT) consensus supported a left axillary-profunda bypass, which was performed with otherwise rigorous infection control measures and sartorius flap coverage of the distal anastomosis.

The patient had a type 2 myocardial infarction peri-operatively that was managed medically. He was discharged home on day 9. At this time he was systemically well and apyrexial, with no wound site concerns and with a warm pink left foot with resolved rest pain. His C-reactive protein (CRP) on discharge was 34 mg/dL and down-trending. Four days after discharge, he presented

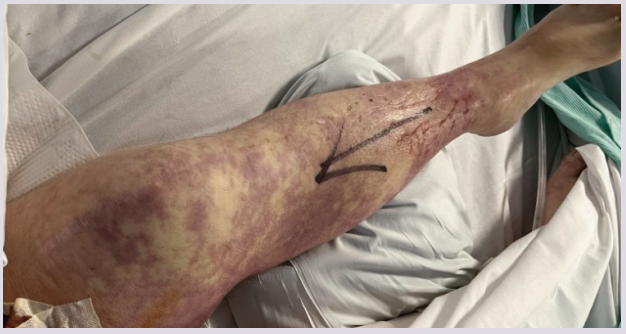
Figure 1 CTA of infected mid to lower PTFE graft, with fluid around the graft (green arrow) and a blown distal anastomosis with contrast extravasation from the distal profunda artery PTFE anastomosis (red arrow).



again with profound haemodynamic collapse, with a swollen erythematous left groin with fresh blood seeping from the groin surgical site. There was erythema and tenderness along the course of his lower graft tunnelling site. His inflammatory markers were now significantly raised with a CRP of 182 mg/dL and a white blood count (WBC) of 29x109/L. He was also complaining of chest pain and his ECG showed ST segment depression. CTA revealed haematoma in the left groin containing gas, with contrast extravasation from the distal graft - profunda artery anastomosis (Figure 1), and fluid around the lower portion of the graft.

The patient was taken to theatre for ligation of the profunda artery and explantation of the PTFE graft. The patient's systolic blood pressure was 60mmHg at the start of the operation, with very high vasoconstrictor requirements throughout. The PTFE graft was encircled by pus up towards mid-abdomen but above this point another incision did not reveal gross infection around the graft at the level of the nipple. Within a damage control context a sub-total graft explantation was performed with around 5cm of graft being left in situ above the nipple. The patient went back to the intensive care unit (ICU) for maximal medical support.

Figure 2 Ischaemic left leg following left profunda artery ligation, with mottling up to knee level.



The following morning his left leg was profoundly ischaemic (Figure 2), necessitating a high left above-knee amputation. The patient slowly recovered, and the explanted graft grew methicillin-sensitive Staphylococcus aureus (MSSA), sensitive to flucloxacillin.

There were concerns that the remaining proximal PTFE graft was highly likely to be infected and about future haemorrhage from the axillary-PTFE anastomosis. Therefore on day 7, under general anaesthetic, via a left brachial artery cutdown, a 11 mm x 5 cm Viabahn self-expanding stent graft (W L Gore & Associates Inc, Flagstaff, Arizona, USA) was placed in the left axillary artery, centred on the surgical-graft anastomosis, with immediate occlusion of the residual graft (Figure 3). The remaining PTFE graft was explanted, and following 20 minutes of direct observation to ensure haemostasis a vacuum-assisted closure (VAC) device was

Figure 3 Left axillary stenting procedure. Surgical clip being used to identify axillary artery cutdown site to help identify remnant PTFE graft site.

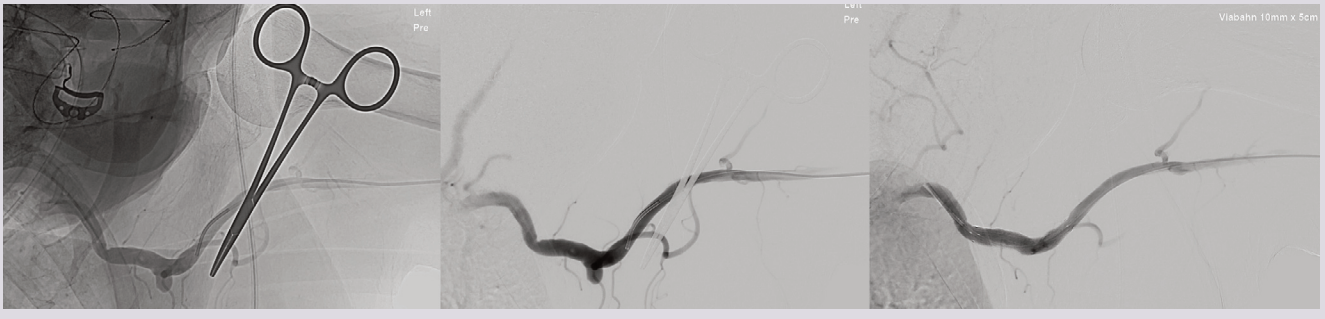


Figure 4 Steps and progression of left axillary EndoVac procedure. Left axillary wound re-opened to expose proximal anastomosis between PTFE and axillary artery end-to-side anastomosis. This is followed by removal of remnant PTFE graft and the covered stent is intentionally exposed at the base of wound. A white VAC sponge is used to directly cover the exposed covered axillary stent, and finally a VAC suction device is used to encourage secondary intention wound healing

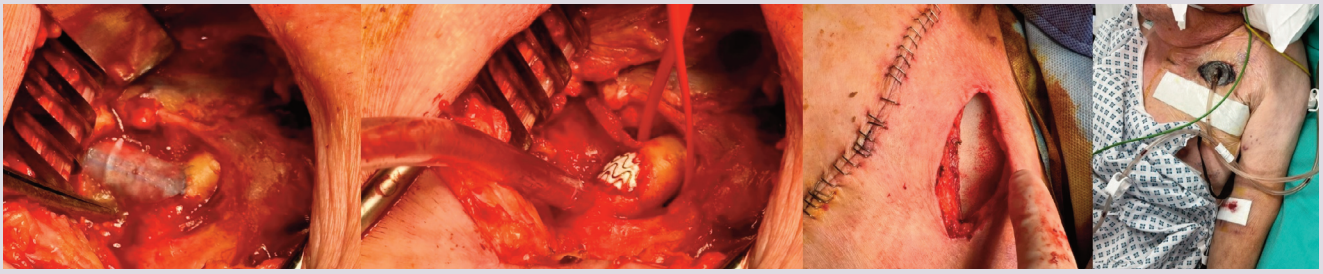
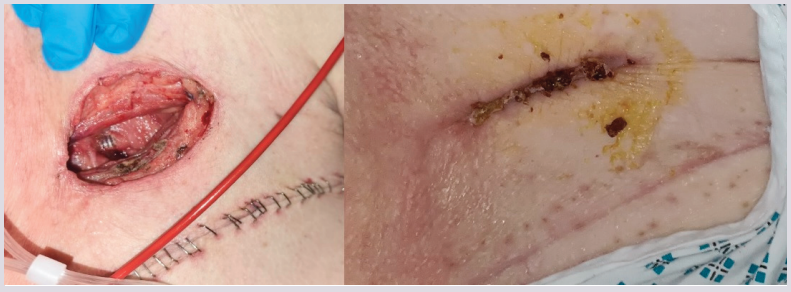


Figure 5 Left axillary wound four days post-operatively with the axillary stent still visible at the base of the wound; and the same wound at six weeks post-operatively which is otherwise now fully healed



applied. A white polyurethane foam sponge was placed directly over the axillary vessel and a black polyurethane foam sponge was used on top to bring the VAC material up to the skin (Figure 4).

For the first 24 hours the VAC was applied at a continuous pressure of 125 mmHg. The following day and beyond the VAC was set intermittently at 125 mmHg for four hours followed by a one-hour rest, with the cycle then repeating. The axillary vessels were covered within a few days and then the VAC was switched to black polyurethane only until the wound was healed enough to allow a switch to regular dressings and normal wound packing.

The left axillary and brachial artery wounds healed over six weeks (Figure 5) and at two months post-operatively the patient was continuing to recover in an intermediate care unit. The patient was continued post-operatively long-term on aspirin 75 mg OD and rivaroxaban 2.5 mg BD. There was no bacterial growth from the residual proximal remnant PTFE graft anastomosed to the axillary artery on microbiological culture but long-term oral antibiotic therapy was continued as treatment for an intra-vascular infection.

Discussion

The reported experience with early axillary graft infections presenting with sepsis and haemorrhage is limited. In such scenarios, initial life-saving damage limitation (haemorrhage control and safe removal of infected material) surgery would seem a sensible option. The most frequent bacteria isolated in such scenarios appear to be Staphylococcus aureus.[1-3] There is variation in subsequent strategies, which include antibiotics alone without any surgical treatment, full or partial explantation of the infected graft, and differing approaches to revascularisation. No one strategy emerges as clearly superior, and amputation rates (18-57%) and mortality rates (16-22%) are significant.[1-5]

Given this context and our previous successful use of the EndoVac procedure in a high-risk surgical patient with a carotid Dacron patch infection, it seemed reasonable to consider the EndoVac procedure in this patient whom we deemed to be at high risk of future catastrophic axillary artery haemorrhage.[6] This was supported by the European Society for Vascular Surgery clinical practice guidelines.[7] However, unlike our reported carotid EndoVac case where stent-graft insertion was performed a few days before the EndoVac operation, on this occasion the axillary stent-graft and EndoVac procedure were performed as a single procedure in a hybrid theatre.

This case report presents the relatively short-term positive outcome for this patient, but the long-term results of a small EndoVac series appear relatively reassuring. Shebab *et al* report satisfactory long-term results for nine patients after carotid EndoVac procedures who were followed up for a median of 7.6 years.[8] All patients healed with no graft-related re-infections; however, in-stent stenoses or occlusions occurred in three patients despite dual antiplatelet therapy. Thus, consideration should be given to anticoagulation and surveillance.[9]

Conclusion

Infected axillo-femoral bypasses are rare but extremely challenging events with high morbidity and mortality

KEY MESSAGES

- We report our experience with an EndoVAC procedure in the management of an infected left axillary-profunda PTFE graft in a co-morbid high-risk patient.
- The axillary artery EndoVAC procedure should be considered a viable damage control management option in a selected cohort of patients, particularly in the acute/emergency situation.

rates. Many of these infections will present in frail, co-morbid, high-risk patients with haemodynamic instability due to sepsis and/or bleeding. There are many different surgical approaches, and conservative and palliative approaches may be relevant. This case report describes an additional approach worth considering in the therapeutic armamentarium. Following initial damage control sub-total graft explantation, the axillary EndoVac procedure can be performed either as a single-stage hybrid procedure or as a two-stage (endovascular stent-graft first, surgical graft explantation/VAC application second) procedure. The single-stage approach used here suggests stent grafting and EndoVac as an emergency option.

Conflict of Interest: None.

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CASE REPORT

A rare case of true tibioperoneal trunk aneurysm resulting in foot drop

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Abstract

A 75-year-old man presented with a six-week history of his right foot "making a slapping sound" whilst he walked and consequently having to adopt a "high-stepping gait". Examination revealed a pulsatile swelling in his right popliteal fossa and signs of a peroneal nerve palsy. Computed tomography angiography (CTA) revealed a 2.5cm tibioperoneal trunk aneurysm. True aneurysms of the tibioperoneal trunk are rare, and compression of surrounding nerves is an indication for surgical correction. This case highlights the importance of thorough vascular clinical assessment and prompt surgical intervention.

Key words: tibioperoneal trunk aneurysm, foot drop.

Case presentation

A 75-year-old man presented to the Orthopaedic outpatient clinic with a six-week history of an abnormal slapping sound from his right foot on walking. He had modified his walking to a high-stepped gait in order to avoid catching his foot and tripping. There was no history of trauma or previous lower limb surgery. The patient had no vascular risk factors and there were no features of critical limb ischaemia. Clinical examination confirmed a pulsatile swelling in the right popliteal fossa. The posterior tibial pulse was present, whereas the dorsalis pedis pulse was absent. Urgent computed tomographic angiography (CTA) of the lower limbs demonstrated a 2.5cm tibioperoneal trunk aneurysm, with patent posterior tibial and peroneal arteries but an occluded anterior tibial artery in the proximal third (Figures 1 and 2).

Figure 1 CTA lower limbs (right). Sagittal view of the infra-popliteal segment

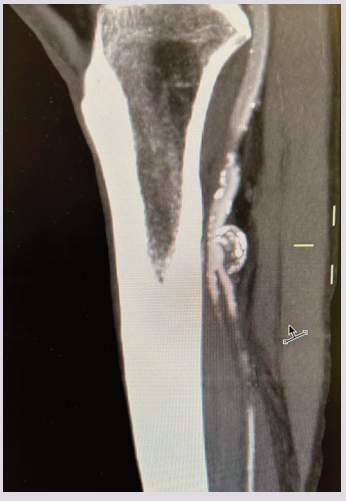


Figure 2 CTA lower limbs (right). Coronal view of the infra-popliteal segment

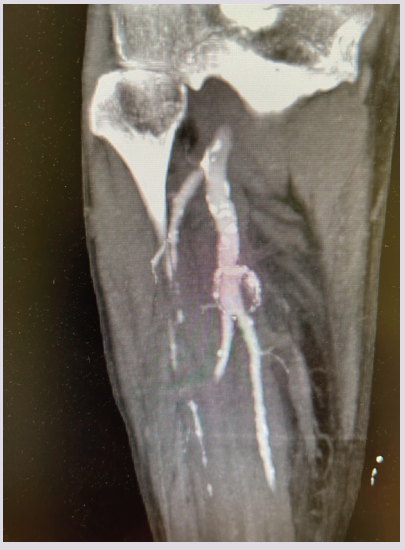
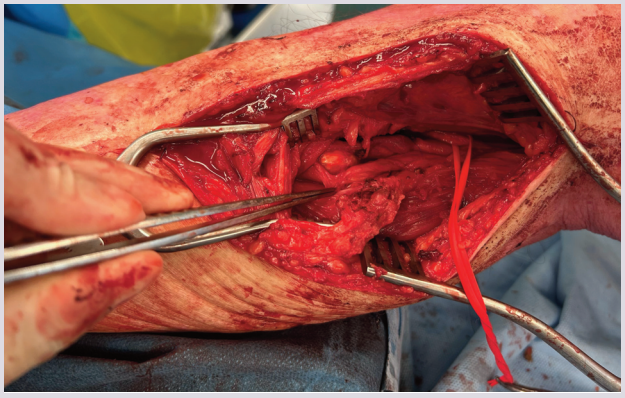


Figure 3 Medial approach to the dissection of the tibioperoneal trunk aneurysm and peroneal nerve



An open approach was selected to relieve the pressure of the aneurysm on the peroneal nerve, and to prevent embolisation of the distal run off. Under general anaesthesia, from a medial approach, control of the inflow from the below-knee popliteal artery was obtained using a silicone sling. Thereafter, the peroneal nerve was identified, preserved and carefully dissected off the aneurysm (Figure 3). The run-off vessels (peroneal and posterior tibial arteries) were also dissected and controlled with slings (Figure 4). The ipsilateral great saphenous vein had been dissected from the same incision prior to arterial dissection. After systemic heparinisation and clamping, the great saphenous vein was reversed and an interposition graft was fashioned, with the distal anastomosis incorporating the origins of both run-off arteries (Figure 5).

Figure 4 Distal control of the posterior tibial and peroneal arteries

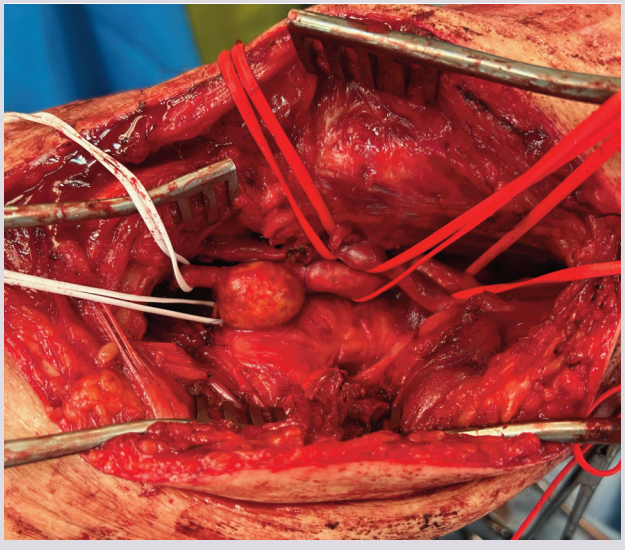
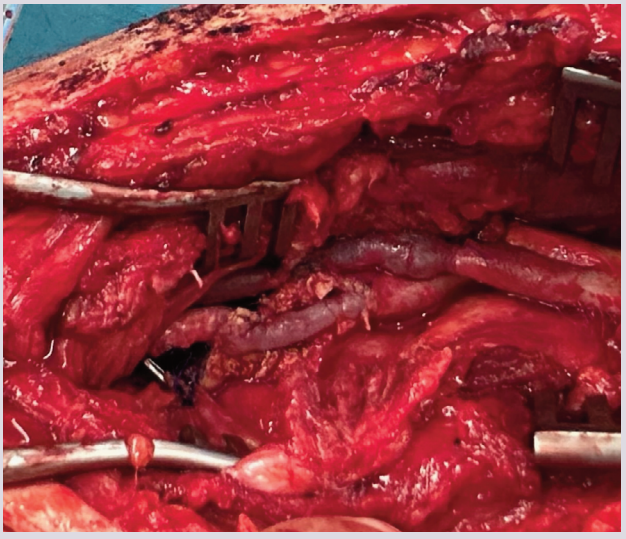


Figure 5 Completed interposition vein graft repair of the tibioperoneal trunk aneurysm



Post-operative ultrasound confirmed triphasic flow through the interposition graft into both run-off arteries and a strongly palpable posterior tibial pulse was detected. Five days post operation the patient was discharged on a statin and recommenced on his usual anticoagulation regime (rivaroxaban for atrial fibrillation).

At the six-week follow-up, the patient had resumed his usual activities, was weight-bearing and walking independently and his foot drop symptoms were improving with ongoing physiotherapy.

Discussion

True aneurysms of the tibioperoneal trunk are rare,[1-5] and may present with atypical (non-vascular) signs and symptoms secondary to nerve compression.[4] Thorough clinical assessment is mandated and high suspicion of a lower limb aneurysm should be managed with urgent arterial imaging (CTA or duplex), prompt vascular surgical review and consideration of surgical correction in order to prevent permanent nerve damage and disability.

Surgical management requires decompression of the aneurysm to relieve pressure on the nerve and distal revascularisation. In this patient, given that both patent run-off arteries were distal to the aneurysm, having gained proximal and distal control and opening the aneurysm sac a direct interposition graft repair was performed.

This case report of a true tibioperoneal trunk artery aneurysm resulting in peroneal nerve palsy and foot drop highlights the importance of vascular clinical assessment for atypical lower limb presentations in order to prevent missed or delayed diagnoses. We encourage surgeons to remain vigilant for rare lower limb aneurysms when presented with symptoms of foot drop and peroneal nerve palsy so that permanent nerve damage and morbidity may be prevented.

KEY MESSAGES

- True tibioperoneal trunk aneurysms are rare.
- Presentations range from asymptomatic swellings to pulsatile masses, pain or nerve compression
- Nerve compression from a tibioperoneal trunk aneurysm is an indication for open surgical correction

Conflict of Interest: None to declare.

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NEWS

Updates from the Vascular Societies

JVSGBI is owned by the Vascular Society for Great Britain and Ireland (VSGBI), for all affiliated societies and the wider vascular community. Here's the latest society news.

The Vascular and Endovascular Research Network (VERN)

www.vascular-research.net
@VascResearchNet

February 2025 update

The Vascular and Endovascular Research Network have been busy since our last update. In late 2024, data collection and validation for the Surgical Site Infection in Major Lower Limb Amputation (SIMBA) study came to an end and the Blood Loss Anaemia and Haemostasis management in vascular surgery (BLAST) study closed to site recruitment. The Arm Ischaemia Study (ARMIES) continues to collect valuable data on acute limb ischaemia and is due to close to new recruitment at the end of March. Following the success of SIMBA, we encourage trainees to get involved with the Surgical Site Infection in Major Lower Limb Amputation – Transmetatarsal Extension (SIMBA-T) which launches on 01/03/2025.

It was a pleasure to meet with friends and colleagues again at the Vascular Societies' Annual Scientific Meeting in Brighton. We were extremely proud of committee member Nina Al-Saadi for winning the poster prize for the 'Greener Vascular Surgery survey' and that Ismay Fabre won the BJS prize presenting the SIMBA study – congratulations to you both! There was an excellent turn out again to the Dragon's Den session, we are grateful to all who attended and to the Dragons: Matthew Popplewell, Philip Stather, Ankur Thapar, Tristan Lane, and Ashish Patel. We congratulate Hannah Daysley for winning the competition and look forward to working with her to deliver the project 'Carbon Emissions in Lower Limb Bypass Surgery'.

Earlier in February, we advertised for a new committee member position: Allied Health Professional representative, thank you for all who have applied thus far. We are excited for this committee expansion and our future collaboration.

For further information and links to study registration, please visit our website (www.vascular-research.net) and follow us on X for regular updates (@VascResearchNet).

Brenig Gwilym
Specialty Registrar,
Vascular Surgery Honorary Research Fellow, Cardiff University

CIRCULATION FOUNDATION
The Vascular Charity

Our Vision: - is a society free of vascular disease, and its associated suffering.

Our Mission:- is to promote awareness into vascular conditions and to support vital research.

Established in 1992 by vascular surgeons, the Circulation Foundation is the only UK vascular charity dedicated to vascular health. It is the charitable foundation of the Vascular Society of Great Britain and Ireland, run by a committee which is accountable to the Trustees of the Vascular Society of Great Britain and Ireland.

Research

The Circulation Foundation makes three major awards per year to fund vascular research. The value of research funds awarded is currently approximately £1/4 million per year. Like a seed bed, we fund primary research which often goes on to large scale, life-transforming studies. In the last four years the Circulation Foundation has awarded over £500,000 in funds for research, pushing the boundaries in the treatment of vascular disease. Get involved and help us save more lives and limbs through our evolving research programme.

Getting involved

- Donations
- In memory and gift in your will.
- Corporate support
- Ambassador Scheme
- Events - create your own personal event, or sign up for a challenge e.g. London Marathon, Great North Run, RideLondon, Swim Serpentine or the Vitality Big Half

Become a Foundation Ambassador

The Circulation Foundation's goal is to establish a Circulation Foundation Network by having an Ambassador in each Arterial Centre and patient representatives across the UK. We would then be able to work together to increase awareness of vascular conditions, share and repeat fundraising success, increase our research grants and make the Circulation Foundation the support centre for patients.

- **Make a real difference to the lives of people who are affected by vascular disease**
- **Help to raise awareness of vascular disease**
- **Continue to use expertise and knowledge**
- **Learn new skills**
- **Be able to network with like-minded people**
- **Give something back to the vascular community**
- **Be part of a professional and committed charity and a valued member of the team**
- **Recognition on social media, newsletter and on the website**
- **Special recognitions at the Annual Scientific Meeting**

THE BODY WALK

#TheBodyWalk is a national campaign in September to raise awareness of vascular disease and for imperative funding. We are hoping everyone can get to collectively achieve the 60,000 miles that make up the circulatory system! Walk, run, cycle, swim ... it is up to you!

Join us to reach the 60,000 miles and raise funds for Circulation Foundation. Sign up at the stand at the Vascular Soceities' Annual Scientific Meeting!

To visit the Circulation Foundation Website

SCAN ME

To donate to the Circulation Foundation

SCAN ME

To discuss getting involved in the Circulation Foundation by fundraising, legacy donations, becoming an ambassasdor or corporate support, please call 020 7205 7151 or email info@circulationfoundation.org.uk.

Text CIRCULATION to 70560 to donate £10. Texts will cost the donation amount plus one standard network rate message.

www.circulationfoundation.org.uk

Charity Number: 1102769