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The Vascular Society for Great Britain and Ireland

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Editor's foreword

Welcome to the 2 year anniversary edition of the *Journal of Vascular Societies Great Britain and Ireland (JVSGBI)*. I am happy to say that the number and quality of articles has increased steadily with each edition.

In this edition we have 3 editorials addressing highly important aspects of vascular surgery, namely facilitating the switch to greener surgery, bringing supervised exercise programmes for claudication up to date with the utilisation of modern technology, and finally an overview of the inspirational and highly successful BSET fellowships.

We have 5 original research articles and a systematic review. The original research papers address subjects as diverse as outcomes following revascularisation for chronic limb threatening ischaemia and the impact of health literacy and socio-economic deprivation; regional variation in attendance for AAA screening; a survey of VTE prophylaxis following endovenous surgery (which data supported the recent funding of the NIHR HTA THRIVE trial); QI project on op notes; and a survey regarding the management of neurogenic thoracic outlet syndrome (NTOS). The systematic review examines the role of rehabilitation following open AAA repair.

A protocol for a systematic review to examine the effectiveness of waxing or epilation in the prevention of surgical site infection is also included.

We also present our first sponsored supplement, which details the Gore satellite symposium – Clinical data, guidelines and real-world outcomes of endovascular iliac aneurysm repair with the GORE® EXCLUDER® Iliac Branch Endoprosthesis – from last years ASM in Brighton. We thank Gore for their support and would welcome interaction with other potential industrial partners.

In Summer 2023 we submitted *JVSGBI* application for MEDLINE approval. We hopefully should be made aware of the outcome any day now and if successful we will progress with PubMed and Scopus applications.

Finally I would like to thank all reviewers and editorial staff & board members for their continued support.

Ian Chetter
Editor in Chief JVSGBI
Vice President Elect

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EDITORIAL

Delivering greener surgery; small changes matter

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Introduction

Countries worldwide have committed to reducing carbon emissions to mitigate the detrimental effect of climate change on the environment. The UK has committed to net zero carbon emissions by 2050. Significant changes are required across all industries, including healthcare, to achieve this target within the deadline.[1] Currently, healthcare systems are estimated to account for 4–5% of the overall global carbon footprint, with surgery identified as a major contributor.[2,3]

The importance of vascular surgery services working towards reducing their carbon footprint has recently been highlighted in an article by the Vascular and Endovascular Research Network *et al*.[4] In this editorial we discuss how simple small changes such as replacing a ubiquitous single-use surgical instrument with a reusable alternative could make a significant difference to carbon emissions and help achieve improved environmental sustainability.

Surgery and its environmental impact

A single surgical procedure in the UK is estimated to produce approximately 104 kg CO_2, which is equivalent to driving a petrol car for 300 miles.[3] With over 3 million operations being performed in the NHS each year, this figure highlights the importance of making changes to surgical practice to minimise the environmental impact.[5]

Studies have previously highlighted that the use of medical equipment contributes significantly to carbon emissions, with single-use items accounting for up to 78% of the carbon footprint in some cases.[6–9] Studies have found that 59% of the total NHS carbon footprint is associated with the entire healthcare supply chain, and 71% of the carbon footprint in healthcare globally.[6] Although continued use of single-use items and recycling is commendable, the impact on reducing the carbon footprint is limited.[10] Using reusable medical equipment as a substitute for single-use surgical instruments has the potential to reduce the carbon footprint of surgical cases by 50–97%.[10–13]

Studies comparing the carbon emissions from surgical procedures between different countries found that developing nations such as India were able to achieve a 30-fold reduction in carbon emissions by using reusable equipment due to saving on the manufacturing and transportation of each item.[14] Despite reusable equipment being a more environmentally sustainable choice, the risk of cross-contamination is often cited as an impediment to change.[15,16] However, there is evidence to the contrary, showing a minimal risk of cross-infection.[17] Therefore, simple steps such as replacing commonly used disposable surgical equipment in the operating theatre should perhaps be the starting point in the pathway to greener surgery.

Diathermy pencils

Electrosurgical pencils, commonly known as diathermy pencils, are one of the most frequently used single-use surgical instruments in cases in the UK. However, these can be replaced with a durable and long-standing reusable alternative (Figure 1).

Whilst evidence exists regarding the carbon emissions produced during the operation of such devices, no current publication addresses the carbon footprint related to each instrument's manufacturing process. By calculating the carbon footprint associated with each component of the diathermy pencil, we have deduced that the production of each unit emits over 3.3 kg CO_2.[18–24] A breakdown of this is shown in Table 1.

Key words: green surgery, diathermy, environmental sustainability, tackling carbon emissions

Figure 1 A reusable diathermy pencil used in surgical procedures

Table 1 Carbon footprint associated with each component of the diathermy pencil.

Diathermy component	Rough estimate of carbon output of production (2 decimal places)
Diathermy electrode	0.01 kg CO_2e[18,19]
Buttons	0.01 kg CO_2e[20,21]
Plastic handle	0.07 kg CO_2e[21,22]
Electrical connector	0.3 kg CO_2e[23]
Electric wire cable	2.95 kg CO_2e[24]

This constitutes approximately 3% of the total carbon emissions from a single operation in the NHS. Assuming a new diathermy pencil is used in half the operations and approximately 3 million surgical procedures take place within the NHS annually,[5] the cumulative carbon emissions from the manufacturing of diathermy pencils each year amounts to roughly 5 million kg of CO_2, which is equivalent to the weight of a new roof in the O2 arena each year. When accounting for additional factors involved in the supply chain of each diathermy unit including packaging, transportation and distribution, this figure would increase further. This underscores the environmental importance of substituting commonly used single-use instruments with reusable counterparts. This can play a pivotal role in advancing greener surgical practices, fostering greater environmental sustainability, and reducing the carbon footprint in surgery and healthcare.

KEY MESSAGES

- Significant changes are required in the field of surgery to achieve net zero carbon emissions.
- Using reusable equipment can help achieve a 30-fold reduction in carbon emissions from theatre.
- A disposable finger-switch diathermy is responsible for 3% of carbon emissions from each surgical case and amounts to roughly 5 million kg of carbon emissions annually.

Conclusion

Given the growing impact and escalating concerns surrounding climate change, swift and well-informed decisions regarding standard operating procedures are imperative to minimising the impact of climate change and securing a more promising future for our planet.

We know that healthcare, and particularly surgery, is a significant contributor to carbon emissions globally. It contributes to a modest yet noteworthy portion of the UK's annual carbon footprint. We also know that there is substantial evidence to support the transition from single-use instruments to reusable alternatives. Diathermy pencils serve as a compelling illustration of a commonplace single-use tool within operating theatres which could be effectively substituted with reusable counterparts with a reduced carbon output. Such shifts may lead to a considerable reduction in carbon emissions associated with surgical practices.

Although we have concentrated on diathermy pencils, it is important to consider this as a representative case and to foster an environment where we evaluate all disposable surgical instruments used in operating theatres. For example, similar tools, such as harmonic scalpels used in laparoscopic surgery, may also be substituted with reusable alternatives. Even if a handful of healthcare trusts embark on this transition to reusable equipment, the resultant decrease in carbon emissions could be noticeable. This collective effort would propel us closer to the aspiration of achieving net zero carbon emissions. This could foster a tangible positive influence on our environment and the planet at large, whilst allowing us to reflect on our current practices and the impact we have on the environment.

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EDITORIAL

Supervised exercise therapy apps for claudication

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Peripheral arterial disease (PAD) has been recognised as a healthcare burden affecting up to 5.56% of the global population over 25 years of age.[1] Intermittent claudication (IC) is often debilitating and results in reduced physical activity which is associated with increased cardiovascular disease and all-cause mortality.[2,3] Early identification and management of PAD is essential to improve symptoms and prevent a downward trajectory towards limb loss. Supervised exercise therapy (SET) is the widely recommended first-line treatment for IC. Despite the benefits of SET, uptake and adherence rates are recognised to be poor.[4] The reasons for poor SET compliance are multifactorial and include time constraints, travelling distance, personal, financial and institutional barriers.[5] To overcome these barriers, alternative methods for delivering SET need to be explored.

The COVID-19 pandemic accentuated the vital contribution of digital health models in modern medicine.[6] Digital health models reduce the need for travel and its associated barriers such as transportation, travel costs and time constraints. They also reduce the utilisation of hospital resources such as healthcare staff, space allocation and equipment.[7] With increasing improvement and usage of electronic healthcare technology, delivering SET through mobile health (mHealth) technology may be the next way forward. mHealth is defined as "medical and public health practice supported by mobile devices such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices".[8] This editorial discusses the role of mHealth technology in improving SET compliance in patients with IC.

The prevalence of PAD has increased by 25% over the last decade and this trend is expected to continue.[9] SET has been widely acknowledged as an effective treatment modality for PAD and has been given level I recommendation by NICE.[10] SET has been shown to improve walking distance, physical activity, quality of life and reduce cardiovascular mortality.[11] Despite the benefits of SET, its provision is variable and compliance poor. A survey of UK vascular units identified that only 38.5% of vascular units had access to SET, with the majority based in hospital facilities. Of all patients referred for SET, less than 60% attended a single session. Of those who attended SET, only 62% sustained 12 weeks of training and only 20% were offered 2–3 sessions per week.[12] Institutional barriers contributing to poor SET implementation include lack of funding, facilities, resources, trained staff and poor referral pathways.[13] Patient barriers contributing to poor attendance and compliance are multifactorial and include time constraints, motivation, transportation, financial and psychological barriers. To optimise the benefits of SET, the barriers to poor compliance need to be overcome.

It has been estimated that over 5 billion people are mobile device users, with half of these using a smartphone.[13] Although the use of mobile technology has expanded in the field of entertainment and communications, the use of apps in healthcare is a relatively recent development which lacks a convincing evidence base.[14] mHealth technologies are considered digital solutions to offer personalised and interactive access to health services. A systematic review looking at mHealth applications in the use of PAD showed a positive correlation with increasing effectiveness and adherence to exercise therapy.[14] Mobile technologies show benefits of personalisation, real-time monitoring, increased accessibility without geographical or

Key words: peripheral arterial disease, exercise therapy, mobile health

structural barriers, 24/7 availability and high cost-effectiveness. They remove geographical barriers for those living in rural areas or those with barriers to transport. The trend of mHealth is evolving in vascular surgery. Applications such as "Control Telehealth Claudication Intermittent (CONTECI)", "TrackPAD" and "JBZetje" promote self-monitoring of disease progression and exercise therapies.[15–17] Other applications are aimed at tracking disease progression, such as "VascTrac".[18]

mHealth applications aimed at delivering SET should focus on goal setting, self-monitoring and performance feedback.[19] The application should use a simple and clear interface to make it appealing to users of all ages. Patients should be able to set their own flexible schedule and reminders to achieve their 3-weekly sessions and monitor their exercise activity throughout the week. To increase motivation and encourage long-term usage, "TrackPAD" integrated positive reinforcements such as incentives (eg, medals and monitoring personal success) and gamification features.[17] Additional social networking features could provide group support, optional group exercises and increase motivation.[20] A feasibility study demonstrated that participants assigned to teams were 66% more likely to engage than those alone.[21]

The "JBZetje" application has evolved synchronisation of real-time data using raw accelerometer data.[15] The ability to synchronise with wearable technologies provides real-time data for users to self-monitor their progress and provide feedback. Wearable technologies are smart devices that can be worn on the wrist, ankle or arm. These devices are comfortable and fashionable accessories that have increased in popularity in recent years with a forecast of 1 billion users by 2022.[14] Wearables use accelerometers and global positioning systems (GPS) to provide valuable information for self-monitoring fitness and daily physical activity. The benefits of using wearables allow for accurate tracking distance and monitoring of physiological activity (eg, heart rate), which would be more accurate at measuring physical activity than more subjective measurements such as pain threshold measurements. Recording of real-time data allows the supervising training practitioner to provide accurate and individualised community assessments.[14] GPS tracking provides options to recommend local training routes, activities and social groups.

Providing alternative modes of exercise is important in keeping users engaged and widening user profile. Although treadmill-based exercises have shown superior outcomes compared with others, using alternative options can increase motivation and compliance. Alternative aerobic exercise (eg, leg/arm ergometry, pole striding, progressive resistance training) can be equally effective as walking-based exercises.[16,22] With these alternative options, users should also have access to free online tutorials to help guide training and proper exercise techniques.

Equality of service is paramount in providing SET via mHealth. It is important that vulnerable groups are not excluded. The typical PAD patient is aged 60 or above and is likely to have fewer experiences with rapidly expanding smartphone technology. People aged 55–70 years have reported more positive outcomes with the use of mHealth, with independence being the most prevalent factor. Complexity associated with using technology was the main barrier to mHealth in the elderly population. As people continue to age, the next elderly user group in 10–15 years will more likely be accustomed to smartphone and mobile technology, thus more likely to adapt to mHealth options. Strategies such as psychological and technological support to overcome such barriers require further research.

KEY MESSAGES

- mHealth applications show increased effectiveness and adherence to exercise therapy
- Applications should focus on goal setting, self-monitoring and performance feedback
- There remains huge potential to tap into mHealth technology to provide SET

Although mHealth has been in the background over the last 20 years or so, the pandemic has played a significant role in bringing it into the limelight. There is huge potential to tap into mHealth technology to better promote and deliver SET. MHealth applications targeting PAD patients are slowly emerging but are far from standard practice. Creating an mHealth application aimed at delivering SET would need to incorporate a comprehensive programme covering all elements from real-time monitoring, alternative exercise options, trainer feedback, goal setting, nutrition, lifestyle modification and social media interaction. There is a pressing need for a randomised controlled trial to evaluate the traditional hospital-based SET versus an mHealth-based SET.

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EDITORIAL

Supporting endovascular practice in 2023 and beyond: the BSET Fellowship Programme

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Background

British Society of Endovascular Therapy (BSET) Fellowships were introduced to provide an opportunity for vascular or interventional radiology trainees to acquire new or more complex endovascular skills during a 6-month period in a UK-based endovascular unit of their choice. They were established in 2008 in response to the rapidly expanding field of endovascular practice, with the aim to support high quality endovascular training as well as a new hybrid skillset for those from a vascular surgical background. Since vascular surgery gained independence as a specialty in 2012, evolutions in both vascular surgery and interventional radiology training programmes have facilitated increased exposure to complex endovascular interventions. However, these Fellowships continue to offer a unique opportunity, where trainees benefit from a period of concentrated exposure, working to develop a specific subspecialty interest and 'fine tune' their skills in preparation for consultant practice. Further, these Fellowships also offer interventional radiology trainees to be exposed to a larger volume and variety of endovascular procedures, benefiting their future independent practice.

BSET also offers the opportunity to embark upon a Travel Fellowship aimed at senior trainees and newly qualified consultants. This Fellowship provides financial assistance to travel to specialist international endovascular centres to gain experience in a subspecialty technique, with the aim of broadening the trainees' experience beyond UK practice and developing global endovascular leaders of the future.

Fellowships have been demonstrated to be beneficial to both trainee and training unit in multiple surgical specialities.[1–4] Trainees gain from experience beyond their base training units in far reaching aspects of their professional development beyond pure technical skills. Non-technical skills including senior level decision making, case preparation and planning, managing a team and training more junior colleagues all contribute to the overall learning experience. Focused training in a subspecialist area builds both confidence and competence in preparation for consultant applications. Building a wider network of colleagues for future collaborative practice provides an excellent springboard into successful career progression, and many past BSET Fellows have been elected to Council and continue to contribute to the Society, providing education and training to future trainees.

What makes a successful fellowship?

Host organisations benefit enormously from having a dedicated committed trainee who can participate enthusiastically in all aspects of departmental activity. The BSET Fellow contributes to the clinical output of the unit, supporting both senior colleagues, more junior trainees as well as the wider multidisciplinary team. As a new team member, the Fellow brings an external perspective on clinical pathways and approaches, from which all can profit. Having a BSET Fellow increases the training profile of the unit and widens the network for future collaborative clinical and academic practice. In most units, BSET Fellows attend endovascular training opportunities supervised by both consultant surgeons and consultant interventional radiologists. The opportunity to host a BSET Fellow within an institution's department can therefore carry reputational advantages as it indicates a healthy and collaborative working environment.

Key words: fellowship training, endovascular training, medical education, fellowship, endovascular

For the incoming Fellow, developing clear aims and objectives achievable within the 6-month timeframe is essential to the success of the Fellowship. The chosen host institution should be well aligned with achieving these goals and applicants are encouraged to approach previous Fellows for advice to ensure a successful partnership. In order to gain the most benefit from the Fellowship, thought should be given to the optimal timing taking into account stage of training as well as personal circumstances. This will allow Fellows to fully immerse themselves in all aspects of the unit culture, including clinical, operative, academic and social opportunities. Positively contributing to the output of the unit promotes collaborative working and provides the foundation for a strong network of colleagues to support a successful future career.

Conclusion

To date, 18 Fellowships have been undertaken at nine units between 2008 and 2023. Previous BSET Fellows have progressed to consultant appointments within the UK and contribute to the ongoing endovascular training and practice fit for the future. This could not have been possible without the vision of the founding members of BSET (Rachel Bell, John Brennan, Nick Cheshire, Rob Sayers and Matt Thompson), the host vascular units participating in the programme (Aberdeen Royal Infirmary, Addenbrooke's Hospital Cambridge, St George's Hospital, Leicester Royal Infirmary, Liverpool Royal Infirmary, Northwick Park Hospital, Southmead Hospital Bristol and St Thomas' Hospital) and the generous support from industry partners (Cook Medical, Medtronic, Gore, Endologix and Vascutek), without whom this would not have been possible. BSET are proud to continue the Fellowship programme and would be happy to discuss opportunities with both trainees and unit hosts. For more information please see the BSET website www.bset.co.uk or contact Jeanette Oliver at the BSET office who will be happy to discuss the opportunities and connect you with past Fellows and potential host units.

Conflict of Interest: None.

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ORIGINAL RESEARCH

Effect of health literacy and socioeconomic deprivation on outcomes after lower limb surgical revascularisation for chronic limb-threatening ischaemia: the HeaLTHI study

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Plain English Summary

Why we undertook the work: Health literacy refers to the ability of patients to understand information related to their health condition so that they can make informed decisions about their health. Moreover, it is also believed that patients from disadvantaged backgrounds who have poor health are more likely to suffer from negative health outcomes. Therefore, we wanted to know whether this is true among our patients with poor leg circulation, particularly in its severe form which is called chronic limb-threatening ischaemia (CLTI) when they are undergoing surgery to improve their leg circulation.

What we did: We looked at patients who underwent major surgery for this disease (CLTI) in the Northern Vascular centre, Freeman Hospital, Newcastle upon Tyne, UK, and we asked them questions to see how much they understand about their condition, and we worked out how much advantaged or disadvantaged background they came from to know if that had any effect on how they did after surgery.

What we found: Our study found that a significant portion of patients with CLTI lacked knowledge about their condition and lived in poor areas. Unfortunately, we discovered that patients who lacked knowledge about their condition and hailed from poor areas were more likely to have complications after surgery.

What this means: Our research found that a patient's understanding of their health condition and the financial and social environment they live in can impact their recovery after surgery to improve their poor leg circulation. However, more studies are needed to better understand this relationship with a larger sample of patients.

Abstract

Introduction: Research has suggested a relationship between health literacy, socioeconomic status and health-related outcomes. The aim of the study was to study the association between health literacy, socioeconomic status and outcomes following infra-inguinal bypass surgery for chronic limb-threatening ischaemia (CLTI).

Methods: Patients with CLTI undergoing lower limb surgical bypass graft operations between January 2016 and December 2018 were included in a cross-sectional observational study. The HLS19-Q12 questionnaire categorised participant's health literacy as inadequate, problematic, sufficient or excellent. Socioeconomic status was assessed using the Index of Multiple Deprivation (IMD). Primary outcomes were major lower limb amputation (MLLA) and adverse cardiovascular events. Secondary outcomes included length of hospital stay, and early postoperative complications including pneumonia, surgical site and graft infection. Kaplan–Meier survival curves were used to compare health literacy and amputation, and Cox proportional regression analysis was conducted to identify differences in limb loss risk against health literacy and social deprivation levels.

Results: The study consisted of 50 patients with an average age of 70±8.7 years. The participants' levels of health literacy were classified as inadequate (28%), problematic (38%), sufficient (24%) or excellent (10%). Approximately 40% of the patients lived in the most deprived areas. While all health literacy groups had similar postoperative outcomes, low health

literacy was connected with lower socioeconomic status (r=0.308, p=0.029). IMD (p=0.017, HR 0.502 (95% CI 0.285 to 0.883)) and haemoglobin (p=0.001, HR 0.919 (95% CI 0.872 to 0.968)) were significant predictors of MLLA.

Conclusion: Patients with lower health literacy are more likely to face higher levels of social deprivation, which may predict amputation following bypass surgery. Enhancing health literacy could play a role in reducing health disparities caused by social deprivation, thereby potentially addressing a vascular James Lind Alliance priority.

Key words: health literacy, social deprivation, health inequalities, chronic limb-threatening ischaemia

Introduction

Health literacy is the degree to which individuals have the capacity to obtain, process and understand basic health information and access services needed to make appropriate health decisions.[1] Health literacy is a complex concept that is influenced by an individual's educational attainment, race, age, deprivation and available healthcare services.[2,3] There are a number of health literacy assessment tools available, including the Rapid Estimate of Adult Literacy in Medicine (REALM) test, the Test of Functional Health Literacy in Adults (TOFHLA), the Newest Vital Sign (NVS) and the 12-item European Health Literacy Survey (HLS19-Q12), which is a brief self-administered questionnaire that was developed by the European Health Literacy Survey (HLS) Consortium and been validated as a reliable measure of health literacy.[4]

Social deprivation has been associated with low health literacy, and is defined as the lack of access to the resources and opportunities that are considered to be essential for individuals to participate fully in society.[1,5] There are a number of social deprivation assessment tools available, including the Townsend deprivation index and the Carstairs deprivation score, which are based on census data, while the Index of Multiple Deprivation (IMD) is a composite measure of income, employment, education, housing and health.

Socioeconomic status is a social determinant of health and individuals with lower socioeconomic status have poorer health outcomes. Data support the association between social deprivation and health inequalities.[6] Social deprivation and health inequalities are particularly pertinent in vascular patients because vascular disease is strongly related to lifestyle through behaviours such as smoking, poor diet and lack of physical activity.[7,8] Chronic limb-threatening ischaemia (CLTI) is the severe presentation of peripheral arterial disease (PAD), producing ischaemic rest pain and tissue loss, reduced quality of life, and high risk of limb loss and/or mortality as well as increased cost and demand on vascular services.[9] Low health literacy can compromise a patient's adherence to lifestyle modification advice, medication compliance and the ability to seek medical advice when required.[1,5] Unfortunately, these are essentials in the management of PAD including CLTI. Inadequate health literacy was doubled among socially deprived cardiovascular patients compared with high socioeconomic status patients. These patients had lower rates of access to health services, late presentation and poorer clinical outcomes.[10–12] Previous reports suggested that socially deprived vascular patients are at an increased risk of amputation up to 65% compared with the least deprived populations in the UK and the USA.[13–15]

Social deprivation and poor health behaviours not only contribute to disease development, but also to clinical outcomes after vascular intervention.[7,16–18] For example, peri-revascularisation smoking increases the risk of early major revascularisation bypass graft failure and limb loss.[19,20] Therefore, social deprivation is associated with an increased risk of major amputation following revascularisation, in contrast to patients with income above the poverty line.[21–23] A recent study suggested that over three-quarters of vascular patients had inadequate health literacy,[24] with an increased risk of hospital readmission, cardiovascular disease and mortality.[25–28] Therefore, understanding the relationship between health literacy and CLTI post-revascularisation outcomes is important given that health literacy is a potentially modifiable factor.[1] Therefore, there is a need for a better understanding of health literacy in this vascular patient group.

This study aimed to assess the relationship between health literacy, social deprivation and clinical outcomes in CLTI patients who have undergone revascularisation surgery.

The study primary research question was: Is health literacy associated with postoperative clinical outcomes in patients with CLTI following lower limb revascularisation surgery? Secondary research questions were: (1) Is there an association between health literacy score and social deprivation score in CLTI patients? and (2) Is the social deprivation score associated with poor clinical outcomes in patients with CLTI following lower limb revascularisation surgery?

Methods

Study design and population

This is a single-centre cross-sectional prospective study of all patients aged >18 years who underwent infra-inguinal lower limb bypass graft surgery for CLTI between January 2016 and December 2018 in the Northern Vascular Centre, Freeman Hospital, Newcastle upon Tyne. CLTI was defined by at least two weeks of ischaemic rest pain, lower limb ulceration or gangrene.

Health Research Authority and Research Ethics Committee

approvals were granted (21/NI/0092) with subsequent Newcastle upon Tyne Hospital research and development department approvals. Informed consent was obtained from all participants.

Procedural data

All patients with CLTI included in the study underwent infra-inguinal lower limb bypass surgery with either autologous vein or prosthetic graft. Patients who underwent endovascular interventions only were not included in the study as primary endovascular procedures are mainly done as day case procedures which makes recruiting and assessing their health literacy more challenging compared with open/hybrid interventions, considering the intervention technicalities have little influence or relevance to the study question. All patients had their regular clinical follow-up as well as research team follow-up with median follow-up of 12 months.

Baseline data collection

Baseline characteristics including demographics and comorbidities were collected by the research team from the patients' electronic healthcare records. Laboratory tests collected include preoperative haemoglobin, sodium, creatinine and estimated glomerular filtration rate.

Comorbidities are defined as per the Society of Vascular Surgery (SVS) guidelines where possible.[29] Diabetes is defined by documented medical history, the use of oral antidiabetic agents or insulin or fasting plasma glucose levels of at least 1.26 g/L; hypertension is defined by documented medical history and use of antihypertensive drugs for this purpose, or systolic blood pressure of at least 140 mmHg or diastolic blood pressure of at least 90 mmHg at admission determined by the average of the first two measurements. The following diseases were recorded based on the patient's documented medical history: ischaemic heart disease or prior myocardial infarction, atrial fibrillation, hypertension, cerebrovascular disease (stroke, including ischaemic or haemorrhagic stroke as well as transient ischaemic attack), end-stage renal failure, renal failure defined as estimated glomerular filtration rate of <15 mL/min/1.73 m^2 and/or requiring dialysis, and/or its documentation in their health records and a documented diagnosis of chronic obstructive pulmonary disease.

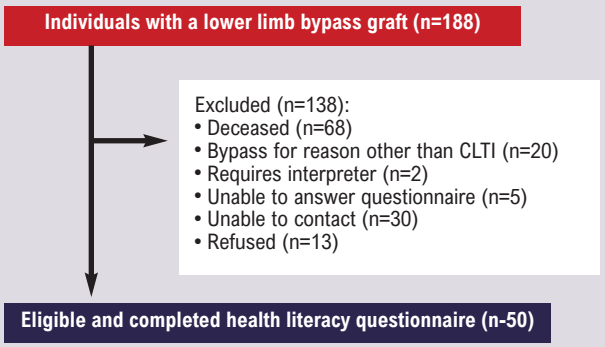
Inclusion criteria (Figure 1)

- Patients aged ≥18 years.
- Patients who have undergone lower limb revascularisation surgery for CLTI at Newcastle upon Tyne Hospitals NHS Foundation Trust between 1 January 2015 and 1 January 2019.
- Patients able to consent to study participation.
- Patients able to answer the health literacy questionnaire.
- Patients who can speak/understand English.

Exclusion criteria (Figure 1)

- Patients aged <18 years.
- Patients who have had lower limb revascularisation surgery for any reason other than CLTI.
- Patients who have had endovascular intervention even for CLTI.
- Patients who have had redo lower limb intervention even for CLTI.
- Patients who are unwilling to consent to study participation.
- Patients with incomplete data sets on the Northern Vascular Centre Register.
- Patients who are unable to speak/understand English.

Figure 1 Consort of participant recruitment.



CLTI, chronic limb-threatening ischaemia.

Socioeconomic status

Socioeconomic status was determined using the Office for National Statistics English Indices of Multiple Deprivation (IMD) 2019 measure.[30] This is a measure of relative deprivation and is calculated for each Lower-layer Super Output Area in England. The IMD tool graded participants' postcode areas, ranking them from 1 (most deprived) to 10 (least deprived).

Health literacy

Health literacy was assessed using the 12-item European Health Literacy Survey (HLS19-Q12).[4] Each response on the HLS19-Q12 was assigned a numerical value ranging from 1 to 4. Subsequently, a total score ranging from 1 to 50 was calculated for each patient, following the HLS19 scoring system. Based on these scores, patients' health literacy was classified into four categories: inadequate (score 0–25 points), which is the severe level of poor health literacy; problematic (score >25–33 points), which is the moderate level of poor health literacy; sufficient (score >33–42 points), which is the mild level of poor health literacy; and excellent (score >42–50 points).

Postoperative outcomes encompassed major lower limb amputation (below, through or above the knee joint) and early postoperative complications including myocardial infarction, hospital acquired pneumonia, 3-month graft occlusion (first postoperative graft surveillance ultrasonography scan), surgical site infection (when documented in the patients' hospital/healthcare records and defined as an infection that occurs at the site of the

bypass and associated with cellulitis and/or purulent discharge) and raised inflammatory markers (leucocyte count and/or C reactive protein level).[31] Graft infection was diagnosed when documented in the patients' hospital/healthcare records and associated with overlying cellulitis, the presence of an exposed prosthetic graft, sinus tract with persistent purulent drainage and/or bleeding, or palpable anastomotic pseudoaneurysm. This is in addition to elevated inflammatory markers such as leucocyte count and/or C-reactive protein levels, and radiological evidence such as peri-graft fluid and/or gas, graft disruption and pseudoaneurysm formation observed on ultrasonography and computed tomography images.[32]

Study outcomes

The primary outcome was to identify the association between health literacy and postoperative outcomes following lower limb revascularisation surgery for CLTI. Secondary outcomes included: (1) to identify if socioeconomic status was associated with an increased risk of limb loss (amputation-free survival) or mortality following lower limb revascularisation surgery for CLTI; and (2) to understand the relationship between socioeconomic status and health literacy scores.

Statistical analyses

Normally distributed data were presented as mean (SD) and hypothesis testing was performed with paired and unpaired t-tests. Categorical data were analysed by means of a χ^2 test. A generalised linear model/Kruskal–Wallis test was used for comparison of mean/median continuous data between groups. IMD quintiles and health literacy categories were treated as ordinal and analysed with rank correlation. Spearman's rank correlation test was performed between IMD and health literacy. Kaplan–Meier survival curves were used with a log-rank test to compare health literacy and amputation. A Cox proportional regression analysis was conducted to identify differences in limb loss to enable hazard analysis. An a priori power analysis was conducted using G*Power3 to test the primary outcomes and survival analyses, with an alpha of 0.05.[33] The results showed that a minimum sample of 48 and 35 participants were required, respectively, to achieve a power of 90%. A p value of <0.05 was considered statistically significant. Statistical analysis was performed using SPSS version 24 (IBM SPSS Statistics for Windows, Version 24.0. IBM Corp, Armonk, New York, USA).

Results

A total of 50 participants were included in the study (39 males, 78.0%) with a mean±SD age of 70±8.7 years and median follow-up of 12 months. Fourteen patients (28%) had inadequate health literacy, 19 (38%) had problematic health literacy, 12 (24%) had sufficient health literacy and 5 (10%) had excellent health literacy. Twenty-five participants (50%) lived in areas of highest deprivation (IMD 1–3), 11 participants (22%) lived in areas of moderate deprivation (IMD 4–6) and 14 (28%) lived in areas of lowest deprivation (IMD 7–10). Baseline demographics were comparable between health literacy groups (Table 1).

A significant difference was found between IMD groups based on the degree of severity of lower limb ischaemia as outlined by the Rutherford grade at the time of intervention (p=0.029) and hypertension (p=0.031) (Table 2). Health literacy was weakly but significantly correlated with IMD score (r=0.308, p=0.029).

There were no significant differences in postoperative outcomes between health literacy groups (Table 3) or IMD quintiles (Table 4), including length of stay, 3-month graft patency, MLLA and myocardial infarction.

The mortality rate over the 12-month period according to health literacy and IMD groups was as follows: Health literacy: inadequate 21.42%, problematic 15.78%, sufficient 8.33%, excellent 0.00%.

Table 1 Baseline characteristics by health literacy group.

Variable	Health literacy group				P value
	Inadequate (n=14)	Problematic (n=19)	Sufficient (n=12)	Excellent (n=5)	
Male	12	14	10	3	
Age, years	71 (7)	71 (9)	70 (10)	66 (10)	
IMD quintile					
1	6	8	5	1	0.124
2	4	3	3	0	
3	2	3	1	0	
4	2	3	1	2	
5	0	2	2	2	
Comorbidities					
Diabetes mellitus	9	6	5	1	0.201
Ischaemic heart disease	4	6	6	1	0.657
Hypertension	8	12	6	3	0.619
Cardiac failure	2	0	0	0	0.157
Renal failure	0	1	0	0	0.613
Chronic respiratory disease	1	4	2	1	0.698
Pre-surgery medication					
Statins	12	12	10	4	0.723
Single antiplatelet	10	12	10	4	0.834
Rutherford grade					
4	4	9	5	2	0.512
5	2	4	0	1	
6	7	4	5	2	
Missing data (n=5)	1	2	2	–	
Laboratory tests					
Haemoglobin, g/L	127 (23)	133 (23)	126 (18)	129 (9)	0.813
Leukocytes, x10^3 mean	9.40 (1.91)	8.63 (2.70)	9.76 (3.08)	8.52 (2.70)	0.646
Total protein, g/L	70 (7)	64 (9)	67 (8)	76 (11)	0.399
Creatinine, µmol/L	89(23)	83 (29)	105 (97)	76 (17)	0.712

Continuous data are presented as mean (SD).
IMD, Indices of Multiple Deprivation.

Table 2 Baseline characteristics by IMD quintile

Variable	IMD Quintile					P value
	1 (n=20)	2 (n=10)	3 (n=6)	4 (n=8)	5 (n=6)	
Male	15	7	5	7	5	
Age, years	69 (9)	69 (6)	68 (8)	71(13)	77 (8)	0.330
Health literacy						
Inadequate	6	4	2	2	0	0.124
Problematic	8	3	3	3	2	
Sufficient	5	3	1	1	2	
Excellent	1	0	0	2	2	
Comorbidities						
Diabetic	8	4	3	5	1	0.525
Ischaemic heart disease	5	2	4	5	1	0.064
Hypertension	13	3	2	8	3	0.031
Cardiac failure	0	1	0	1	0	0.492
Renal failure	0	0	0	1	0	0.321
Chronic respiratory disease	4	3	0	0	1	0.349
Pre-surgery medication						
Statins	14	8	5	7	4	0.565
Single antiplatelet	13	8	5	6	4	0.682
Rutherford grade						0.029
4	6	6	1	6	1	0.221
5	2	2	1	1	1	
6	10	1	3	1	3	
Missing data	2	1	1	–	1	
Laboratory tests						
Haemoglobin, g/L						0.808
Leukocytes, x10^3	9.56 (2.17)	8.11 (1.42)	10.63 (3.09)	8.77 (2.57)	8.70 (4.72)	0.408
Total protein, g/L						
Creatinine, µmol/L	95 (80)	80 (27)	87 (14)	94 (35)	90 (25)	0.978

Continuous data are presented as mean (SD). IMD, Indices of Multiple Deprivation.

Table 3 Lower limb revascularisation outcomes by health literacy group

Outcomes	Health literacy group				P value
	Inadequate (n=14)	Problematic (n=19)	Sufficient (n=12)	Excellent (n=5)	
Length of stay (days)	25 (22)	12(15)	19 (25)	7(5)	0.201
3-month graft patency	3	8	1	1	0.157
MLLA	5	5	4	0	0.487
MI	0	1	0	0	0.683
Wound infection	1	3	2	0	0.715
Graft infection	1	0	2	0	0.277

Continuous data are presented as mean (SD). MLLA, major lower limb amputation; MI, myocardial infarction.

IMD: 1st quintile 30%, 2nd quintile 10%, 3rd quintile 33.3%, 4th quintile 12.5%, 5th quintile 0.00%. Kaplan–Meier analysis revealed no significant difference in amputation-free survival between health literacy groups (log rank p=0.545) and IMD groups (log rank p=0.887) (Figure 2A). Cox regression analysis showed that IMD (p=0.017, HR 0.502 (95% CI 0.285 to 0.883)) and haemoglobin (p=0.001, HR 0.919 (95% CI 0.872 to 0.968)) were significant predictors of MLLA (Table 5). Only one patient developed postoperative myocardial infarction, so Cox regression could not be calculated for this outcome.

Discussion

To our knowledge, this is the first study to investigate the association between health literacy among patients with CLTI undergoing lower limb revascularisation bypass surgery and postoperative outcomes. We found that socioeconomic status is associated with the health literacy level and the degree of severity of vascular disease in patients who underwent vascular intervention for CLTI. Social deprivation level measured by IMD was found to be a significant predictor of major adverse limb events; however, there was no significant difference in major adverse clinical outcomes among health literacy groups.

Our study cohort showed a weak correlation between health literacy and IMD. This correlation was also demonstrated by a previous report and showed that lower socioeconomic groups are more likely to have low health literacy, resulting in poor health status. This is because health literacy was shown to mediate the relationship between socioeconomic status and health status, quality of life and health-related outcomes. This could be particularly true in patients with PAD as their socioeconomic status is likely to influence their health behaviours such as smoking, poor diet and physical activity.[34,35]

Approximately half of our study population were from areas of high levels of social deprivation. Patients from high levels of social deprivation were likely to have inadequate health literacy, as a significant correlation was found between socioeconomic status and health literacy (p=0.029). This was better explained when 70% of participants in the lowest IMD quintile had inadequate or problematic health literacy, while in the highest IMD quintile only 33% had problematic health literacy. This is comparable to the European study which found limited health literacy in 73.9% of individuals with low social status.[36]

Although no difference was found in postoperative outcomes between IMD groups, similar to a UK multiple national databases study, there was no association between patients' socioeconomic deprivation and one-year postoperative death following major amputation for CLTI, but the authors concluded that the relationship

Table 4 Lower limb revascularisation outcomes by IMD quintile

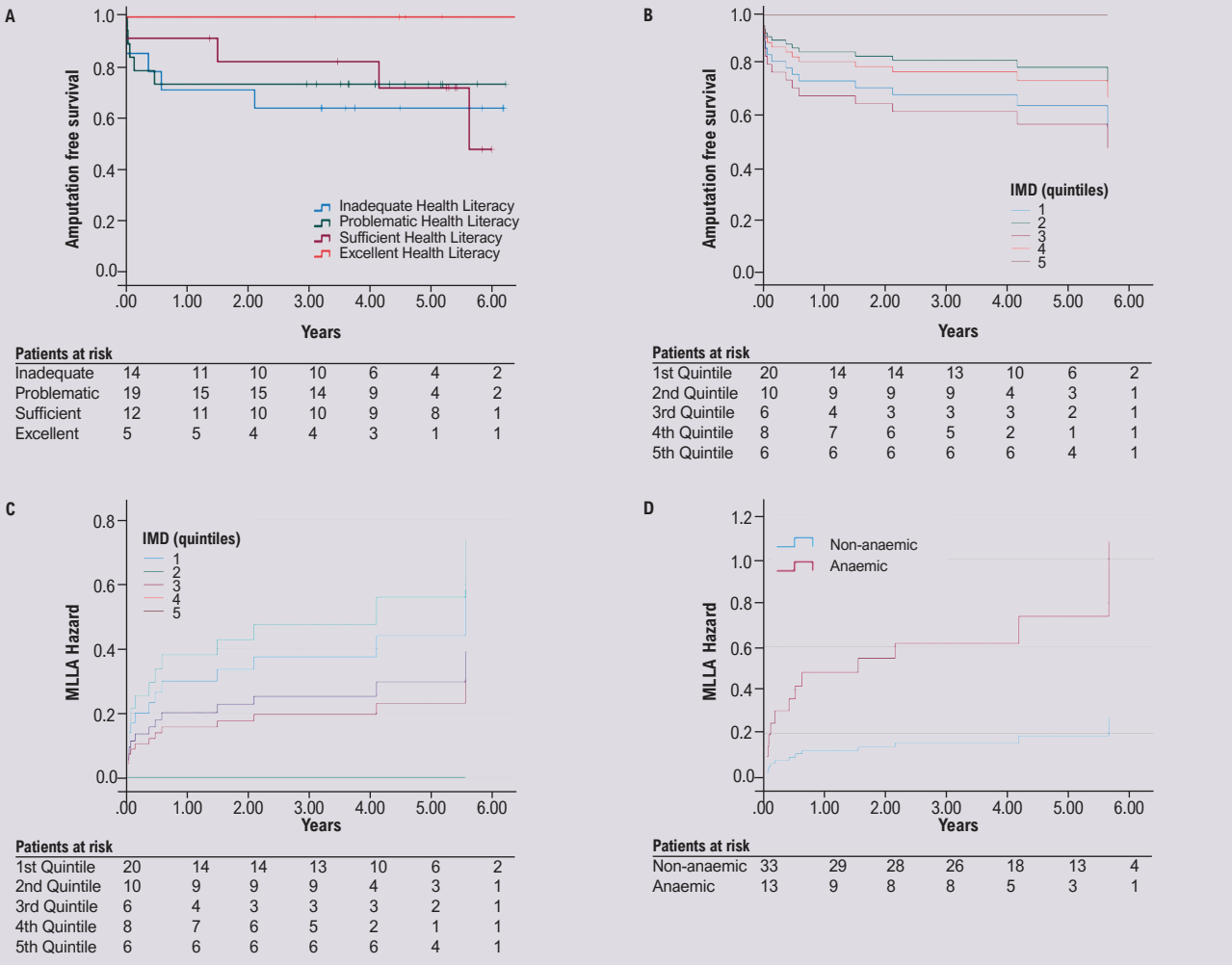
Variable	IMD Quintile					P value
	1 (n=20)	2 (n=10)	3 (n=8)	4 (n=6)	5 (n=8)	
Length of stay, days	22 (25)	12 (14)	23 (19)	10 (13)	10 (10)	0.460
3-month graft patency	5	0	4	3	1	0.057
MLLA	7	2	3	2	0	0.348
MI	1	0	0	0	0	0.852
Wound infection	2	1	1	0	2	0.520
Graft infection	2	1	0	0	0	0.736

Continuous data are presented as mean (SD).
IMD, Indices of Multiple Deprivation; MLLA, major lower limb amputation; MI, myocardial infarction.

between social deprivation and CLTI is potentially more complex and suggested a prospective investigation of this relationship.[37] However, our Cox regression analysis showed that IMD was a significant predictor of major lower limb amputation. This finding is supported by previous studies that showed patients from deprived areas were 2.4 times more at risk of amputation compared with less deprived areas.[38]

In our cohort, although not statistically significant, participants from areas of highest deprivation were younger (69 years) compared with the participants in the lowest deprivation

Figure 2 Amputation-free survival predictors. (A) Kaplan–Meier amputation-free survival curve by health literacy group (log rank p=0.54). Vertical lines indicate censored data. (B) Kaplan–Meier amputation-free survival curve by IMD quintiles (p=0.017). (C and D) Cox regression hazard plots showing MLLA risk as per IMD (p=0.044) and anaemia (p=0.001).



IMD, Indices of Multiple Deprivation (Quintile); MLLA, major lower limb amputation.

Table 5 Predictors of major lower limb amputation following revascularisation by Cox regression analysis

	Hazard ratio	95% CI	P value
IMD	0.502	0.285 to 0.883	0.017
HL	0.799	0.344 to 1.860	0.603
Age	1.047	0.955 to 1.147	0.311
Sex	0.368	0.050 to 2.690	0.324
Diabetes mellitus	2.665	0.558 to 12.740	0.219
Ischaemic heart disease	1.104	0.361 to 3.377	0.863
Hypertension	0.688	0.128 to 3.701	0.663
COPD	0.252	0.026 to 2.405	0.231
Rutherford grade	1.330	0.444 to 3.984	0.611
Haemoglobin	0.919	0.872 to 0.968	0.001

COPD, chronic obstructive pulmonary disease; HL, health literacy; IMD, Indices of Multiple Deprivation (Quintile).

areas (77 years). Previous reports have found individuals from high deprivation areas presented with similar pathology and comorbidities at a younger age compared with their less socially deprived counterparts.[39]

In our patient cohort, none of the participants with excellent health literacy had an amputation. One could assume that excellent health literacy could be a protective effect against major amputation. Nevertheless, caution is advised as the 'excellent health literacy group' was small in this study (n=5), and a larger cohort of patients in a wider study is needed for better evaluation of this association.

The majority of our participants (66%) had inadequate or problematic health literacy, which is considerably higher than the 47.6% of individuals with inadequate or problematic health literacy in a previous European study.[31] Similar high rates of low health literacy (76.7%) were reported among PAD clinic patients in the Netherlands.[21] Limited data exist for a comparison of health literacy in England. Although our cohort of patients did not show a significant difference in postoperative outcomes among health literacy groups, other surgical areas have found significant differences. For example, patients with poor health literacy spent a longer time in the hospital following major abdominal surgery and suffered from an increased risk of complications such as surgical site infections and, when they were discharged, they had decreased compliance with discharge instructions including medication compliance and wound/drain care.[40–42]

Social deprivation combined with reduced health literacy can be linked with an increased display of poor lifestyle behaviours including smoking, poor diet and inadequate physical activity leading to poorer health outcomes. This could be particularly true in patients with PAD as their socioeconomic status is likely to influence their health behaviours such as smoking, poor diet and physical activity, which are common risk factors for PAD and amputation.[8,43–45]

Lack of awareness of vascular disease symptoms and inequalities in access to healthcare services may lead to socially deprived patients presenting with more advanced vascular disease at a younger age. Requiring surgical intervention at a younger age could result in higher disability life-years experienced and more life-years lost, therefore leading to reduced health-related quality of life.[39,46]

Recent studies have shown that patients with adequate health literacy will have the knowledge, skills and confidence to navigate the healthcare system, leading to more efficient use of healthcare services and better health outcomes.[35,47] Improving health literacy could therefore have a mediating role in the relationship between social deprivation and health outcomes through health literacy interventions. This could improve the outcomes for patients with PAD following vascular intervention.

In this study we have shown that health literacy could be a social determinant of health, as health literacy follows a social gradient and creates health inequalities. We believe health literacy is a potentially modifiable factor and could be a facilitator in reducing the gap in health inequalities and social deprivation, with subsequent improved health outcomes.[35,47] Health literacy intervention remains in its infancy, with most research being conducted in the USA, including patient-centred communication and self-management programmes.[48,49]

Health literacy is influenced by race and ethnicity as individuals from different cultures may struggle to navigate through the healthcare system due, for example, to language barrier, different levels of education and different beliefs about health and illness. A number of studies have shown that people from racial and ethnic minority groups are more likely to have low health literacy than those from white majority groups. For example, a study by the National Centre for Education Statistics found that 44% of African Americans and 42% of Hispanics had low health literacy compared with 28% of white subjects.[50]

Improving health literacy is recognised as a national imperative, prompting collaborative efforts between Health Education England, Public Health England and NHS England, and it was one of the foremost priorities identified by the James Lind Alliance for PAD management coupled with improving the educational support for patients with poor leg circulation. Therefore, health literacy enhancement could be a potential avenue for mitigating health inequities stemming from socioeconomic disadvantages, thereby aligning with a key vascular priority established by the James Lind Alliance.[51] Health literacy interventions should be tailored at an individual level for an improved patients' understanding and more efficient use of healthcare services, better health outcomes and improved quality of life for patients.[2,3] As social deprivation and health literacy are linked, there may be merit in identifying vascular patients with a low IMD postcode and targeting these patients for perioperative risk modification to improve postoperative outcomes.[39]

KEY MESSAGES

- There is an association between poor health literacy and social deprivation among patients with CLTI.
- Patients with poor health literacy coming from socially deprived areas are at higher risk of amputation following lower limb revascularisation for CLTI.

Study limitations

The study has several limitations that should be acknowledged. First, the sample size was relatively small, consisting of patients from a single centre. Additionally, the study population was relatively homogenous, comprising individuals residing in the North-East of England. Therefore, the findings may not be generalisable to broader populations. Despite these limitations, the study provides valuable insights and warrants future investigation through larger multicentre prospective observational studies. These studies should aim to evaluate the impact of health literacy and social deprivation on patients with CLTI and their revascularisation outcomes.

Conclusion

This study provides valuable insights into the clinical implications of health literacy and social deprivation in patients with PAD. There is an association between poor health literacy and social deprivation among patients with CLTI. Patients with poor health literacy coming from socially deprived areas are at higher risk of MLLA following lower limb revascularisation for CLTI. Based on the findings of this study, tailored health literacy interventions could be implemented to mitigate the negative impact of low health literacy and social deprivation on postoperative outcomes.

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ORIGINAL RESEARCH

Spatio-temporal analysis of non-attendance for the National Abdominal Aortic Aneurysm Screening Program in Cambridgeshire, Peterborough and West Suffolk region between 2018 and 2022 and its link to socioeconomic deprivation

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Plain English Summary

Why we undertook the work: The NHS provides an ultrasound screening programme to detect abdominal aortic aneurysms (AAA), which is a dilatation of the aorta – the main blood vessel in the abdomen. AAA generally do not cause any symptoms until they rupture, which is usually fatal. Non-attendance at these screening appointments may delay the diagnosis of AAA and lead to missed opportunities of early intervention.

What we did: We examined the pattern of non-attendance in the screening programme in Cambridgeshire, Peterborough and West Suffolk, using specialised software to try to identify potential 'hot spots' of where non-attendance is higher compared with other regions and investigate any association between socioeconomic deprivation and non-attendance.

What we found: We found one hotspot of non-attendance in Peterborough and three in Cambridge. Degree of deprivation was found to be a contributing factor to non-attendance in Peterborough, but its impact was less evident in Cambridge.

What this means: This information will allow the local screening programme to target interventions to try to increase uptake in these non-attending hotspots in order to optimise early detection of AAA. Future research is warranted to investigate other factors associated with high non-attendance (eg, ethnicity mix, ease of access to screening clinic) and assess the effectiveness of interventions to improve uptake.

Abstract

Objective: Non-attendance for National Abdominal Aortic Aneurysm Screening Program (NAAASP) screening scans results in a lost opportunity to improve public health and has financial implications for the healthcare system as a whole. This study aimed to assess the spatio-temporal distribution of the 'did-not-attend' (DNA) rate and identify high-risk geographical areas and associated risk factors for future policy making and allocation of healthcare resources.

Methods: This was a retrospective spatio-temporal analysis of non-attendance to the NAAASP in Cambridgeshire, Peterborough and West Suffolk from 2018 to 2022. With the data from the national AAA screening system, Screening Management and Referral Tracking (SMaRT), the DNA rate was established for each postcode district and compared with the overall DNA rate. Using the number of 'non-attenders' in each postcode district, optimised hotspot analysis was performed to identify hotspots of non-attendance for each year between 2018 and 2022. Multiple logistic regression was used to investigate the association between degree of deprivation and non-attendance.

Results: Overall, 6,364 of 23,957 people (26.6%) being called for screening did not attend from 2018 to 2022. Optimised hotspot analysis identified eight statistically significant hotspots of non-attendance. Postcode districts PE10 (n=8, 80%), PE1 (n=433, 44.5%), CB4 (n=331, 40.2%), CB3 (n=114, 36.7%) and CB1 (n=320, 35.8%) were identified as areas with statistically significantly higher DNA rates. PE1, CB1, CB3 and CB4 were high-risk areas with

both high DNA rates and high numbers of non-attenders. A consistent spatial pattern of hotspots was observed while there was a significant drop in the DNA rate in 2020/21. While degree of deprivation was closely linked to non-attendance in Peterborough, the link was less obvious in Cambridge with little socioeconomic deprivation.

Conclusion: PE1, CB1, CB3 and CB4 were identified as high-risk postcodes. These areas comprise 12.6% of the total screened population. The degree of deprivation is found to be a major contributing factor to non-attendance. Focusing resources to try and improve attendance in these cohorts should be a more cost-effective approach than targeting the population as a whole. Future research is needed to explore the risk factors associated with high non-attendance in these postcode districts in order to identify actions to improve uptake and access to the screening services.

Key words: vascular surgery, screening, abdominal aortic aneurysm; spatio-temporal analysis, non-attendance/DNA

Introduction

The National Abdominal Aortic Aneurysm Screening Program (NAAASP) offers a screening ultrasound scan to all men aged 65 in the UK by the National Health Service (NHS), with the aim of screening and surveillance of aortic aneurysms. The NAAASP was established after multiple randomised clinical trials showed a significant reduction in the mortality rate with the screening intervention.[1,2] Current surveillance schedule in the NAAASP (annually for small AAA of 3–4.4 cm diameter, quarterly for medium AAA of 4.5–5.4 cm diameter) also results in a very low rupture risk of <0.5% per annum, even in men whose AAA is just <5.5 cm, the current referral threshold.[3]

Non-attendance at the initial screening appointment may cause a delayed diagnosis of AAA leading to themissed chance of early detection and intervention provided by the NAAASP. Attending the screening appointment could provide an additional opportunity for healthcare providers to educate people about modifiable risk factors associated with AAA, instigating behavioural change. Non-attendance also wastes clinical resources including pre-allocated staffing, facilities and equipment. Furthermore, it increases the bureaucratic burden by adding more administrative work for rescheduling appointments, all of which creates inefficiency and increased cost.[4]

Non-attendance may be the result of health inequality as it is closely associated with socioeconomic deprivation[5,6] and geographical variation in service provision. Moreover, the 'did-not-attend' (DNA) rate is higher among underserved groups and ethnic minorities.[7] Geographic Information Systems (GIS) have the capability to geocode 'non-attender' postal codes and postcode districts, conduct spatial analysis, and visualise the incidence and rate of DNA patterns across larger areas. In combination with the findings of the contributing factors to non-attendance (eg, socioeconomic deprivation), a local screening programme could use the information to aid allocation of healthcare resources and decision analytics on appropriate resource use.

Spatial analysis and GIS have been used in multiple studies. Soleimani and Bagheri examined the spatial distribution of myocardial infarction in rural Iran,[8] Kuehnl *et al* analysed the spatial distribution and regional variation of the hospital incidence and in-hospital mortality of AAA in Germany[9] and Khan *et al* explored attendance at the screening venues for breast cancer in Australia using spatial analysis and GIS.[10] Yet, no study has investigated the spatial distribution of the NAAASP DNA incidence and rate in the UK. Therefore, we aimed to (1) identify the hotspots (postcode districts with high DNA incidence), (2) visualise the spatio-temporal pattern of DNA incidence throughout the years in these regions and (3) investigate the association between socioeconomic deprivation and non-attendance. The results of this study could enable policymakers to identify and target the areas at risk of a high DNA rate and incidence, which might improve uptake and access to the screening service in Cambridgeshire, Peterborough and West Suffolk in the UK.

Methods

This study was a retrospective spatio-temporal analysis of the DNA rate in the NAAASP in Cambridgeshire, Peterborough and West Suffolk in the UK from 2018 to 2022. Data were collected from the National AAA screening system, Screening Management and Referral Tracking (SMaRT), with attributes including contact postcode, GP practice and preferred language. Postcode district refers to the first half of the postcode/outward code (eg, CB1 is the postcode district of CB1 2RF). Postcode districts that fell outside the regional boundaries were excluded from the study. Men who were already under surveillance with the NAAASP were also excluded.

Men who attended their first screening appointment were classified as 'attenders' while men who missed their first screening appointment were classified as 'non-attenders'. The DNA rate in each postcode district was calculated by dividing the number of non-attenders by the total number of non-attenders and attenders. Postcode districts with a statistically significantly higher DNA rate were identified using Fisher's exact test with a Bonferroni correction for multiple tests.

The latitude and longitude coordinates of each postcode district and postal code were obtained from Ordnance Survey, the national mapping agency for the UK. These data were subsequently

imported into Tableau software and ArcGIS Pro software for data visualisation and spatial analysis, respectively.

To identify statistically significant hotspots among postal district DNA incidences in the region, optimised hotspot analysis using the Getis-Ord Gi* statistics[11] was used. A hotspot is defined as an area with a significantly higher DNA incidence and clustering compared with surrounding areas (ie, an area that has a greater than average number of DNA events). The output of hotspot analysis includes a P-value, a Z-score, and a confidence interval (CI) bin field (Gi-Bin) for each feature class (fishnet grid in this case). The fishnet grid in the ±3 bins reflects statistical significance with a 99% CI; the ±2 bins 95% CI; the ±1 bins 90% CI. The clustering for bin 0 is not statistically significant. The mean Gi-Bin value was then mapped with the polygonal shape of each postal district and visualised with ArcGIS software.

High risk areas were defined as regions with both a high DNA rate and high DNA incidence.

To investigate whether the degree of deprivation is associated with non-attendance, the index of multiple deprivation (IMD) decile of each Lower Super Output Areas (LSOA) from English indices of deprivation 2019[12] was mapped and overlaid with the boundary of postal districts using ArcGIS software. Multiple logistics regression was done in R to investigate the association of non-attendance with each of seven domains of degree of deprivation: income, employment, education, health and disability, crime, housing and living environment.

Table 1 Number of people invited for screening and the number and percentage of did-not-attend (DNA) in each postal district

Postcode district	Total number of people invited	Total number of DNA	Percentage of DNA (%)	Postcode district	Total number of people invited	Total number of DNA	Percentage of DNA (%)
CB1	893	320	35.834*	IP6	1	1	100.000
CB10	26	4	15.385	MK44	98	19	19.388
CB11	4	0	0.000	NN9	7	2	28.571
CB2	245	82	33.469	PE1	972	433	44.547*
CB21	400	87	21.750	PE10	10	8	80.000*
CB22	618	149	24.110	PE11	2	2	100.000
CB23	657	161	24.505	PE12	49	15	30.612
CB24	794	185	23.300	PE13	910	264	29.011
CB25	439	98	22.323	PE14	213	47	22.066
CB3	311	114	36.656*	PE15	787	205	26.048
CB4	823	331	40.219*	PE16	258	71	27.519
CB5	204	60	29.126	PE19	1027	265	25.803
CB6	878	199	22.665	PE2	985	294	29.848
CB7	605	146	24.132	PE21	1	1	100.000
CB8	745	211	28.322	PE26	279	65	23.297
CB9	638	166	26.019	PE27	471	109	23.142
CO10	1153	254	22.029	PE28	1346	305	22.660
CO8	52	15	28.846	PE29	613	174	28.385
CO9	45	8	17.778	PE3	588	180	30.612
IP14	46	5	10.870	PE31	1	0	0.000
IP18	2	2	100.000	PE33	1	0	0.000
IP21	4	0	0.000	PE37	1	0	0.000
IP22	286	52	18.182	PE38	30	8	26.667
IP23	44	5	11.364	PE4	673	169	25.111
IP24	22	5	22.727	PE5	30	5	16.667
IP25	1	0	0.000	PE6	276	63	22.826
IP26	57	12	21.053	PE7	945	231	24.444
IP27	392	112	28.571	PE8	11	3	27.273
IP28	433	144	27.017	PE9	3	0	0.000
IP29	234	30	12.821	SG19	29	3	10.345
IP30	355	67	18.873	SG4	2	2	100.000
IP31	535	93	17.383	SG8	395	84	21.266
IP32	306	79	25.817	SG9	7	2	28.571
IP33	543	138	25.275	**Total:**	**23916**	**6364**	**26.6**

*Statistically significant (p<0.00075).

Results

Between 2018 and 2022, 23,957 eligible men were invited for AAA screening in Cambridgeshire, Peterborough and West Suffolk. They resided in 95 different postcode districts. We excluded 28 postcode districts as they fell outside the service provision boundary, which amounted to 41 subjects being excluded. After exclusion, there were 23,916 eligible men who had been invited to an AAA screening appointment in the region, of which 17,552 attended the appointment and 6364 (26.6%) did not attend (Table 1).

The highest statistically significant DNA rates were observed in postcode districts PE10 (n=8, 80%), PE1 (n=433, 44.5%), CB4 (n=331, 40.2%), CB3 (n=114, 36.7%) and CB1 (n=320, 35.8%) ($p<0.00075$) (areas in red in Figure 1). Using the number of non-attenders in each postcode district, optimised hotspot analysis identified eight statistically significant hotspots with a 95% confidence interval: PE1-4 (Peterborough), CB1-4 (Cambridge) (Figure 2). PE1, CB1, CB3 and CB4 were identified as areas with both high DNA rates and high DNA incidences (Figure 3).

Across the years, the DNA incidence and DNA rate varied and diminished significantly in 2020/21. There were 2166 and 2101 non-attenders in the region in 2018/19 and 2019/20, respectively. The DNA incidence sharply decreased to 628 cases in 2020/21 and increased to 1469 in 2021/22 (Table 2). Similarly, the DNA rate was 34.2% and 34.3% in 2018/19 and 2019/20, respectively, yet in 2020/21 it dropped to 11.8% ($p=0.0195$) and rose to 23.9% in 2021/22. The total number of screening appointments followed a similar trend; there was a total of 6334 and 6123 appointments in

Figure 1 Overall did-not-attend (DNA) rate in the National Abdominal Aortic Aneurysm Screening Program (NAAASP) in each postal district of Cambridgeshire, Peterborough and West Suffolk from 2018 to 2022. The areas in red are areas with the highest DNA rate: PE10 (80%), PE1 (44.5%), CB4 (40.2%), CB3 (36.7%), CB1 (35.8%), and PE11 (100%). Statistical significance was observed in PE10, PE1, CB4, CB3 and CB1 ($p<0.00075$).

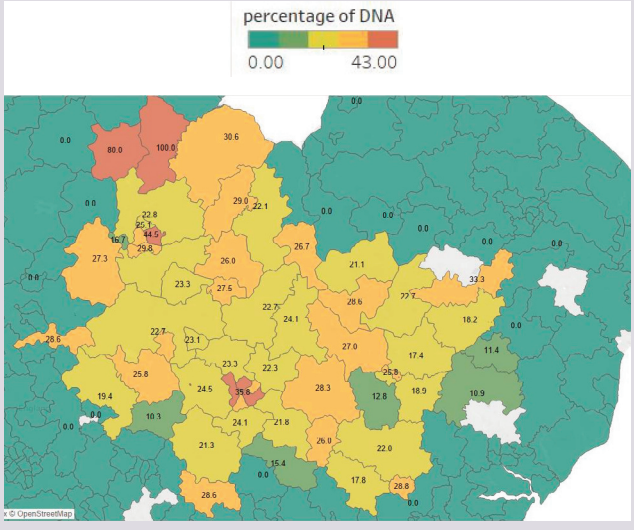


Figure 2 (A) Overall spatial distribution of the did-not-attend (DNA) incidence in the region from 2018 to 2022. (B) Hotspot analysis of the incidence within fishnet grid (fishnet grid in red are hotspots with 99% confidence). (C) Hotspot analysis of the DNA incidence in the region of postal districts. The areas in red are PE1–4 (Peterborough) and CB1–4 (Cambridge). They have a mean Gi-bin confidence interval (CI) bin field of at least 2 (95% confidence interval) and subsequently were identified as high-risk areas.

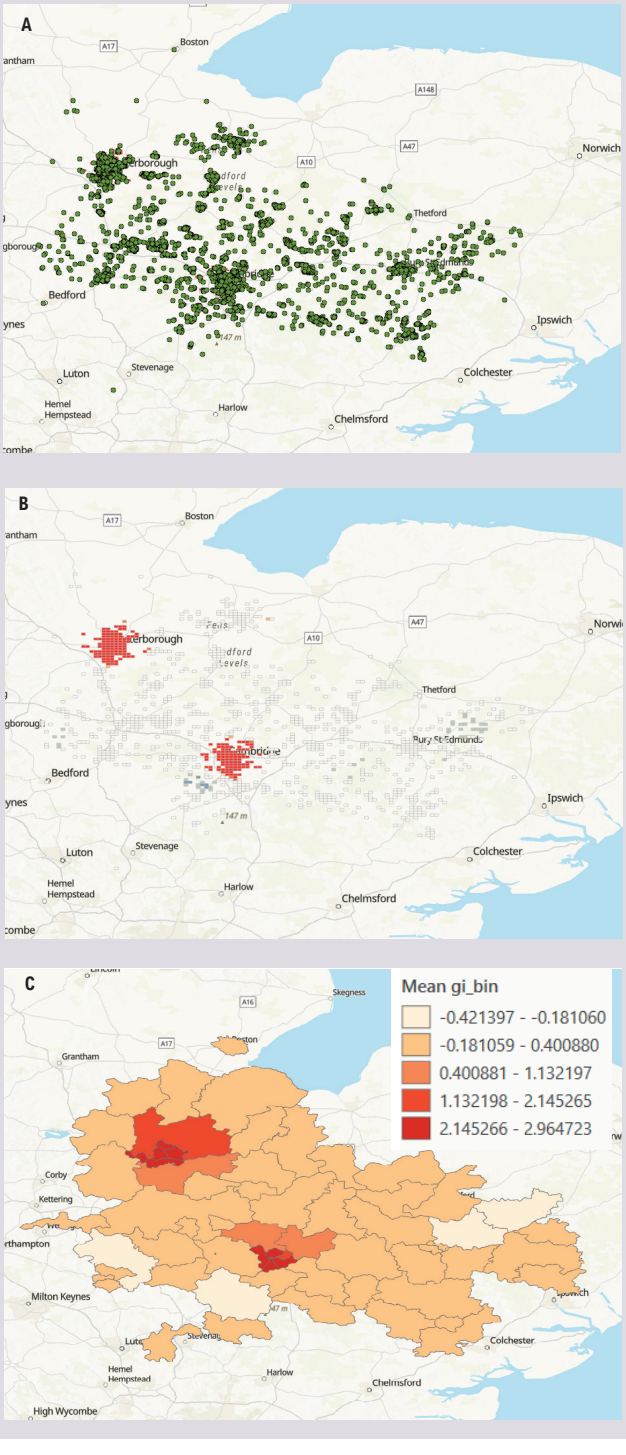
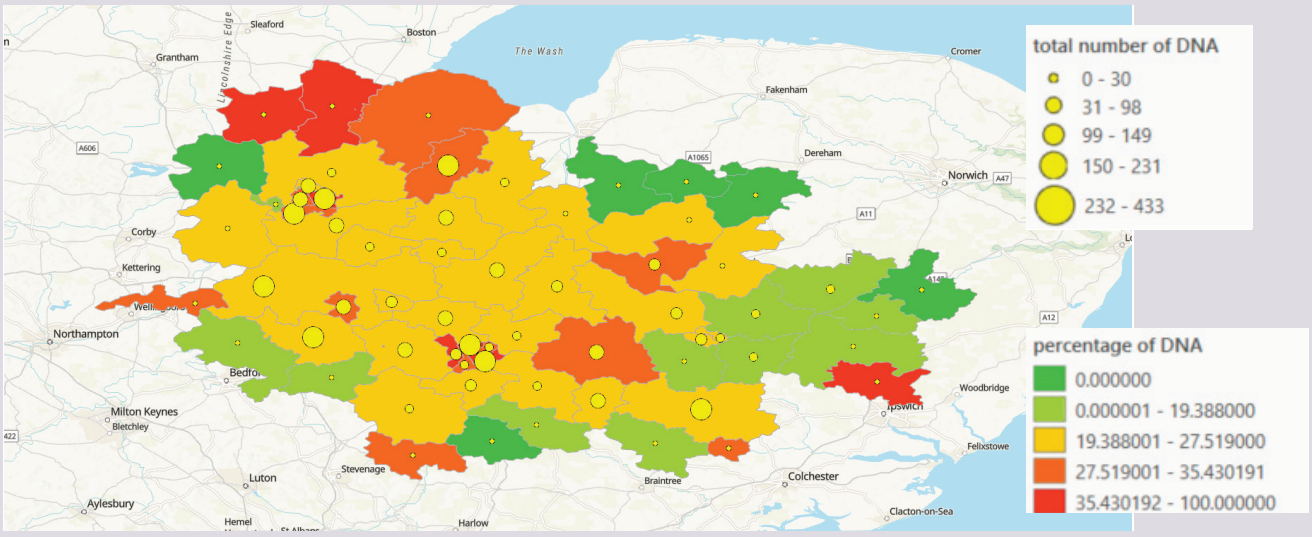


Figure 3 Spatial visualisation of did-not-attend (DNA) rate (colour) and DNA incidence (spots) in each postal district. Combining the two, high-risk areas with both a high DNA rate and high DNA incidence were identified (PE1, CB1, CB3 and CB4).



2018/19 and 2019/20 but then fell to 5313 in 2020/21, followed by an increase back to 6146 in 2021/22.

Optimised hotspot analysis across the years showed a consistent pattern. Peterborough city centre (PE1–4) was identified as a statistically significant hotspot with a 95% confidence interval every year from 2018 to 2022, despite a decrease in the DNA incidence in 2020/21. Interestingly, CB1,3,4 were identified as hotspots with a 95% confidence interval in all years apart from 2020/21.

By linking the 2019 IMD[12] and postcode district, it shows that PE1 contains a relatively higher number of Lower Super Output Area (LSOA) on bottom deciles, indicating a possible link to socioeconomic factors. Despite being the hotspots, CB1–3 are relatively affluent with little socioeconomic deprivation, most of which being on the 3rd and 4th decile of IMD (Figure 4).

Multiple logistics regression showed that income ($p<0.05$), health deprivation and disability ($p<0.05$) and crime ($p<0.005$) were the three main contributing factors to non-attendance in

Figure 4 Index of Multiple Deprivation Decile in Lower Super Output Area (LSOA), overlaid with the boundary of postal districts. Areas in red are LSOA on bottom deciles. PE1 contains a relatively higher number of them.

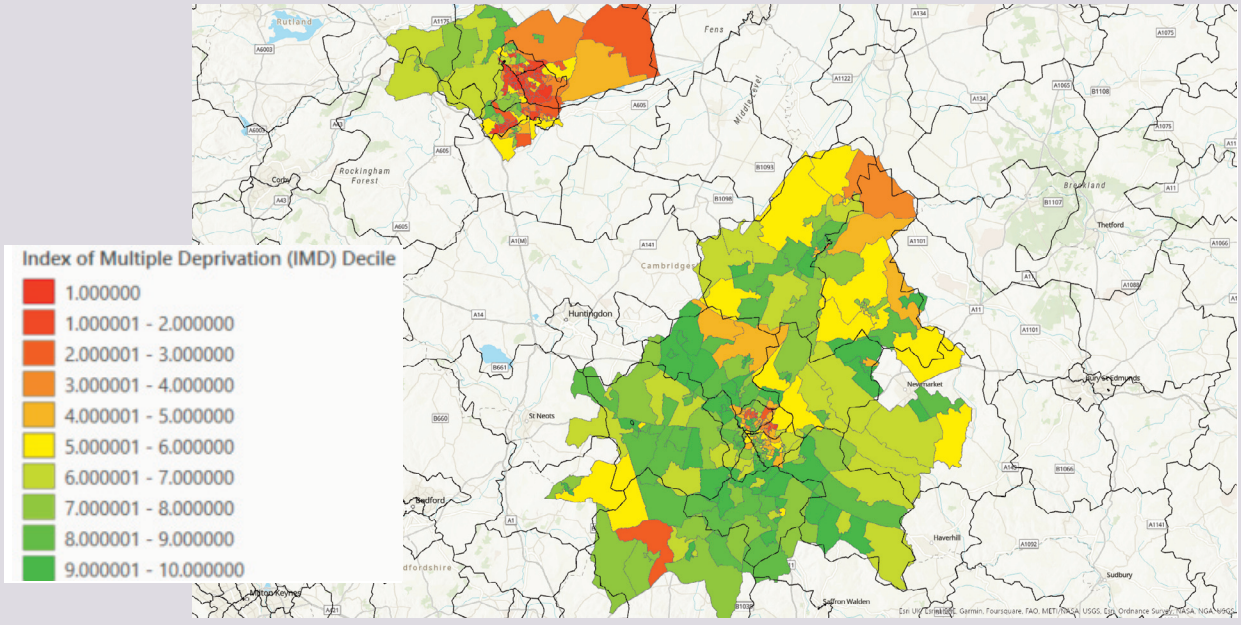


Table 2 Number of people invited for screening and number and percentage of did-not-attend (DNA) each year from 2018 to 2022.

	Number of people invited for screening	Number of DNA	Percentage of DNA (%)
2018–2019	6334	2166	34.2%
2019–2020	6123	2101	34.4%
2020–2021	5313	628	11.8%
2021–2022	6146	1469	23.9%

Peterborough whereas, in Cambridge, there was a combination of factors: education, health deprivation and disability, crime, barriers to housing, living environment (all $p<0.005$)

Discussion

Key result

With an overall DNA rate of 26.6%, PE1, CB1, CB3 and CB4 were the non-attending areas with both a high proportionate rate of DNA and high absolute number of non-attendees. A consistent spatial distribution of DNA rate and incidence was observed from 2018 to 2022. However, there was a significant drop in the DNA rate and incidence in 2020/21, and only PE1–4 but not CB1,2,3,4 were detected as hotspots that year.

The degree of deprivation is found to be closely linked with non-attendance. However, the contributing factors differed between Peterborough and Cambridge. Income, health deprivation and disability, and crime contributed significantly to the non-attendance in Peterborough whereas there seems to be a combination of factors in play in Cambridge.

Interpretation

The overall DNA rate of 26.6% is higher than the nationally acceptable threshold of performance (≤25%)[13] and noticeably higher than the actual national DNA range of 19–23% from 2018 to 2022. These further pose urgency to policymakers to implement action and devise strategy for intervention.

The significant drop in the DNA rate in 2020/21 is most likely related to the impact of the COVID-19 pandemic. In March 2020 the initial screening and surveillance scans in the NAAASP were temporarily suspended for 9 months (until November 2020) and 5 months (until July 2020), respectively, leading to a drop in the total number of appointments. The greater drop in the DNA incidence and rate might be due to the greater willingness and availability of eligible men to attend appointments during the lockdown. It might be linked to social deprivation as men aged 65 and from socioeconomically deprived areas are more likely to work beyond their state pension age. During the pandemic their jobs with lower skills were more likely to be negatively impacted and to be furloughed,[14] which might have increased their availability for screening appointments.

A similar pattern of uptake in the NAAASP was observed in other regions of the UK, according to the AAA standards report 2020–2021 published by NHS England.[15] Interestingly, high outpatient attendance rates during the COVID-19 pandemic were observed in other studies.[16–18] The summary report published by NHS England[19] shows that the overall outpatient DNA rate was also lower in 2020/2021 compared with the previous years. However, it should be noted that the temporal drop is likely to be an exception and is not shown to affect the causes of the overall distribution of non-attendance.

Socioeconomic deprivation and its association with non-attendance has recently been investigated and reported in various publications.[6,7] The general findings are that non-attendance is more prevalent in socioeconomically deprived areas,[7] which could be attributed to various factors including health deprivation and disability, outdoor living environment and adult education.[6] Whereas this is consistent with our findings in Peterborough, CB1–4 has been identified as hotspots with relatively little socioeconomic deprivation, which is an exception to the current literature finding. It might be due to the large working population in the region, yet the multiple logistics regression revealed a combination of factors might be in play, which warrants further research.

Limitations

One of the limitations of this study is data availability. Smoking history and a family history of AAA are important risk factors for AAA, yet this information is not routinely collected from men who are invited to the screening programme. Throughout the study period the location of screening clinics also changed considerably on a yearly basis due to the availability of facilities. Ease of access to screening clinic, smoking and family history of AAA could all influence both non-attendance and socioeconomic status. Yet, without these data, we could not investigate the potential confounding factors and their impact.

Future work

The study findings warrant future research to investigate the association between the DNA rate and different factors such as index of deprivation, ethnic mix, first language spoken and the distance to the screening clinic. This could be achieved by geographic weighted regression. Combining an understanding of the risk factors and the geographical distribution impacting non-attendance would facilitate the most targeted future quality improvement interventions.

It is suggested that the study findings be communicated with the local screening programmes for improving uptake in non-attending areas, including targeted actions such as booking more accessible venues for subjects with a disability or a safer screening location to tackle the deterrent effect of crime on attending screening appointments, especially in Peterborough. Follow-up spatio-temporal analysis should be done to evaluate the effectiveness of the intervention.

KEY MESSAGES

- PE1, CB1, CB3 and CB4 were identified as high-risk areas of NAAASP non-attendance.
- There was a significant drop in the non-attendance rate and incidence in 2020/21 during the COVID pandemic, and only PE1–4 but not CB1,2,3,4 were detected as hotspots that year.
- The degree of deprivation is found to be closely linked with non-attendance, but the contributing factors can differ between regions.

Conclusion

PE1, CB1, CB3 and CB4 were identified as non-attending areas of NAAASP with a high DNA incidence and rate. There was a significant drop in the non-attendance rate and incidence in 2020/21 during the COVID pandemic, and only PE1–4 but not CB1,2,3,4 were detected as hotspots that year. The degree of deprivation is found to be closely linked with non-attendance in Peterborough but less evident in Cambridge. The contributing factors to non-attendance can differ between regions. Future research is warranted to investigate the association between the DNA rate and different factors such as index of deprivation, ethnic mix, first language spoken and the distance to the screening clinic. It is suggested that the findings are regularly communicated with the local screening programme to devise a targeted strategy in order to improve uptake in non-attending areas.

Conflict of Interest: None.

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ORIGINAL RESEARCH

Thromboprophylaxis strategies in patients undergoing endovenous thermal ablation: a UK survey

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Plain English Summary

Why we undertook the work: Varicose veins are a common condition and are typically managed through non-invasive treatments. However, these treatments can occasionally result in the development of blood clots due to their connection with larger leg veins. To gain insight into how healthcare providers reduce the risk of blood clot formation after these procedures, we explored the preventative measures currently adopted by clinicians in the UK.

What we did: An online survey was designed and circulated via email to vascular surgeons across the UK and promoted on social media. Responses were gathered and analysed to determine the current practices and trends in blood clot prevention during local anaesthetic varicose vein procedures.

What we found: Responses were gathered from 33 unique respondents across England and Northern Ireland. All respondents reported routine use of elastic stockings immediately after these procedures. Around two-thirds of clinicians reported routine prescription of anticoagulants, with a single dose of anticoagulation being the preferred practice. One-third of clinicians reported that they do not routinely prescribe anticoagulants to these participants.

What this means: There are different ways to reduce the risk of blood clots in patients undergoing varicose vein treatment, with the most common method being the prescription of blood-thinning medication. However, it is unclear whether this approach truly benefits these patients, as there is currently no high-quality evidence to support it. To address this uncertainty, it is crucial to conduct high-quality research that can either confirm or refute the effectiveness of blood-thinning medication in these cases. If it turns out that these medications do not provide any real benefit to these patients, it could potentially lead to cost savings for the NHS and prevent patients from experiencing unnecessary side effects.

Abstract

Introduction: It remains unclear whether patients undergoing endovenous thermal ablation (EVTA) for superficial venous incompetence (SVI) should receive pharmacological thromboprophylaxis. A survey was conducted to assess current thromboprophylaxis practices across the UK in patients undergoing EVTA for SVI.

Methods: To examine the thromboprophylaxis practices of clinicians performing EVTA for SVI in the UK, an online survey was developed using the Qualtrics online survey tool. The survey link was circulated via email to members of the multidisciplinary collaborative Vascular and Endovascular Research Network (VERN) and promoted through social media. The primary focus of the survey was to gather information regarding venous thromboembolism (VTE) prophylaxis during EVTA for SVI.

Results: A total of 32 vascular surgeons and one vascular nurse specialist based in the UK participated in the survey. All respondents reported routine prescription of compression therapy in the immediate postoperative period. Of all the respondents, 67% (n=22) reported routine prescription of pharmacological thromboprophylaxis during the peri-procedural period. Extended prophylaxis was routinely offered by 15% (n=5) of all respondents. Among those who provided extended prophylaxis, the majority (80%, n=4) used low molecular weight heparin (LMWH), while 20% (n=1) opted for a direct-acting oral anticoagulant (DOAC).

Conclusion: The findings from this survey indicate that a significant proportion of patients undergoing EVTA for SVI routinely receive pharmacological thromboprophylaxis, with a single

perioperative dose of LMWH being the prevailing practice. However, there is a notable lack of robust high-quality evidence to substantiate this practice. Grade A evidence is required to assess the potential benefit of pharmacological thromboprophylaxis in the context of EVTA to guide the development of clinically relevant guidelines. Should pharmacological thromboprophylaxis prove to offer no additional benefit for this specific patient population, this could result in cost savings for the NHS and enable patients to avoid unwanted side effects associated with anticoagulation therapy.

Key words: endovenous intervention, venous thromboembolism, survey

Introduction

Background

Superficial venous incompetence (SVI) is a prevalent medical condition that often leads to the development of symptomatic varicose veins, significantly impacting one's quality of life.[1] Moreover, SVI carries the potential for major complications including bleeding, ulceration and phlebitis.[2] Endovenous thermal ablation (EVTA) is now the recommended first-choice management for the treatment of symptomatic varicose veins, with up to 35,000 procedures being performed annually within the NHS.[3–5] When compared with conventional open surgery, endothermal techniques are often preferred due to their minimally invasive nature, faster recovery time, lower wound infection rate and reduced postoperative pain.[6,7]

Venous thromboembolism (VTE), comprising deep vein thrombosis (DVT) and pulmonary embolism (PE), is a significant cause of morbidity and mortality and has considerable societal and economic implications.[8] Postoperative VTE is a known complication of EVTA; however, the incidence of this remains unclear. Administration of pharmacological thromboprophylaxis serves as a preventative measure to reduce the risk of postoperative VTE and thus many clinicians prescribe anticoagulants for EVTA either peri-procedurally or for an extended period post-procedure. According to a survey conducted in 2019, the majority (73.3%) of vascular surgeons in Ireland reported routine prescription of pharmacological thromboprophylaxis for superficial endovenous intervention.[9] However, there is no high-quality evidence to support this practice and thus it remains unclear whether patients undergoing EVTA for SVI benefit from pharmacological thromboprophylaxis.

There is also a lack of consensus within the current guidelines regarding the best approach to VTE prophylaxis for EVTA. The European Society of Vascular Surgery (ESVS) 2022 Clinical Practice Guidelines provide a Class IIa recommendation for individualised prophylaxis strategies for superficial venous intervention,[4] whilst guidelines issued by the National Institute for Health and Care Excellence (NICE) advise that VTE prophylaxis is generally not required for patients undergoing varicose vein surgery if they are assessed to be low-risk for VTE and have a total anaesthesia time of <90 min.[10] The paucity of robust grade A evidence and clear guideline recommendations for preventing VTE in patients undergoing EVTA for SVI has resulted in significant differences in how clinicians approach thromboprophylaxis for these patients. Often, the choice relies on clinician discretion, leading to varied practices.

Aim

A survey was designed with the objective of establishing the range of thromboprophylaxis practices in vascular surgical units across the UK for patients undergoing EVTA for SVI.

Methods

Survey development

An online eight-question survey was developed by a focus group of surgeons and a Trial Manager using Qualtrics XM survey software.[11] While previous iterations of comparable surveys offered valuable insights, this survey aimed to place a greater emphasis on determining thromboprophylaxis regimens for EVTA as well as identifying the specific anticoagulants chosen for extended prophylaxis.[12,13] The survey was internally piloted, iterated and user tested by researchers at Imperial College London prior to distribution.

Questionnaire structure

The survey incorporated a mix of binary choices, multiple-choice and open-ended questions, allowing respondents to provide free-text responses. The survey was split into two sections to gather data on the following aspects:

1. Regional Information: To ensure a comprehensive representation of the entire UK, this section was designed to gather data pertaining to the institutions where the respondents were actively involved in their respective practices.
2. Thromboprophylaxis regimens: This section focused on exploring the different thromboprophylaxis regimens adopted during EVTA for SVI. It encompassed questions regarding the application of both mechanical and pharmacological approaches to thromboprophylaxis.

Questionnaire distribution

The survey link, along with the survey's objectives, was circulated via email to members of the multidisciplinary collaborative Vascular and Endovascular Research Network (VERN) and reminders were sent via email at appropriate

intervals to enhance the response rate.[14] The survey link was also promoted online through social media.

Questionnaire analysis

Survey responses were gathered using the Qualtrics XM platform and data were exported to Excel.

Ethics and governance

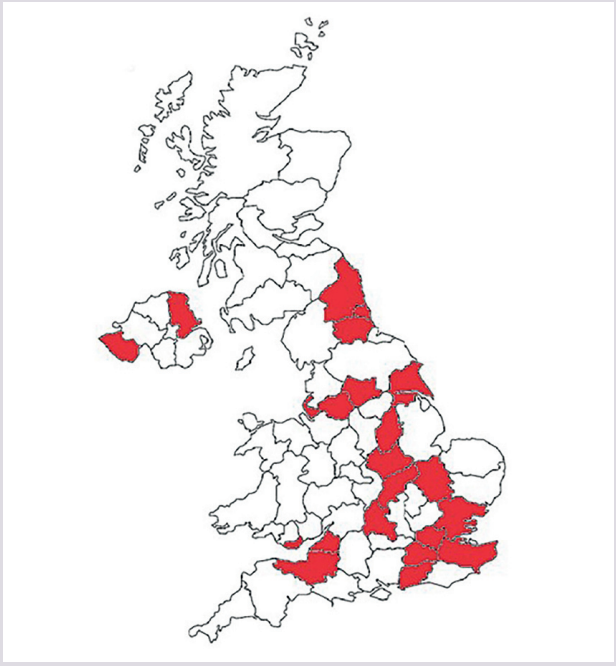
Ethical approval was not required for the study as it focused on surveying healthcare professionals and did not include patients.[15] Participation in the survey served as an indication of consent, and any respondent identifiable information was treated confidentially.

Results

Respondents

A total of 37 respondents contributed to the survey. Of these 37 respondents, four were removed as they were outside the UK. A total of 33 unique and valid responses were therefore included in the analysis. Survey responses were gathered from a total of 28 vascular centres widely distributed across the UK (Figure 1). Most respondents (97%, n=32) were vascular surgeons and 3% (n=1) were vascular nurse specialists.

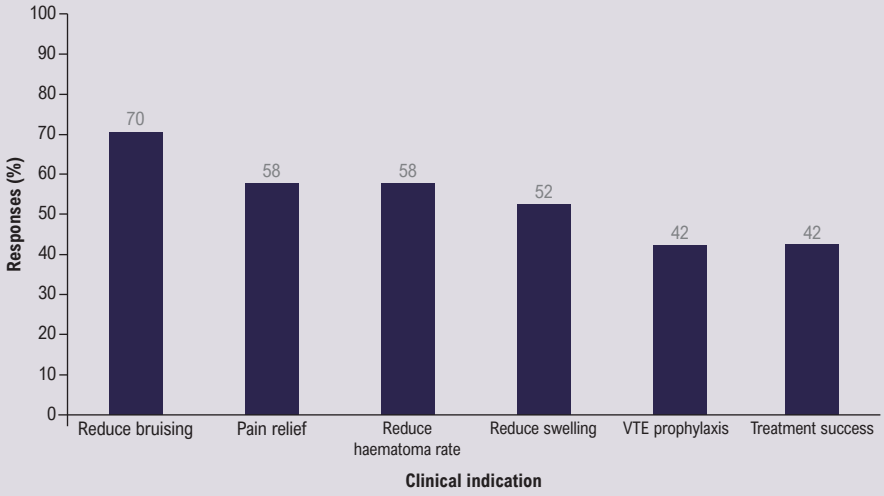
Figure 1 Distribution of survey responses across the UK



Provision of compression therapy

All respondents (n=33, 100%) reported routine prescription of compression therapy in the immediate postoperative period in the absence of clinical contraindications. Of the 33 respondents, 55% (n=18) routinely used either compression stockings or compression bandaging, while 39% (n=13) only offered compression stockings, and 6% (n=2) only offered compression bandaging. The reported clinical indications for using compression therapy post-procedure were to reduce bruising (n=23, 70%), pain relief (n=19, 58%), reduce haematoma rate (n=19, 58%), reduce swelling (n=17, 52%), VTE prophylaxis (n=14, 42%) and treatment success (n=14, 42%) (Figure 2). These options were presented in a multiple-choice format, allowing respondents to select more than one option.

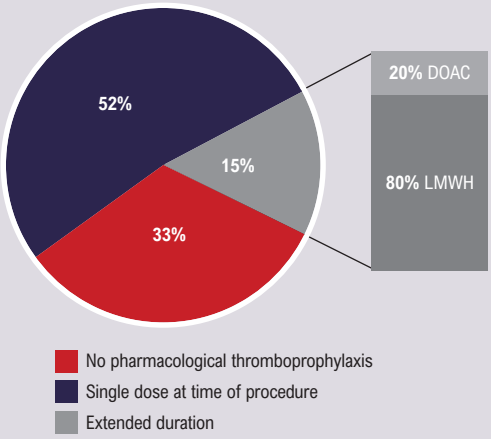
Figure 2 Clinical indications for compression therapy during varicose vein procedures



Provision of pharmacological thromboprophylaxis

Of the 33 respondents, 33% (n=11) reported that they did not routinely prescribe pharmacological thromboprophylaxis to patients undergoing EVTA, while 67% (n=22) reported routine prescription of pharmacological thromboprophylaxis (Figure 3). Seventeen of the respondents (52%) reported that they routinely prescribed a single dose of pharmacological thromboprophylaxis at the time of procedure, while five (15%) routinely prescribed an extended course of pharmacological thromboprophylaxis. Of the five respondents who provided extended thromboprophylaxis, four (80%) routinely used low molecular weight heparin (LMWH) while one (20%) opted for a direct-acting oral anticoagulant (DOAC).

Figure 3 Pharmacological thromboprophylaxis strategies adopted by clinicians during local anaesthetic varicose vein procedures



Discussion

Our findings indicate that all respondents offered at least one form of compression therapy to all patients in the immediate postoperative period following EVTA for SVI. This practice aligns with the current ESVS 2022 Clinical Practice Guidelines, which provide a level IIa, Grade A, recommendation for compression therapy after EVTA for SVI.[4] Furthermore, our findings are consistent with those of a similar survey conducted in 2016, which specifically examined compression regimes following endovenous ablation for SVI.[12]

There is a discernible trend among clinicians who are progressively showing a preference for using compression stockings over bandages.[12] This growing preference may be attributed to the convenience of applying stockings, which is particularly valuable in healthcare settings where time constraints are prevalent. Additionally, stockings are available in standardised sizes, which reduces the variability associated with operator-dependent bandage application.[16] However, it has also been suggested that the choice of compression therapy following EVTA may be influenced by the selected treatment modality.[12] This suggestion implies a potential shift in the endothermal techniques being performed for SVI over the last decade, possibly due to the adoption of more cost-effective techniques.[17]

In contrast to the ESVS guidelines, which recommend the use of compression after EVTA for SVI, the NICE guidelines present a contradicting recommendation. NICE guidelines advise that mechanical thromboprophylaxis following EVTA should only be considered for patients who are at an increased risk of VTE and where pharmacological thromboprophylaxis is contraindicated.[10] Our survey, however, indicated that less than half of respondents used compression therapy for VTE prophylaxis.[10] Instead, the majority of respondents reported alternative clinical indications unrelated to VTE prophylaxis, such as reduced bruising. Recent patient and public involvement work has revealed that patients are inclined to favour receiving compression therapy due to these non-thrombotic benefits. Consequently, patients who may not be at an increased risk of VTE are likely to receive postoperative compression, despite NICE guidelines suggesting otherwise.[10] The observed variability in clinical indications for postoperative compression aligns with the existing literature, which recognises compression therapy as an established approach for mitigating postoperative pain following EVTA.[18,19] However, the effectiveness of compression therapy in reducing swelling, improving treatment success and serving as VTE prophylaxis remains uncertain.[20,21]

This survey indicates that all three thromboprophylaxis practices are adopted across the UK and are considered the standard of care, with a preference for a single perioperative dose of LMWH. A consensus study conducted in 2020 also revealed that consultants predominantly prescribed a single perioperative dose of LMWH for moderate-risk VTE patients.[13] This practice is consistent with the findings of a recent meta-analysis which showed a significant reduction in DVT rates following pharmacological thromboprophylaxis for endovenous varicose vein interventions.[22] Our survey findings are further supported by a survey conducted at The Royal Society of Medicine Venous Forum 2023, a national vascular conference focused on venous disease treatment. In a session pertaining to SVI, attendees were surveyed to gain insights into their typical approach to VTE prophylaxis during EVTA. Out of 32 respondents, 31% did not routinely prescribe pharmacological thromboprophylaxis for these procedures, while 53% and 16% reported routine use of a single perioperative dose and up to two weeks of anticoagulation, respectively. There is, however, a notable lack of robust grade A evidence to substantiate the provision of pharmacological thromboprophylaxis in this patient population. High-quality evidence is essential to either support or refute this current practice. The upcoming THRIVE trial (UK), funded by the National Institute for Health Research (NIHR) Health Technology Assessment (HTA) in 2022,[23] will serve as a large randomised controlled trial providing grade A evidence to inform future practices. If pharmacological thromboprophylaxis is demonstrated to offer no additional benefit to patients undergoing endovenous interventions, discontinuing this practice could result in cost savings for the NHS. Moreover, avoiding unnecessary administration of anticoagulants provides benefits to patients by minimising the potential for hindering treatment success and preventing adverse effects associated with anticoagulant use, including excessive bleeding – a concern that was highlighted in our recent research on patient perspectives.

Risk stratification prior to endovenous intervention is essential given the heterogeneity in VTE risk among individuals.[22] In 2020, the Venous Forum of the Royal Society of Medicine (RSMVF) issued guidelines aimed at assisting clinicians in determining VTE prophylaxis strategies for varicose vein procedures.[24] These guidelines classify patients into three risk categories: low-risk patients, for whom anticoagulation prophylaxis lacks conclusive evidence; patients at 'additional risk', who are likely to require

extended prophylaxis; and high-risk patients, who should receive extended prophylaxis.

In 2022 the ESVS introduced a Class I recommendation for individualised risk assessment for patients undergoing superficial venous intervention, along with a Class IIa recommendation for considering individualised prophylaxis.[4] However, it is important to note that this recommendation is based on two randomised controlled trials, one of which did not incorporate risk assessments while the other focused solely on moderate-risk patients.[25,26] Even on a global scale, guidelines remain somewhat ambiguous. The American Venous Forum (AVF) guidelines provide a Grade 2B recommendation for selective prophylaxis post-risk assessment.[27] They advise against thromboprophylaxis using LMWH, low-dose unfractionated heparin, or fondaparinux for patients without additional thromboembolic risk factors. This recommendation, however, references the American College of Physicians (ACP) guidelines,[28] which do not specifically address endovenous ablation procedures. Furthermore, the ESVS and RSMVF guidelines are contradicted by the current NICE guidelines, which state that VTE prophylaxis is generally not required for patients undergoing varicose vein surgery at low risk of VTE with a total anaesthesia time of <90 min.[10]

In the UK, the Department of Health Risk Assessment (DHRA) tool is used to stratify patients undergoing endovenous interventions for SVI and assess their VTE risk.[29] However, consultants perceive risk factors for VTE in this patient population that are not adequately captured by this tool.[13] Additionally, other risk assessment models, such as the widely-used Caprini RAM in Europe and the United States for varicose vein patients, have been reported to have limited predictive accuracy for VTE.[30] Hence, a validated preoperative risk assessment tool is needed to accurately stratify patients before endovenous interventions for SVI and ensure appropriate thromboprophylaxis based on their risk level.

Compared with previous reports,[9,13] there appears to be a rising trend among clinicians in choosing to abstain from the administration of pharmacological thromboprophylaxis for patients undergoing EVTA for SVI. Our findings suggest that this percentage has risen to 33%, whereas it stood considerably lower at 6.7% in 2019 and 5% in 2020. This is interesting, given the introduction of the ESVS recommendation in 2022 advising clinicians to consider individualised prophylaxis following a personalised risk assessment.[4] One possible explanation for this shift could be that clinicians are conducting more comprehensive risk assessments to identify patients less likely to require pharmacological thromboprophylaxis.[4] Additionally, financial considerations, including budget constraints, may be influencing these decisions, as the provision of pharmacological thromboprophylaxis and the management of potential anticoagulant side effects can incur significant costs. Further investigation is needed to determine whether there are any discernible trends regarding thromboprophylaxis administration based on the healthcare setting (NHS vs private).

KEY MESSAGES

- 67% of all respondents routinely prescribed pharmacological thromboprophylaxis to patients undergoing superficial endovenous treatment.
- Among those respondents who prescribed a single dose of anticoagulation peri-procedurally, LMWH was the most common.
- Grade A evidence is required to establish whether patients undergoing endovenous interventions benefit from pharmacological thromboprophylaxis.

Determining the true incidence of postoperative VTE in patients undergoing EVTA for SVI presents a formidable challenge, primarily due to the high heterogeneity observed in current study designs,[22] as noted in the literature. Consequently, there is currently a lack of consensus on this matter. While prevailing estimates place the incidence within a range of 0.51–3.2%,[31,32] some reports have even suggested an incidence as low as 0%.[33] Determining the true incidence of VTE in this patient population holds significant importance as it would not only facilitate the development of evidence-based guidelines that can adequately inform thromboprophylaxis practice but would also aid clinicians in assessing the overall risk associated with endovenous procedures and make informed decisions regarding VTE prophylaxis. The forthcoming THRIVE trial is also expected to contribute to addressing this important issue.[23]

Limitations

Although this survey gathered responses from various vascular centres across England and Northern Ireland, it is important to note the absence of responses from Scotland and Wales. Therefore, while this survey provides insights into the prevailing thromboprophylaxis practices in England and Northern Ireland, its ability to accurately reflect practices in Scotland and Wales remains questionable, possibly restricting the generalisability of the findings. It may be valuable to consider conducting a future iteration of this survey, with a focus on reaching out directly to specific regions in the UK and Ireland via email to enhance their representation. The relatively small overall sample size and reliance on self-reported data may also lead to selection bias, potentially further impacting the generalisability of the findings.

Conclusions

The results of this survey suggest that, in the UK, the prevailing practice for thromboprophylaxis following EVTA for SVI is a single perioperative dose of LMWH. There is, however, a range of practices in this regard, underpinned by a lack of clear high-quality evidence-based guidelines. Grade A evidence is therefore required to evaluate the potential benefits of pharmacological thromboprophylaxis within this specific patient population, thereby either validating or refuting the current

practices. Future research endeavours could involve conducting a similar survey to track the evolving trends in practice over time. Additionally, investigating whether disparities in practices exist between the NHS and the private sector would be valuable, aiming to discern whether the healthcare setting itself influences thromboprophylaxis practices.

Conflict of interest: AHD and DC (co-authors) are the Chief Investigator and Co-Chief Investigator of the NIHR-funded THRIVE (THRomboprophylaxis in Individuals undergoing superficial endoVEnous intervention) trial, which has been mentioned in this manuscript. MM, LB and SO are co-applicants on the THRIVE trial grant application.

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ORIGINAL RESEARCH

A quality improvement project on operative records

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Plain English Summary

Why we undertook the work: Clear and accurate notes taken during surgery are vital for providing patients' postoperative care and for legal purposes. The Royal College of Surgeons of England (RCSEng) stresses the importance of good documentation in medical practice to provide the highest level of patient care. To improve the quality of our surgical notes, we conducted an assessment and introduced an electronic system to replace handwritten notes. This change was prompted by issues like missing records, hard-to-read handwriting and incomplete instructions, which caused challenges for our nursing staff and doctors.

What we did: We conducted a review of our surgery records to improve their quality.
In the first review we checked records over specific periods and used a standard guideline for what should be included. To make things better, we talked to colleagues, put up posters and sent reminder emails. We then assessed our operative records after our interventions. In the second review we worked on an electronic template to replace handwritten notes. We made some changes based on feedback from surgeons and eventually implemented the electronic system for all.

What we found: In the first review we looked at 24 surgical notes before the intervention and 28 surgical notes after the intervention. We discovered that some important information was missing, such as the name of the anaesthetist, surgical findings and postoperative instructions. After making changes, there were improvements in the quality of the surgical notes. The description of the incision increased by 43%, specifying the diagnosis improved by 35%, and closure technique description improved by 8%. Postoperative instructions also got better by 10%. However, there are areas where we still need to work on documenting, such as postoperative venous thromboembolism instructions. In the second review we were able to create an electronic note template through multiple loops of feedback from other vascular surgeons in our unit. However, some surgeons found it challenging to use due to computer access and printing issues. We are currently working on improving access and encouraging everyone to embrace the benefits of electronic records.

What this means: We observed positive changes within our vascular unit through the implementation of a system for electronic operative records. More quality improvement projects should be done in the future to ensure compliance and improvement in the quality of the operative records and the barriers faced in this study have been solved.

Abstract

Introduction: In 2013 the Royal College of Surgeons of England (RCSEng) published a Standard of Good Practice for surgeons to adhere to in the UK. The guideline included the importance of legible documentation and what should be included in the operative notes. We conducted an audit and quality improvement project in our regional vascular unit in Northern Ireland which showed multiple elements of our operative records that could be improved, such as the documentation of deep vein thrombosis prophylaxis, antibiotic prophylaxis and the use of electronic operative records.

Methods: We organised an audit between 3rd and 16th October 2022 where operative notes were collected consecutively and analysed. Multifaceted interventions such as discussion with colleagues, reminder emails and the placement of guidelines around the vascular theatres were done. The second loop of audit was completed between 7th and 20th November 2022. After the audit, we underwent four cycles of Plan-Do-Study-Act (PDSA) where we designed and developed an electronic operative note template and linked it to our electronic records system within the Trust.

Results: A total of 24 and 28 operative records were collected, respectively, in the first and second loop of the audit. The majority of the domain showed improvement after the multifaceted interventions: for instance, the documentation of incision (from 46% to 89%), operative diagnosis (from 58% to 93%) and details of closure technique (from 92% to 100%). Through our PDSA cycles, an electronic operative note template was created and improved via feedback from the vascular surgeons. Logistic and IT issues were addressed and we are currently in the process of increasing the number of computers and printers around the vascular theatres. The Vascular Surgical Unit is currently slowly adapting to the use of electronic operative records.

Conclusion: Our work has improved the compliance of operative records with the RCSEng guideline and increased the use of electronic operative notes, which are more accessible and legible for our multidisciplinary team.

Key words: quality improvement, vascular, electronic health records, surgical procedures

Background

Accurate and legible operative notes are critical for providing high-quality postoperative care and they also serve a crucial role for medicolegal disputes.[1,2] The General Medical Council (GMC) has emphasised the importance of good documentation as part of good medical practice.[3] Additionally, the Royal College of Surgeons of England (RCSEng) has developed a guideline that contains recommendations on the content of operative notes and also encourages the use of electronic operative notes.[4] Various quality improvement studies have been done to evaluate the compliance and quality of operative notes with the RCSEng guideline, and there have been positive changes in their respective units.[1,5,6] The Vascular Surgical Unit in Northern Ireland is a tertiary centre with 10 vascular surgeons. In the unit, hand-written operative notes have traditionally been used. However, issues such as missing records, illegible handwriting and incomplete postoperative instructions have been reported, posing significant challenges to the nursing staff and doctors in our unit.

We aimed to evaluate and improve the quality of our operative notes by doing a closed loop audit. We also aimed to establish an electronic system for operative notes through the process of quality improvement via Plan-Do-Study-Act (PDSA) cycles.

Methods

Audit

In the closed loop audit study, the baseline measurements included the adherence to RCSEng guidelines on operative notes,[4] listed below:

- Date and time
- Elective/emergency procedure
- Names of the operating surgeon and assistant
- Name of the theatre anaesthetist
- Operative procedure carried out
- Incision
- Operative diagnosis
- Operative findings
- Any problems/complications
- Any extra procedure performed and the reason why it was performed
- Details of tissue removed, added or altered
- Identification of any prosthesis used, including the serial numbers of prostheses and other implanted materials
- Details of closure technique
- Anticipated blood loss
- Antibiotic prophylaxis (where applicable)
- Deep vein thrombosis prophylaxis (where applicable)
- Detailed postoperative care instructions
- Signature

A closed loop audit on the quality of our operative records was initially done from 3rd to 16th October 2022 and from 7th to 20th November 2022. We based the standard on the RCSEng guideline, which specified 18 elements that should be included in each operation note. For the first audit cycle we collected data over two weeks before implementing our intervention. The interventions included formal discussions with colleagues to highlight the RCSEng standard, placing posters in each of the operating theatres and sending a reminder to all of our department members via email. A further two-week period of data collection closed the audit loop.

Quality Improvement Project

We also conducted a quality improvement project that began on 21st November 2022 using the PDSA system. Each PDSA cycle was trialled for a month.

PDSA Cycle 1

Two of the 10 vascular surgeons used an electronic operative note template that was accessible via our local "Patient Centre" software system. After a month, the surgeons gave feedback regarding the ergonomics and accessibility of the electronic note template. Software problems and ergonomic issues with the template were highlighted and it was decided to change software and modify the template.

PDSA Cycle 2

A new template was designed with the help of the Urology Department which provided us with their electronic operative notes for reference. The new template could be saved as a PDF file and directly uploaded to our more modern intranet-based Northern Ireland Electronic Care Record (NIECR) system. Two surgeons evaluated this system for a month and felt that it was effective. We proceeded to roll it out to the whole unit.

PDSA Cycle 3

The remaining eight vascular surgeons in the unit gave feedback on the content of the template and amendments were made to it. The revised electronic template was made available to all surgeons in our unit and it became the recommended method of creating operative notes; however, compliance with the new system remained a challenge. The barriers to compliance were mainly the prolonged time needed to type and a lack of computers and printers within the operating theatres.

PDSA Cycle 4

This cycle is currently underway and involves enhancing access to computers and printers by liaising with the IT department and continually emphasising the benefits of electronic records to our colleagues in order to enhance compliance.

Figure 1 Findings that showed improvement between first and second loops

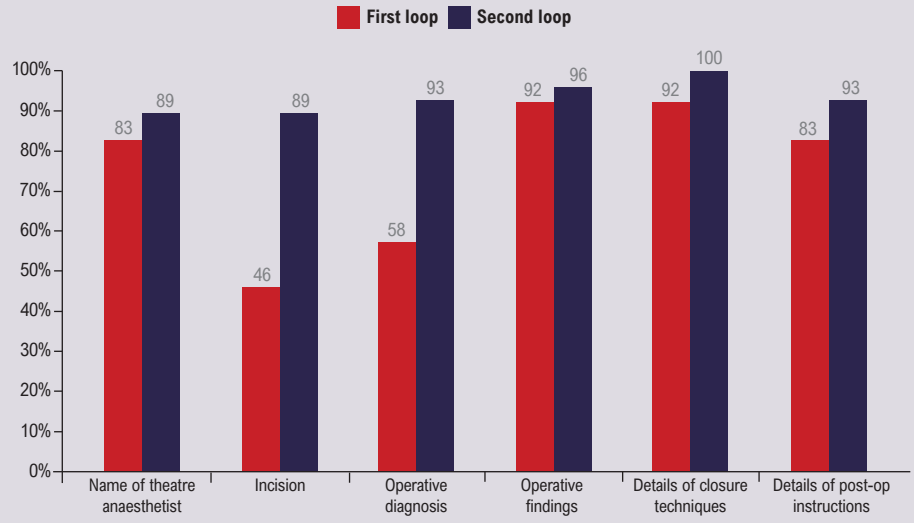
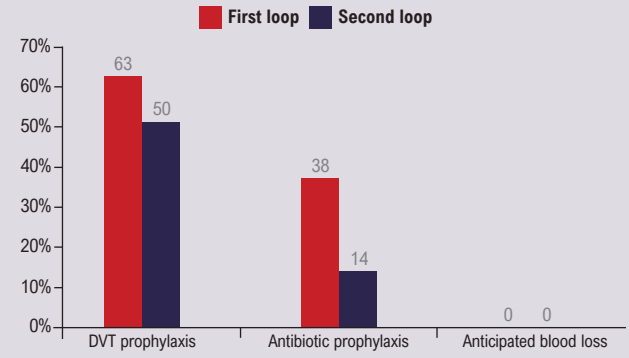


Figure 2 Findings that showed regression or no improvement between first and second loops



Results

A total of 24 and 28 operative records were collected, respectively, in the first and second loops of the audit. The first loop audit study showed all operative notes contained date and time, names of surgeons, details of operative procedure, descriptions of tissue removed, identification of prosthetics, and surgeon's signature. After the intervention, several areas showed improvement. There was a 6% increase in the documentation of the name of the anaesthetist (from 83% to 89%), a 43% increase in the description of the incision (from 46% to 89%), a 35% increase in specifying the operative diagnosis (58% to 93%), a 4% increase in operative findings, an 8% increase in closure technique description (from 92% to 100%) and a 10% increase in the documentation of postoperative instructions (from 83% to 93%) (Figure 1). There was a decrease in deep vein thrombosis and antibiotic prophylaxis documentation of 13% (from 63% to 50%) and 24% (from 38% to 14%), respectively (Figure 2). There was no documentation of anticipated blood loss in either cycle. No operative notes were fully compliant with the RCSEng guideline in either loops. We measured the proportion of completed domains out of the 18 elements included in the RCSEng guideline, gave each operative note a score and calculated the average score for each loop. There was an improvement in the mean operative note score after the intervention from 61% (11/18) to 66% (12/18) (Table 1).

In our quality improvement project we have been able to establish an electronic operative note system effectively and responsibly by using the PDSA system. The vascular surgeons in our unit have provided positive feedback during our monthly clinical governance meeting regarding the latest version of the electronic operative notes.

Discussion

The aim of this study is to improve the quality of operative notes according to the RCSEng guideline. Our initial audit showed there was poor documentation and compliance with various elements of the RCSEng guideline, such as incision type and operative

Table 1 Findings between first and second loop of audit

	First loop	Second loop
Date and time	24/24 (100%)	28/28 (100%)
Elective/emergency procedure	1/24 (4%)	0/28 (0%)
Names of the operating surgeon and assistant	24/24 (100%)	28/28 (100%)
Name of the theatre anaesthetist	20/24 (83%)	25/28 (89%)
Operative procedure	24/24 (100%)	28/28 (100%)
Incision	11/24 (46%)	25/28 (89%)
Operative diagnosis	14/24 (58%)	26/28 (93%)
Operative findings	22/24 (92%)	27/28 (96%)
Any problems/complications	7/24	1/28
Any extra procedure performed and the reason why it was performed	1/24	0/28
Details of tissue removed, added or altered	13/13 (100%)	10/10 (100%)
Identification of any prosthesis used, including the serial numbers of prostheses and other implanted materials	13/13 (100%)	10/10 (100%)
Details of closure technique	22/24 (92%)	28/28 (100%)
Anticipated blood loss	0/24 (0%)	0/28 (0%)
Antibiotic prophylaxis	9/24 (38%)	4/28 (14%)
DVT prophylaxis	15/24 (63%)	14/28 (50%)
Detailed postoperative care instructions	20/24 (83%)	26/28 (93%)
Signature	24/24 (100%)	28/28 (100%)

diagnosis. The multi-faceted intervention between the first and second loops improved compliance with the RCSEng guideline, where documentation of operative diagnosis and closure techniques was 58% and 92%, respectively, pre-intervention and 93% and 100%, respectively, post-intervention. Furthermore, we designed and continuously update the new electronic operative notes through feedback from other vascular surgeons. Integrating the template to the local NIECR system allowed better access to operative notes for other healthcare colleagues such as general practitioners and nursing staff. The limitation of this study is the short time period of data collection and PDSA cycle, and a further quality improvement project should be repeated to assess compliance of the new electronic operative notes with the RCSEng guideline. There are still barriers to using our electronic operation note system including inadequate access to computers and printers in theatres. The latest version of the electronic template is in use and we are liaising with our IT department to provide more computers near the vascular theatres.

KEY MESSAGES

- Implementation of electronic operative notes improved the quality of operative notes according to the Royal College of Surgeons of England guidelines.
- Barriers to compliance with the electronic operative note system include lack of access to computers and printers in the vascular theatre.
- Future cycles of the audit and quality improvement project should be done to assess the compliance and quality of vascular operative notes.

Conclusion

Our work has improved accessibility and legibility of operation notes for nursing and medical staff. We have met the aim of this study to improve compliance and record keeping of operative notes. More quality improvement projects should be done in the future to ensure compliance and quality of the operative records improves and the barriers faced in this study have been solved.

Conflicts of interest: None.

Ethical approval: This study did not involve human subjects. Ethical approval was not needed for this project.

Acknowledgement: We would like to thank Mr David Curry for providing us with guidance on designing the electronic operative note template.

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ORIGINAL RESEARCH

Exploring the assessment, diagnosis and conservative management of patients with neurogenic thoracic outlet syndrome (NTOS): an online survey of UK medical and allied health professionals

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Plain English Summary

Why we undertook the work: Neurogenic thoracic outlet syndrome (NTOS) is challenging to recognise and manage. While exercise and physiotherapy is widely recommended as the first-line treatment for NTOS, it is not clear what exercises should be performed, what the role of physiotherapy is, and which people will benefit from it. We therefore aimed to explore the experiences and opinions of UK therapy and medical professionals regarding their practices with people with NTOS.

What we did: An online survey was created and shared through email and social media and participants were encouraged to share with others who may be interested. The survey remained active for 4 weeks and targeted healthcare professionals with experience of treating NTOS, ending May 2023.

What we found: Forty-six of 55 (83.6%) responses were used in the results. The majority worked in the NHS, with 41% (16/39) specialising in nerve teams, and most (58.7%, 27/46) had over 10 years of experience treating NTOS. Key findings included: NTOS assessment (performed by ≥91%) involved clinicians asking patients about their complaints and what conditions made them better/worse, looking at neck and shoulder movements, checking their reflexes, strength and feeling of their arms, and assessing a patient's understanding of NTOS. Physiotherapy treatment (provided by ≥94%) consisted of advice and education to assist patients to manage their condition by providing them with exercises to increase the flexibility of the neck, shoulder and back. Three-quarters (76.1%, 35/46) of respondents reported an absence of treatment guidelines for NTOS, and 98% (45/46) expressed the need for further research into exercise and physiotherapy management for NTOS.

What this means: Clinicians feel NTOS is a complex condition that lacks treatment guidelines which could assist them in providing better care to patients. Physiotherapy remains highly recommended in current treatment pathways. Further research to understand what exercises should be provided to people with NTOS, and which people will benefit from them, would be beneficial.

Abstract

Objective: Neurogenic thoracic outlet syndrome (NTOS) is challenging to diagnose and manage. While physiotherapy is widely recognised as the primary treatment for NTOS, treatment specifics and target populations are poorly described. The objective of this cross-sectional survey was to explore the experiences and opinions of UK therapy and medical professionals regarding the assessment, diagnosis and physiotherapy management of patients with NTOS.

Methods: An online survey was distributed through a multimodal recruitment strategy employing snowball sampling. The survey remained active for 4 weeks and targeted healthcare professionals with experience of treating NTOS, ending May 2023.

Results: 46/55 (83.6%) responses were deemed eligible for analysis. 84.7% (39/46) worked in the NHS, with 41% (16/39) specialising in multidisciplinary team nerve services and most (58.7%, 27/46) having >10 years of experience treating NTOS. Key findings included: NTOS assessment (performed by ≥91%) involved taking a subjective history, evaluating cervical and

shoulder active range-of-motion, upper limb neurological screening and assessing the patient's understanding of NTOS. Physiotherapy treatment (provided by ≥94%) consisted of advice and education, range of motion exercises for the shoulder, cervical and thoracic regions, postural advice, activity modification and a home exercise plan. Three-quarters (76.1%, 35/46) of respondents reported an absence of treatment guidelines for NTOS, and 98% (45/46) expressed the need for further research into exercise and physiotherapy management for NTOS.

Conclusion: While clinicians perceive NTOS as a complex condition lacking treatment guidelines, physiotherapy remains a mainstay in the current treatment pathways. Further research is warranted to enhance the understanding of NTOS and develop evidence-based management strategies.

Key words: thoracic outlet syndrome, physiotherapy, rehabilitation, peripheral nerve, survey, assessment

Introduction

Thoracic outlet syndrome (TOS) is a highly controversial medical diagnosis, as highlighted in a Cochrane review by Povlsen *et al* in 2014.[1] Diagnosis is challenging due to the existence of four reported subgroups of TOS – namely, neurogenic, arterial, vascular and disputed – each presenting with diverse and wide-ranging symptoms.[1–3]

Authors describe three pertinent anatomical spaces of compression in TOS: the scalene triangle, costoclavicular and subcoracoid spaces.[2–5]

TOS is believed to be caused by congenital, acquired or traumatic factors, which subsequently create a compromised space for neurological/vascular structures to pass through. Neurogenic TOS (NTOS) refers to an assumed dynamic positional compression of the brachial plexus,[6] which can present with an array of symptoms including neck/shoulder/arm pain, paraesthesia and weakness often exacerbated by repetitive overhead motions (occupational or recreational), and can lead to significant functional disabilities.[2,3,5,7]

NTOS stands out as the most elusive in terms of definition and diagnosis, often being referred to as a 'diagnosis of exclusion'.[2,8] Consequently, conducting studies that possess methodological homogeneity becomes exceedingly challenging.

Since the Cochrane review in 2014,[1] considerable progress has been made in the field of TOS. An agreed clinical diagnostic criterion (CDC) by Thompson in 2016 provided a standardised framework for identifying and diagnosing TOS.[9] Validation of these criteria against Patient Reported Outcome Measures (PROMs) has been completed.[10] Furthermore, standardised reporting standards have been published by the Society of Vascular Surgeons (SVS) to encourage increased homogeneity of care through consistent reporting of TOS cases.[11] However, it is unclear whether healthcare professionals are aware of these guidelines and are using them to support the management of NTOS.

Physiotherapy management and efficacy

Many papers refer to physiotherapy as a 'mainstay' of treatment.[5] However, the descriptions of physiotherapy programmes are often insufficient, providing only brief summaries that are difficult to reproduce.[12] Various papers state the aim of physiotherapy is to: 'improve postural alignment',[3,4,13] 'improve scapular control/stabilisation'[7,14,15] along with 'strengthening and lengthening exercises for the shoulder girdle muscles'.[3–5,7,15]

A recent publication by Goeteyn *et al* in 2022 marked the first randomised clinical trial (STOPNTOS) comparing continued physiotherapy with surgery for persistent NTOS, which was refractory to change with physiotherapy.[7] Details of the physiotherapy regime for patients in this study were directed to previously published reviews.[14,16] Although these reviews comprehensively describe a scapular stabilisation programme starting at rest and building through range, they document evidence of the programme's effectiveness is anecdotal and not specifically linked to NTOS. They also acknowledged the need for high-quality research to determine the most effective conservative management strategies for individuals with NTOS. In the recent STOPNTOS trial,[7] statistically significant differences in outcomes were reported favouring surgical intervention over continued physiotherapy in 50 randomised patients with persistent NTOS. It should be noted that the characteristics of patients who did respond favourably to physiotherapy were not described in this study.

The literature on the efficacy of physiotherapy in NTOS suggests that for many patients it is ineffective as, despite receiving physiotherapy treatment, a considerable proportion of patients (60–70%) still require surgical intervention.[6,10,15] Additionally, it should be stated that currently, due to lack of standardisation of the assessment and treatment of NTOS, some patients may not respond to treatment for NTOS because the diagnosis may be incorrect.

There are two prospective studies in which a proportion of NTOS patients did respond favourably to conservative management and did not require surgery.[10,15] Both studies used the CDC and SVS reporting guidelines to diagnose and classify their cohorts. 27% (40/150) of NTOS patients improved sufficiently with specific physiotherapy, with mean QuickDASH percentage change of 29.5±5.7%. Within this study,[10] conservative treatment consisted

of 4–6 weeks of stretching and 'relaxing' exercises for scalene and pectoralis muscles, along with shoulder girdle and scapular mobility, postural advice and breathing exercises. Mean follow-up for the physiotherapy group was 21.1 months. The remaining 60% of patients (90/150) did not respond sufficiently and underwent surgery, and achieved a higher percentage change in QuickDASH scores (47.9±3.6%).[10] Although not statistically significant, the patients who responded to therapy versus those requiring surgery trended towards having less severe symptoms at baseline.[10]

Unfortunately, in the other study,[15] the 39.1% (186/476) of patients who were reported to respond effectively to physiotherapy and did not require surgery did not have their characteristics described or receive any follow-up visits. This limits the conclusions that can be drawn. Although characteristics were not described, the authors did state that physiotherapy was conducted for 6–12 weeks and consisted of 'posture evaluation', 'scapular mobility' and 'shoulder girdle therapy'.

The current survey aims to address this gap by investigating practices among UK medical and allied health professionals (AHPs) regarding the assessment, diagnosis and physiotherapy management of people with NTOS.

Methods

Survey design and development

An online anonymous cross-sectional descriptive survey was used. Survey questions were piloted independently by four of the authors' clinical colleagues. Ethical oversight and governance was granted by Keele University (REC- 0472 30/03/2023). The survey was designed and reported using the Checklist for Reporting Results of Internet E-surveys (CHERRIES).[17]

Study population

Respondents met the inclusion criteria if they were either a medical professional (surgeon or medical doctor) or registered AHP based in the UK with experience of caring for patients with NTOS.

Invitation and consent

The survey was hosted on the Microsoft 365 online platform via Microsoft Forms (www.office.com). A multimodal recruitment strategy was used to promote the survey via email, Twitter, the interactive Chartered Society of Physiotherapy (iCSP) website (http://www.csp.org.uk/icsp) and via the authors' professional networks, including the British Association of Hand Therapists (BAHT) and the British Society for Surgery of the Hand (BSSH) membership. Peer-to-peer snowball sampling was encouraged. This method of sampling has been previously employed in other studies using online surveys.[18]

The survey opened for 4 weeks, closing on 2 May 2023 due to similar studies using this timeframe.[19] Respondents were directed to an online information sheet outlining the purpose of the study, and provided assurances of anonymity and that completion was voluntary. Consent was assumed based on submission of the survey and this was explicit in the information sheet. Contact details and processes for outlining any concerns regarding the study were made explicitly clear. Confirmation of eligibility was required prior to commencing the survey. Ineligible responders were unable to

Table 1 Characteristics of survey respondents.

		n	%
Profession (n=46)	Therapist	33	71.7
	Physiotherapist	32/33	96.9
	Occupational therapist	1/33	3.1
	Medical professional	13	28.3
	Surgeon	12/13	92.3
	Medical doctor	1/13	7.7
Grade (medical) (n=13)	Consultant	13	100
Grade (therapist) (n=33)	Band 6	2	6.1
	Band 7	11	33.3
	Band 8a	11	33.3
	Band 8b	3	9.1
	Not applicable	6	18.2
Primary area of work (n=46)	NHS	39	84.7
	Specialist MDT nerve unit	16/39	41
	Acute hospital	15/39	38.4
	District general hospital	2/39	5.1
	Primary care	6/39	15.4
	Private practice	6	13.1
	Other	1	2.2
Geographical area of work (n=46)	England	40	87.0
	South West	1/40	2.5
	South East	1/40	2.5
	London	8/40	20.0
	East	2/40	5.0
	East Midlands	5/40	12.5
	West Midlands	18/40	45.0
	North West	3/40	7.5
	North East	1/40	2.5
	Scotland	4	8.7
	Wales	2	4.3

Table 2 Respondents' clinical experience of neurogenic thoracic outlet syndrome (NTOS)

		n	%
Clinicians' years of experience assessing/ treating NTOS (n=46)	0–4 years	5	10.9
	5–9 years	14	30.4
	10–14 years	10	21.7
	15+ years	17	37.0
Estimated number of NTOS patients experience assessed/ treated per year (n=46)	<12 (<1 per month)	21	45.7
	12–24 (1–2 per month)	9	19.6
	25–36 (2–3 per month)	6	13.0
	37–48 (3–4 per month)	7	15.2
	50–99	2	4.3
	>100	1	2.2

proceed. The survey had to be completed in one sitting, with no function to partially save and return to complete at a later date.

Survey questionnaire

The survey's primary aim was to explore AHP and medical professionals' experience and opinions of the assessment, diagnosis and physiotherapy management of people with NTOS.

Thirty-five closed-style questions were asked with a combination of response options including dichotomous yes/no answers, multiple choice, 5-point Likert scales and free-text options.

The Likert scales ranged from 'never' to 'always' to describe the clinician's frequency of use of certain diagnostic, assessment or physiotherapy treatments. To aid readability, and in conjunction with a similar survey,[20] the respondents who selected 'always' or 'sometimes' have been combined to describe the most selected components. All future references to 'commonly' refer to this.

Data analysis

Data were imported into Excel (Microsoft Corps, Redmond, CA, USA) and analysed using descriptive statistics. The authors used a threshold of ≥70% of similar responses to indicate consensus, due to this threshold level being used in large consensus studies.[21]

Results

Survey response and characteristics

In the 4 weeks during which the survey was live there were 55 responders, of whom 46 (83.6%) indicated they met the survey's inclusion criteria. 71.7% (33/46) were therapists, the vast majority being physiotherapists (32/33). Surgeons (92.3%, 12/13) were the most common medical professional to respond. 84.7% (39/46) of respondents worked within the NHS, with 41% working in specialist MDT Nerve Units (Table 1).

Clinical experience of NTOS

58.7% (27/46) of respondents had more than 10 years of clinical experience treating people with NTOS, with 54.3% (25/46) stating they saw at least 1–2 people with NTOS per month (Table 2).

NTOS diagnosis

91.4% of respondents (42/46) indicated that nerve conduction/electromyography studies were the most common diagnostic investigation used compared with 84.8% (39/46) for chest/cervical plain x-ray and 82.6% (38/46) for brachial plexus magnetic resonance imaging. Targeted injections into scalene/pectoralis minor as part of a diagnostic work-up were 'sometimes' used by 43.5% (20/46) of respondents (Figure 1).

Implementation of published literature in NTOS in UK practice

Only 36.9% (17/46) of respondents stated that they used the CORE-TOS Clinical Diagnostic Criteria developed by Thompson,[9] whereas 50% (23/46) either were 'unaware' or 'never' implemented it. Additionally, 56.6% (26/46) of respondents stated they were not aware or 'never' used the TOS reporting standards developed by Illig *et al*,[11] although 26.1% used them commonly (Figure 2).

Clinical assessment of NTOS

Commonly used assessment components (>70% of respondents)

All clinicians reported that taking a comprehensive subjective history was commonly part of the assessment. High agreement (≥91%) of common use was also achieved for 'cervical range of motion (ROM)', 'upper limb neurological screening', 'shoulder ROM', 'establishing the patient's understanding of NTOS', and the use of 'clinical tests such as Adson's/EAST/Roos' (Figure 3).

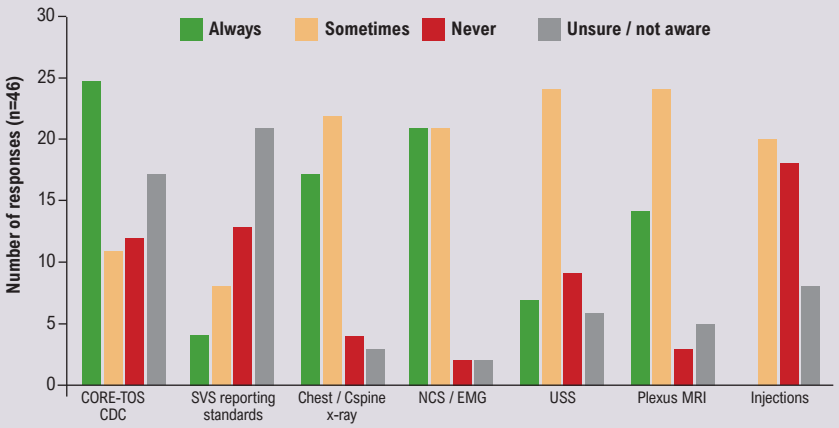
Less commonly used assessment components (<70% of respondents)

Six assessment components were reported by less than 70% of respondents of being performed at least 'sometimes'. These were: 'Tinel sign' (67%, 31/42), 'specific muscle length assessment' (65%, 30/46), 'specific upper limb strength measures' (65%, 30/46), 'breathing assessment' (44%, 20/46) and both 'vertebrae' and 'first rib' mobilisations (both 39%, 18/46).

Comparison of AHPs' and medical clinicians' responses

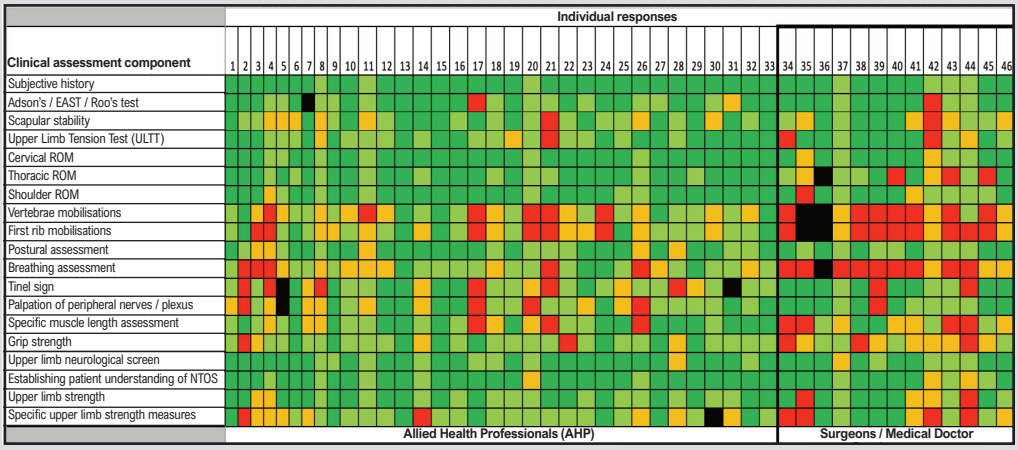
Figure 4 provides a visual representation of the responses for clinical assessment based on the profession of the respondents. The largest percentage differences in responses favouring regular AHP use were observed in 'breathing assessment' (61%, 20/33 vs 0/13), 'grip strength' (54%, 28/33 vs 4/13), 'first rib mobilisations' (53%, 18/33 vs 0/13), 'thoracic ROM' (46%, 33/33 vs 7/13), 'vertebrae mobilisations' (44%, 17/33 vs 1/13) and 'specific upper

Figure 1 Respondents' frequency of use for diagnostic purposes in neurogenic thoracic outlet syndrome (NTOS).



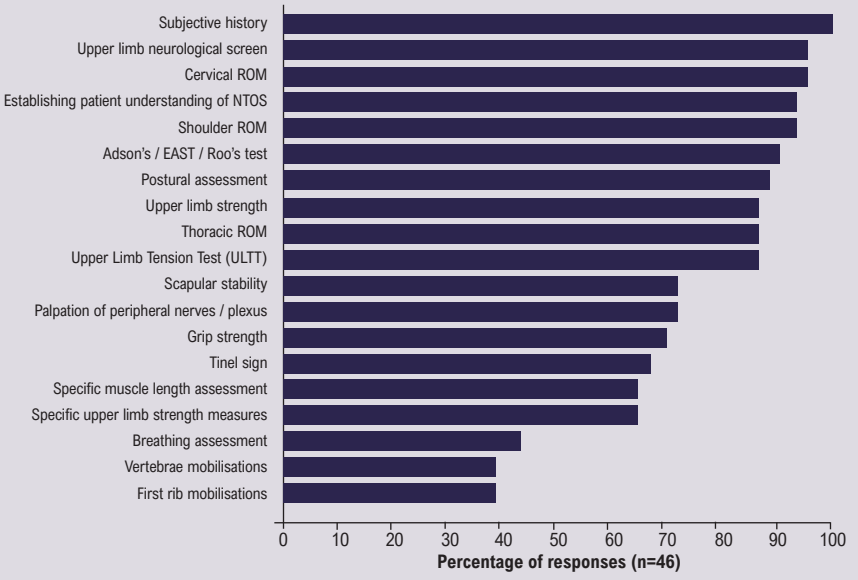
CORE-TOS CDC, CORE Thoracic Outlet Syndrome Group Clinical Diagnostic Criteria; SVS, Society of Vascular Surgeons; NCS/EMG, nerve conduction studies/electromyography; USS, ultrasound scan.

Figure 2 A Visual individual Likert data (VILD) chart for frequency of use of clinical assessment components in patients with neurogenic thoracic outlet syndrome (NTOS).



Key: dark green, always; light green, sometimes; amber, rarely; red, never; black, unaware of option.

Figure 3 Percentage of assessment components in neurogenic thoracic outlet syndrome (NTOS) commonly used ('always' or 'sometimes').



limb muscle length assessment' (37%, 25/33 vs 5/13). Conversely, medical professionals favoured the use of 'palpation of peripheral nerves/brachial plexus' (31%, 13/13 vs 20/33) and 'Tinel sign' (24%, 11/13 vs 20/33) more frequently than their therapy counterparts.

Physiotherapy and NTOS

Triage of NTOS referrals to grade of therapist and justification

Over three-quarters of respondents (76.1%, 34/46) indicated that NTOS patients are triaged to either a highly specialised NTOS therapist or an experienced therapist within musculoskeletal specialty. Respondents were also asked their justification for why NTOS patients were referred to a particular grade of therapist (Figure 5). 82.6% (38/46) indicated that 'overall clinical complexity' was the main justification. Additionally, difficulty with assessment (47.8%, 22/46), diagnosis (43.5%, 20/46) and management of patient expectations (41.3%, 19/46) were indicated.

Timeframe, measuring response to physiotherapy and outcomes of physiotherapy informing future management

When asked about the period that patients with NTOS should engage in therapy, between 3 and 6 months was the most prevalent answer (45.7%, 21/46) (Figure 6).

In terms of interpreting the response of patients with NTOS to physiotherapy, there was a mixed response to the use of PROMs or specific objective markers. The vast majority (89.1%, 41/46) indicated that response to therapy was measured 'subjectively via patient/therapist'.

Changes to specific NTOS objective tests such as EAST, Adson's and ULTT, and changes in NTOS-specific PROMs (QuickDASH, Cervical Brachial Symptom Questionnaire, TOS Disability Questionnaire, etc) were indicated to be used in a minority of respondents with 36.9% (17/46) and 26.1% (12/46), respectively.

Physiotherapy treatment guidance for NTOS

Over three-quarters of respondents (76.1%, 35/46) indicated that there were no guidelines or protocol for their physiotherapy treatment for patients with NTOS.

Physiotherapy treatment package components

The frequency of use of physiotherapy treatment components for NTOS are presented visually in Figure 7.

Provision of 'advice and education', a 'home exercise plan' and 'thoracic ROM exercises' were reported by 100% (33/33) of therapists as being commonly used as part of their treatment package. There was also high agreement for the use of 'cervical ROM exercises' and 'postural advice' (both 97%, 32/33), 'shoulder ROM exercises' and 'activity modification' (both 94%, 31/33).

Figure 4 Comparison of therapy and medical professional's common use ('always' or 'sometimes') of assessment components in neurogenic thoracic outlet syndrome (NTOS).

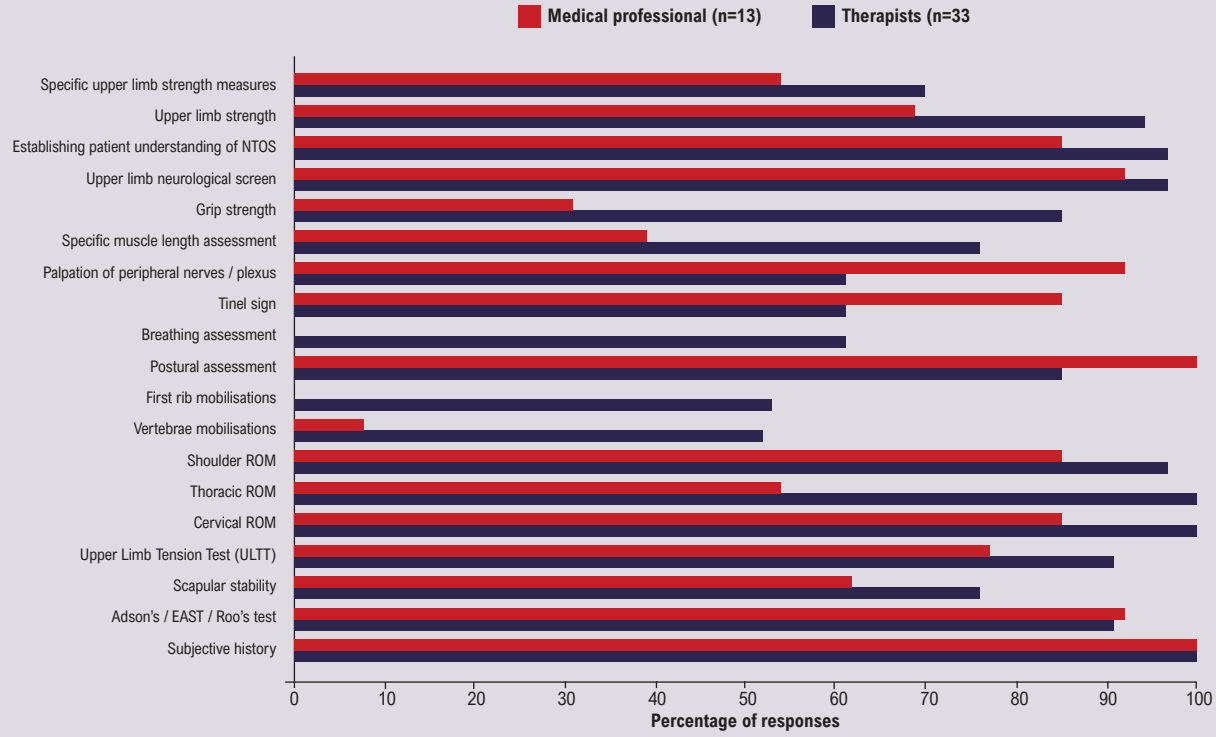
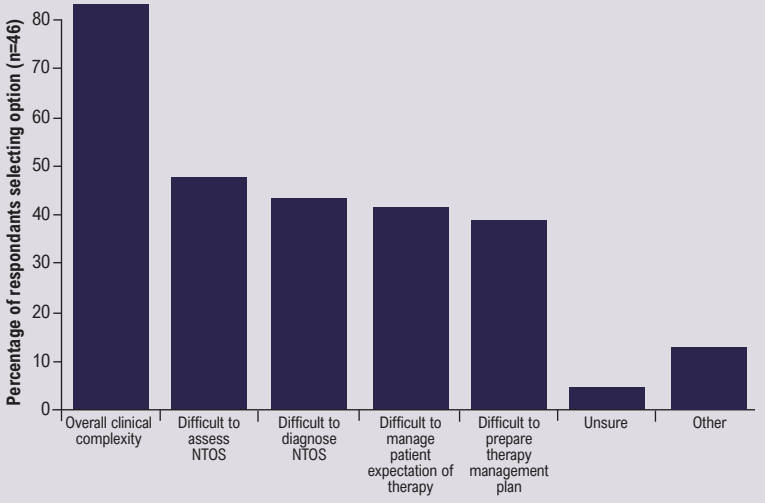


Figure 5 Respondents' justification of physiotherapy triage process (n=46).



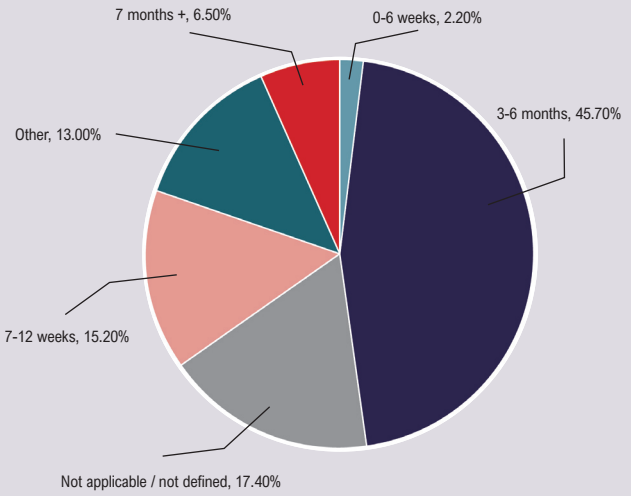
Six other treatment components were reported by ≥70% of respondents as being commonly used (see Figure 8 for further details). Seven components received less than 70% agreement for commonly being part of a physiotherapy package for NTOS, with 'acupuncture' and 'provision of equipment/braces' having the lowest use at 15% (5/33).

Factors associated with a positive response to physiotherapy and overall physiotherapy rationale in NTOS management

Clinicians' thoughts on what factors may influence a positive response to physiotherapy in the management of NTOS are presented in Figure 9. A high level of 'patient understanding' (82.6%, 38/46) and patients having 'belief in a positive response to therapy' (73.9%, 34/46) received the highest gradings of being 'extremely important'. Additionally, 52.2% (24/46) of respondents felt it was 'extremely important' to receive specialist therapy from an experienced NTOS clinician to promote a positive response to therapy.

Clinicians were also asked what they thought was the 'overall rationale' for the role of physiotherapy in the management of patients with NTOS (Figure 10). 'Improving patient understanding' (78.3%, 36/46) and building an 'effective therapist–patient therapeutic relationship' (73.9%, 34/46) were deemed 'extremely likely to be relevant'. 'Improving neural mobility' had the lowest proportion of clinicians feeling it was 'extremely likely to be relevant' to the overall rationale of physiotherapy in NTOS management (28.3%, 13/46), whereas 'increasing ROM in specific areas' such as the scalene

Figure 6 Amount of time a patient with neurogenic thoracic outlet syndrome (NTOS) completes physiotherapy until they are deemed 'non-responsive'.



triangle/pectoral space received the most responses of being 'unlikely to be relevant' (13%, 4/46).

Future research into exercise for NTOS

Finally, when clinicians were asked whether they thought further research into exercise/physiotherapy management of NTOS patients would be beneficial, 98% (45/46) stated 'Yes'.

Discussion

This paper reports the findings of a cross-sectional survey of UK AHPs and medical professionals concerning the assessment, diagnosis and physiotherapy management of NTOS.

Main findings

Assessment

A comprehensive subjective assessment of NTOS was commonly undertaken by all clinicians who responded. This was most frequently (87%, 40/46) complemented with assessment of ROM (cervical, thoracic and shoulder), posture, upper limb strength and neurological screening; NTOS clinical tests (Adson's, EAST/Roos, ULTT) and establishing a patient's understanding of NTOS. Vertebrae/first rib mobilisations were rarely used as an assessment modality (39%, 18/46).

Medical professionals favoured the use of peripheral nerve palpation and the Tinel sign compared with therapists. The Tinel sign can be used to evaluate nerve compression, injury or regeneration, although its validity for use in NTOS is unknown.[22]

Implementation of published literature in NTOS in UK practice

In recent years, studies have attempted to address the heterogeneity of NTOS reporting by producing standardised reporting guidelines,[11] with the aim of being able to reliably compare interventions for NTOS. However, according to this survey's responses, these guidelines have not translated into UK practice to the extent they may have in the Netherlands where there have been multiple recent prospective studies.[7,15,23] If higher quality research examining the management of NTOS in the UK is to be published, this needs to be addressed again. A UK TOS Registry[24] has been mooted but has not come to fruition at the time of publication.

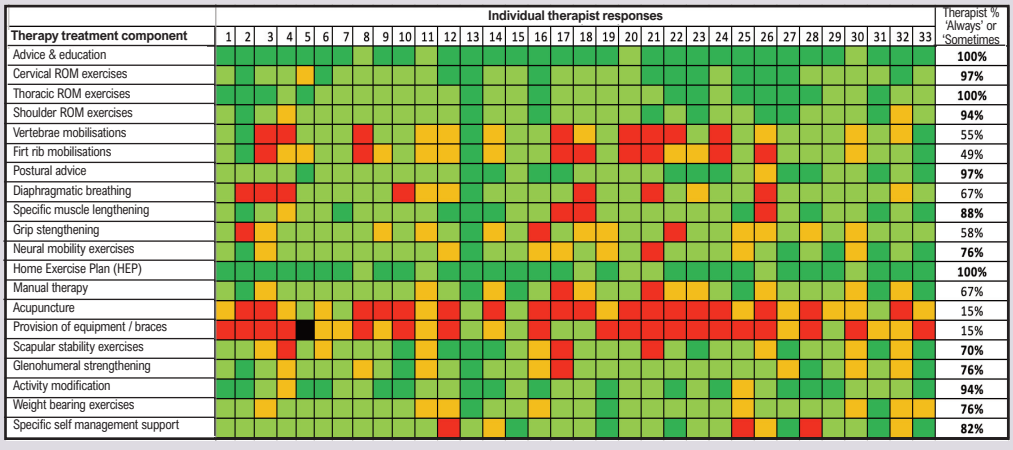
Although most respondents of this survey were not using or were not aware of the reporting standards or CDC for NTOS, the clinicians did indicate they were using many of the reporting standards' recommended assessment components for NTOS, with a high use of clinical tests such as Adson's, EAST and ULTT.

Physiotherapy treatment times and evaluation

The respondents of this survey echo other published literature that NTOS is a highly complex condition to both assess and treat.[1,2] The majority stated that a highly specialised/experienced clinician was needed to treat these patients due to the overall clinical complexity.

The timeframe for NTOS patients receiving physiotherapy before it is deemed non-responsive in the literature is variable. Studies in the USA[6,10] opt for shorter bursts of therapy compared with that reported in this survey (3–6 months), likely reflecting our different healthcare models. The majority (89.1%, 41/46) of respondents reported that a patient's response to

Figure 7 A Visual individual Likert data (VILD) chart for frequency of use of physiotherapy treatment components in patients with neurogenic thoracic outlet syndrome (NTOS).



Key: dark green, always; light green, sometimes; amber, rarely; red, never; black, unaware of option (AHP respondents only).

Figure 8 Percentage of physiotherapy treatment components commonly used ('always' or 'sometimes') in neurogenic thoracic outlet syndrome (NTOS) (AHP respondents only n=33).

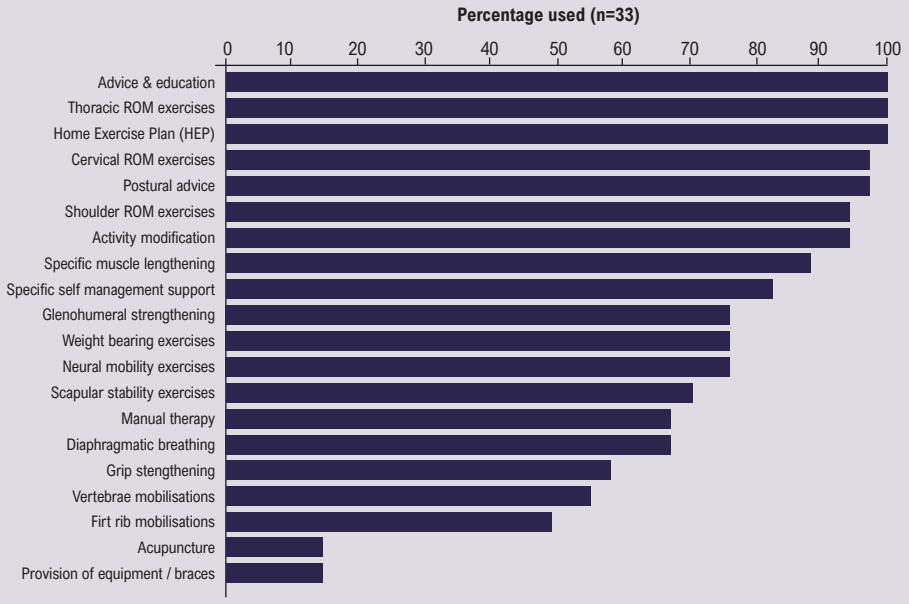
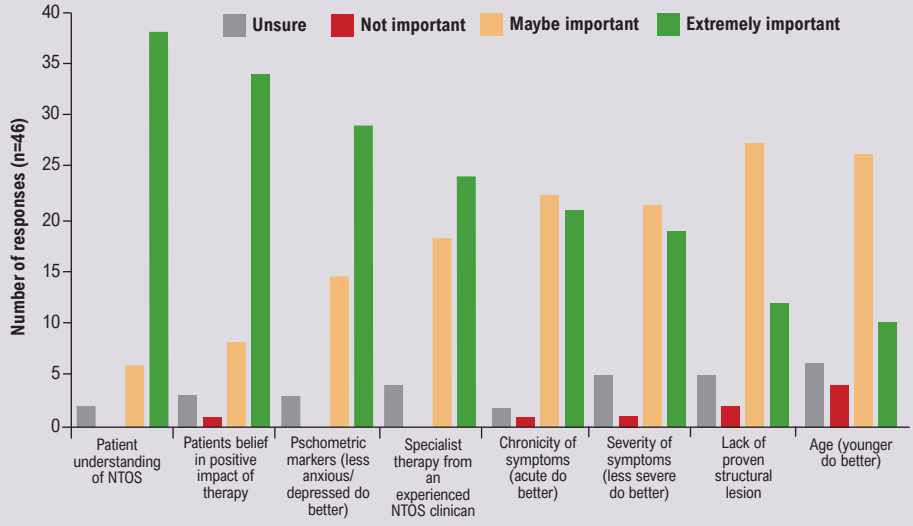


Figure 9 Factors associated with a positive response to physiotherapy in neurogenic thoracic outlet syndrome (NTOS) patients (all respondents).



physiotherapy is measured through subjective questioning by the clinician, rather than using PROMs or objective clinical signs. The use of validated outcome measures to monitor patients' progress has been recommended in best practice care.[25] Three-quarters of responders also indicated that they have no local guidelines for treating NTOS, which may highlight the clinical uncertainty in NTOS.

Physiotherapy treatment

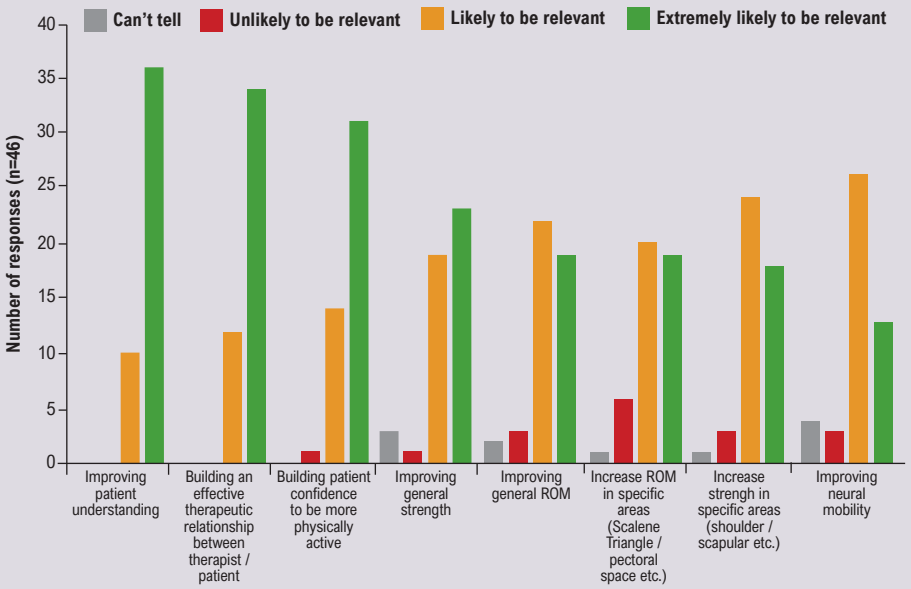
AHP respondents indicated that they most commonly prescribe interventions to aid and support self-management of NTOS. Advice and education, postural advice, activity modification, specific self-management support and a home exercise plan were all commonly provided more than 70% of the time. Additionally, exercises to improve ROM (shoulder, thoracic and cervical spine), glenohumeral strengthening, neural mobility and specific muscle lengthening (scalene and pectoralis minor) exercises were all commonly used by >70%.

Respondents indicated less common use (<55%) of 'passive' interventions such as acupuncture, provision of equipment and manual therapy/vertebrae mobilisations. This may be due to a general trend of moving away from hands-on therapy, with recent National Institute for Clinical Excellence (NICE) guidelines for back pain removing the recommendation of isolated manual therapy and acupuncture for common care.[26]

Therapists indicated that the level of a patient's understanding of NTOS, along with their belief in a positive therapy outcome and having fewer psychosocial markers, may be correlated with a more favourable outcome for NTOS. These results align with a longitudinal cohort study of 1030 patients with shoulder pain[27] and may be important if further work investigating clinical prediction rules for NTOS are conducted.

Clinicians felt the overall rationale for physiotherapy in the management of NTOS was more likely concerned with educating and coaching patients to assist with general improvements in physical activity, ROM and strength, rather than attempting to elicit specific muscle length, strength or neural mobility changes. Despite this, most clinicians in this survey reported that they provided both neural mobility (76%, 25/33) and specific muscle lengthening (88%, 29/33) exercises as part of their common treatment for NTOS. This highlights and mirrors both the uncertainty of rehabilitation for NTOS and wider musculoskeletal conditions, with studies arguing both for and against the effectiveness of region-specific exercises over general exercises in conditions such as spinal pain and knee osteoarthritis.[28,29]

Figure 10 Respondents' view on the overall rationale for physiotherapy in the management of neurogenic thoracic outlet syndrome (NTOS) (all respondents).



that now is the right time to build on this evidence base and lay the foundations for work in other contentious areas within the management of NTOS, such as the development of a consensus approach to physiotherapy management.

Limitations

Although the authors acknowledge that this is a small sample of clinicians, we feel the spread of clinicians from around the UK is a strength, given the small number of specialist MDT nerve services. In addition, the clinical experience of the respondents was substantial. The challenge of recruitment to online surveys has been well documented, as is the ability to calculate response rates.[30]

KEY MESSAGES

- Physiotherapy is referred to as the 'mainstay' of conservative treatment for neurogenic thoracic outlet syndrome (NTOS), but its description and target population are poorly described.
- Three-quarters of clinicians report not having treatment guidelines to assist them, and the vast majority feel further research into exercise and NTOS would be beneficial.
- Designing an optimal physiotherapy treatment package and prospectively studying it would advance knowledge in this area.

Further research

98% (45/46) of clinicians felt that further research concerning exercise in NTOS would be beneficial, which has also been advocated by multiple authors.[3,8,13–15] Expanding the knowledge base surrounding exercise and physiotherapy for NTOS could have wide-reaching implications in improving patients' experiences, pathways and outcomes, in addition to potential efficiency savings for healthcare providers. For this to be achieved, we need to be able to produce homogeneous studies, allowing direct comparison of treatments with standardised assessments.

Although there are still understandable questions relating to the diagnosis of NTOS, in recent years since the introduction of the CORE Thoracic Outlet Syndrome Group (CORE-TOS) and SVS reporting standards there has been an emergence of randomised clinical trials[7] and prospective studies,[6,10,15] with repeatable comparable diagnostic criteria for the first time. This may suggest

Conclusions

Most survey responders completed a comprehensive assessment for NTOS including subjective, objective and NTOS-specific clinical tests. AHPs prescribe treatments aimed at assisting self-management, in addition to exercises for ROM, strength and neural mobility. Passive interventions are less commonly prescribed.

Most clinicians recognise NTOS as a complex condition which requires experienced therapists to treat, although a patient's response to physiotherapy is not measured consistently. Three-quarters of respondents did not have physiotherapy treatment guidelines to assist them. Clinicians are overwhelmingly in favour of further research pertaining to exercise and NTOS. In addition to research on physiotherapy, further efforts to standardise the assessment and treatment of NTOS within the UK are required.

Conflict of Interest: None.

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SYSTEMATIC REVIEW

Changes in functional health status following open abdominal aortic aneurysm repair and the role of exercise-based rehabilitation: a systematic review

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Plain English Summary

Why we undertook this work: An abdominal aortic aneurysm (AAA) is a balloon-like swelling of the aorta, which has a higher chance of rupturing if it grows beyond 5.5 cm. Surgery within 8 weeks is therefore recommended for all suitable patients with aneurysms greater than 5.5 cm. Delayed recovery and complications are common following open AAA repair. Complications include temporary or long-term damage to the lungs, kidneys and/or bowel. Also, reductions in functional ability are likely due to the required bed rest and the demands of surgery. At present we do not know how much functional ability reduces after AAA repair. Additionally, exercise-based therapy following AAA repair could reverse these reductions in functional ability, although we do not know if there is enough evidence to support this suggestion.

What we did: We systematically reviewed the current evidence to improve our understanding of the reduction in functional ability following AAA repair (component 1). We did the same to increase our understanding about whether exercise can improve functional ability (component 2) following AAA repair. Databases were searched to identify trials that have explored the changes in functional ability and the effect of exercise following AAA surgery.

What we found: We found no published evidence or ongoing studies to improve our understanding of the reduction in functional ability following AAA repair (component 1). One study met the criteria for component 2. This trial compared the impact of a forward or backward walking-based physiotherapy programme with standard physiotherapy following surgery. Patients who underwent walking-based physiotherapy could walk for a longer distance during the 6-minute walk test and also had better energy reserves than patients who underwent standard physiotherapy.

What this means: No evidence is available to help us understand the changes in functional ability following AAA repair. There is limited evidence available to help us understand the impact of exercise-based rehabilitation. Therefore, future research is urgently needed to explore these areas.

Abstract

Background: Physical domains of quality of life measures are negatively impacted following abdominal aortic aneurysm (AAA) repair. This is likely to reflect a reduction in objective measures of functional status, although this is yet to be established. These reductions can be targeted via exercise-based rehabilitation. This review aims to systematically evaluate the current evidence quantifying changes in functional status following open AAA repair and to consider the role of exercise-based rehabilitation for these patients.

Methods: The Medline, EMBASE and Cochrane CENTRAL databases were searched using two distinct search strategies. We included all prospective randomised and non-randomised trials that considered the impact of open AAA repair on functional status and/or the effect of exercise-based rehabilitation following open AAA repair. The primary outcomes were changes in objective measures of functional status following AAA repair and changes in these measures following exercise-based rehabilitation. Risk of bias was independently assessed by two review authors using the criteria outlined in the revised Cochrane tool (ROB 2.0) or the risk of bias in non-randomised studies of interventions (ROBINS-I) tool.

Results: No studies were identified that quantified changes in functional status following open AAA repair. One study considered exercise-based rehabilitation. This three-arm randomised trial compared two walking-based exercise programmes with routine care physiotherapy.

Patients who underwent backward walking-based rehabilitation had a significantly lesser decline in functional status than the other groups, based on the 6-minute walk test and standard metabolic equivalents. There were no significant differences in length of stay or pulmonary function.

Discussion: This is the first systematic review to explore the objective decline in functional status and the role of exercise-based rehabilitation following open AAA repair. There is no evidence to quantify functional decline following AAA repair and limited low quality evidence to support exercise-based rehabilitation. The ideal next step for future research would be a feasibility or observational before-and-after cohort study using direct measures of physical function such as the short physical performance battery or the 6-minute walk test.

Key words: abdominal aortic aneurysm, exercise therapy, postoperative care, rehabilitation, function recovery

Introduction

Patients with abdominal aortic aneurysms (AAA) are usually older adults with widespread atherosclerosis and considerable cardiovascular risk factors.[1–3] As a result, open surgical repair is associated with significant perioperative morbidity which may require a prolonged inpatient or intensive care stay.[4,5] The associated metabolic and cardiopulmonary challenges may have substantial resultant consequences on functional status and quality of life (QoL).[6,7] The current evidence suggests that there are initial declines in both mental and physical domains of QoL following AAA repair, with the mental domains recovering to preoperative levels by 4–6 weeks post-surgery. The physical domains, however, may take more than a year to recover.[8,9] This suggests that there are likely to be quantitative changes in functional status following AAA repair that are reflected in these reductions in physical QoL domains. However, no systematic review evidence has considered these quantitative changes.

Exercise-based rehabilitation has the potential to ameliorate some of these reductions in functional status and QoL following open AAA repair. However, the evidence to support this has also not been synthesised. This is despite evidence to suggest that exercise programmes performed preoperatively improve functional capacity and postoperative outcomes,[10,11] as well as the recommendations to enrol patients in exercise-based cardiovascular rehabilitation following major cardiac surgery.[12]

Therefore, the aims of this study are to (1) review the evidence considering quantitative changes in functional status following AAA repair, and (2) review the evidence for postoperative exercise-based rehabilitation following AAA repair.

Methods

This review was split into two components to specifically address each of the aims above. Aims 1 and 2 will be referred to as components 1 and 2, respectively. The full study protocol has been published previously, and outlines the search strategy, inclusion criteria, data management selection and collection process, outcome measures, risk of bias and quality of evidence rating and planned data analysis.[13]

Briefly, searches were performed on the MEDLINE, EMBASE and Cochrane CENTRAL databases from inception to 23 June 2022. For component 1, search terms included “Aortic Aneurysm” [AND] “Functional Capacity” [OR] “Functional decline” [OR] “Functional capacity” [OR] “Aerobic endurance” [OR] “Functional Fitness” and for component two, terms included “Aortic Aneurysm” [AND] “Exercise therapy” [OR] “Physical Therapy” [OR] “rehabilitation”. All randomised and non-randomised trials were eligible for inclusion. For component 1, trials that considered the impact of AAA surgery on quantitative measures of functional capacity and physical function were eligible whilst, for component 2, trials that considered the effect of exercise-based rehabilitation following AAA repair were eligible. Study screening, data extraction and risk of bias and quality assessment was performed by two independent reviewers, with a third reviewer consulted to resolve conflicts.

The primary outcome was changes in objective measures of functional status either after AAA repair (component 1) or after exercise-based rehabilitation (component 2), including but not limited to metabolic equivalent of task (MET), cardiopulmonary exercise test parameters such as maximum oxygen consumption (VO_2 max), ventilatory efficiency (VE/VCO_2 slope), anaerobic threshold (AT), or objective measures of physical function such as the six-minute walk test (6MWT), short physical performance battery (SPPB) or timed up and go (TUG). For component 2, secondary outcomes included all-cause mortality, cardiovascular mortality, event-free survival, rate of rehospitalisation, changes in QoL and adverse events related to the intervention.

For each component we intended to produce a narrative synthesis with a summary of findings table. Meta-analysis was planned, but this was precluded by a lack of available data.

Results

Component 1

Out of 365 potential studies screened, none met the inclusion criteria (Figure 1). There was therefore no available evidence to

evaluate the changes in objective measures of functional status following AAA repair.

Component 2

Out of 431 potential studies screened, one met the inclusion criteria (Figure 2). The included study was a three-arm randomised trial that compared two walking-based exercise programmes with routine care physiotherapy in a cohort of 65 patients (Table 1).[14] The risk of bias summary for this trial is shown in Figure 3.

Routine postoperative physiotherapy consisted of a range of low intensity conditioning exercises along with patient education to improve awareness about postoperative rehabilitation. The walking-based interventions included forward or backward walking performed in an interval fashion. The training intensity was customised for each patient based on their baseline functional status. The frequency of training started at once per day, increasing to three times per day, whilst exercise duration was also gradually increased. Exercise was performed from the first day post-surgery to the day of discharge. The results of this study demonstrated that patients who underwent backward walking-based rehabilitation had a lesser decline in functional status, which was statistically significant. These findings were based on changes in the six-minute walk distance and METs, calculated as:

$$\frac{\text{Mean walking distance in kmph x } 1.667 + 3.5}{3.5}$$

None of the three groups had a significant improvement in pulmonary function nor a significant reduction in length of stay. There were also no differences between these groups for these outcomes.

A risk of bias assessment of this study revealed some concerns for bias, with the overall predicted direction favouring the experimental group. This rating was mainly because study participants were recruited from a larger purposefully selected cohort and there was a lack of blinding (Figure 3).

Figure 1 Considering quantitative changes in functional capacity and physical function following abdominal aortic aneurysm repair (component 1).

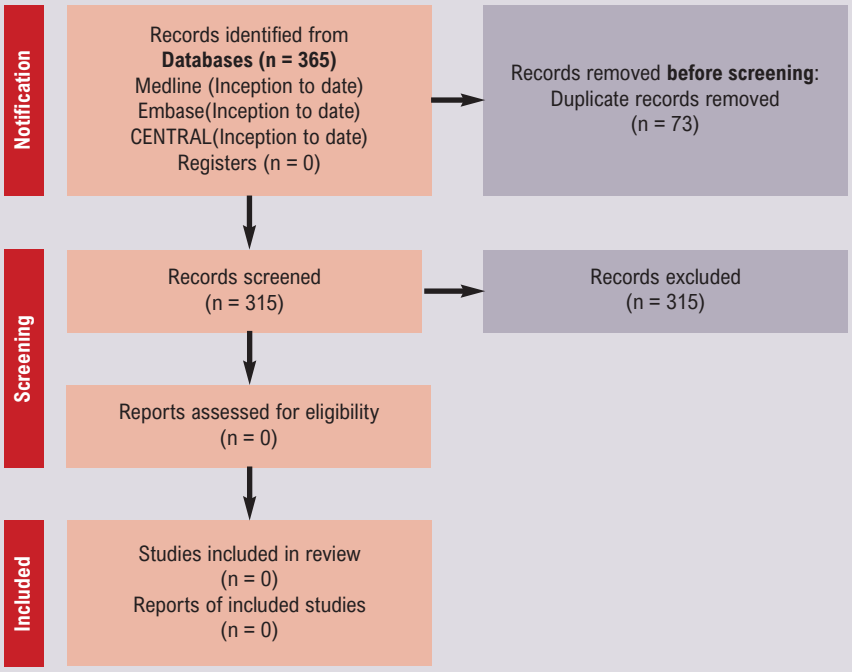


Figure 2 Role of exercise-based rehabilitation following abdominal aortic aneurysm repair.

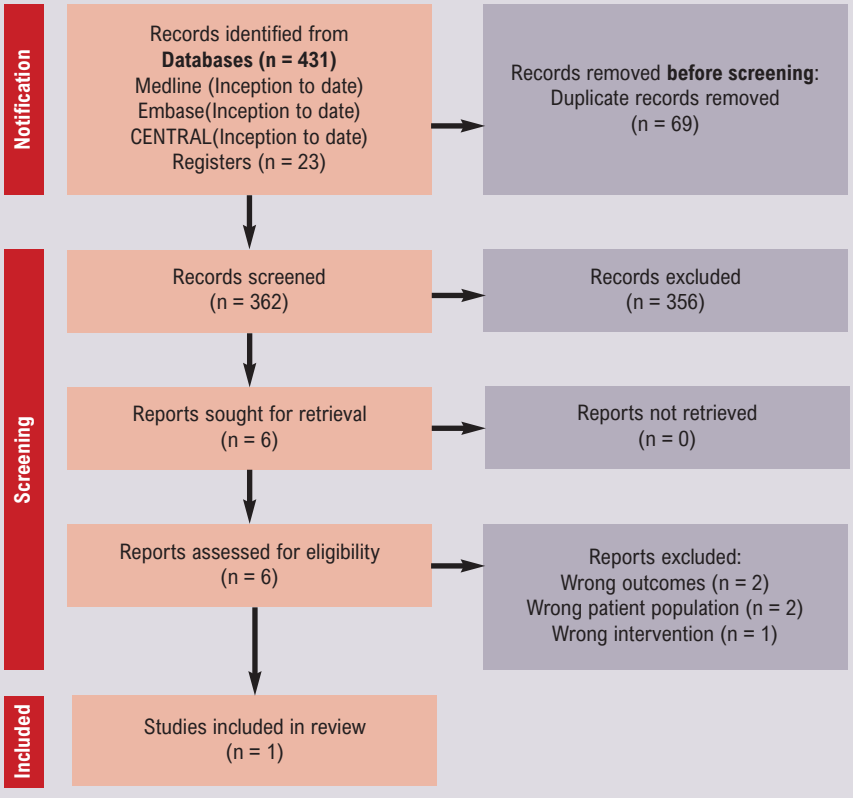
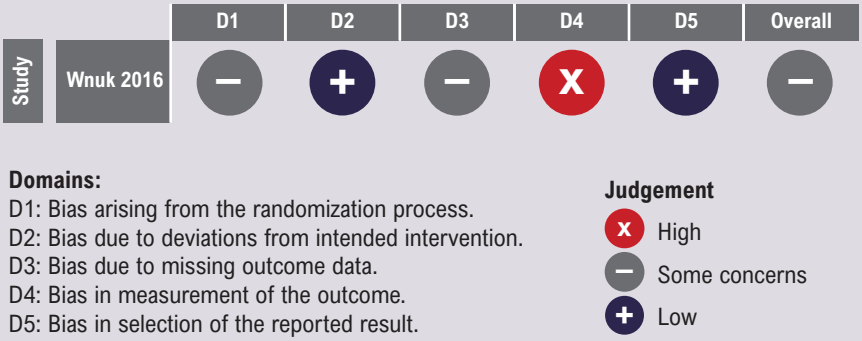


Table 1 Study characteristics of the study included in component 2

Study (country, design)	Sample	Description of interventions	Outcome measures	Main findings
Wnuk, 2016[14] Poland, 3-arm randomised controlled trial	N=65 Patients who underwent open repair of an asymptomatic non-ruptured abdominal aortic aneurysm which exceeded the threshold for repair. Patients with symptomatic aneurysms, dissections and other severe medical comorbidities were excluded	Patients were divided into two experimental groups and one control group. The two experimental groups underwent either forward or backward walking-based rehabilitation in an interval fashion. 3 days of preoperative gait training that included 4, 5 and 6 minute interval training sessions (1:1 minute exercise/rest interval) on each day. The postoperative training regimen included similar interval training sessions (1:1 minute exercise/rest intervals) performed once on day 1, twice on day 2 and thrice from day 3 with an extra minute of training progressively added to every session until the day of discharge. The intensity of interval training was customised for each patient based on their functional status evaluated by a stress test and 6-MWT. Control: Routine postoperative physiotherapy consisting of a range of low intensity conditioning exercises along with patient education.	6-Min walking test Training heart rate Mean speed Standard metabolic equivalent Forced vital capacity (FVC) Forced expiratory volume (FEV_1) FEV_1/FVC Peak expiratory flow rate Length of hospital stay (LOS)	Patients who underwent backward walking-based rehabilitation had a significantly lesser decline in functional status than the other groups based on the 6-minute walk distance (p=0.027) and standard metabolic equivalents (p=0.031). None of the groups demonstrated a statistically significant change in pulmonary function or a reduction in the length of stay.

Figure 3 Risk of bias domains.



We were unable to assess the certainty of evidence with just one study eligible for the review.

Discussion

We identified no completed or ongoing studies that quantitatively assessed the decline in functional status following open AAA repair. We searched for studies irrespective of publication year, publication type and publication status. We also searched relevant clinical trial registries to identify ongoing trials or any that had not yet been published. This makes it likely that this finding is a true reflection of the current evidence base.

We identified one completed randomised clinical trial that evaluated the effects of exercise-based rehabilitation following open AAA repair, which showed promising results.[15] However, there were some concerns of bias because of purposeful patient sampling and the single blind nature of the study. Moreover, the authors also acknowledge that the study was underpowered.

We identified another study considering the feasibility of a home-based exercise programme following major surgery, including open AAA repair. However, the results are not available so this study cannot yet contribute to the evidence base.[15] Clearly, the evidence base considering the impact of AAA repair on functional status and the role of exercise-based rehabilitation is almost non-existent.

Functional outcomes after major vascular surgery have become an increasingly important area of interest in recent years, especially with the limited amount of published data.[16] Significant declines in subjective physical health composite scores have been

demonstrated after both open and endovascular repair, with open repair being associated with a statistically significant decline in three out of four physical health domains.[17] Other attempts have been made to assess the general wellbeing in patients after AAA repair, but these have been limited in scope and have not contained specific end points.[18,19] As such, there is a paucity of data quantifying whether there is an objective decline in functional status following AAA repair. It would, however, be reasonable to expect a decline in functional status, given the possible complications and associated perioperative metabolic and cardiopulmonary challenges. Indeed, this has been demonstrated in patients undergoing coronary artery bypass grafting,[20] but is yet to be evaluated in those undergoing AAA repair. Exercise-based rehabilitation has the potential to ameliorate some of the reductions in functional status and QoL following AAA repair. However, we have also demonstrated a paucity of data to support this notion.

Therefore, as anticipated in the protocol for this review, we have demonstrated that there is little or limited evidence exploring these current areas of interest. Despite the recommendation that all patients undergo cardiovascular rehabilitation following major cardiac surgery,[21–24] which is supported by strong evidence,[25] the evidence for such interventions following AAA repair is limited to just one study. This is also surprising considering that preoperative exercise programmes improve fitness and reduce complications in patients undergoing AAA repair,[11] and such gains are likely to be furthered via the use of postoperative exercise programmes.

Given that there is limited evidence to support the efficacy of exercise-based rehabilitation in those undergoing AAA repair, known barriers such as a lack of funding, expertise and patient motivation will be all the more pertinent.[26]

Based on the limited evidence identified by this review, important evidence gaps remain. First, the extent to which functional status is impacted by open AAA repair needs to be established. Second, the effect of exercise-based rehabilitation on functional status and QoL also needs to be established.

This review is not without limitations. The clear lack of evidence precludes our ability to make any conclusions or recommendations, other than those for future research. However, we followed the guidance of the Cochrane handbook and performed a comprehensive literature search across several databases that span both published and unpublished sources. We therefore believe that this review highlights a true lack of evidence, rather than evidence that has been missed due to poor methodology.

Overall, this review has identified that there is no evidence quantitatively objectifying the impact of open AAA repair on functional status. It has also identified that there is extremely limited evidence to support exercise-based rehabilitation following AAA repair. Future research is urgently needed to establish this evidence base. Identifying any objective decline in physical function is imperative to ascertain the need for targeted postoperative rehabilitation, especially in a cohort likely to derive significant benefit from exercise-based rehabilitation. The ideal next step for future research would be a feasibility or observational before-and-after cohort study using direct measures of physical function such as the SPPB and 6MWT to track the objective decline in physical function over time following AAA repair.

KEY MESSAGES

- This paper includes two systematic reviews to summarise the current evidence surrounding the changes in functional status following abdominal aortic aneurysm (AAA) repair (component 1) and the role of exercise-based rehabilitation programmes (component 2).
- No study met the criteria for component 1 out of 365 prospective studies and one study met the criteria for component 2 out of 425 studies. The three-arm randomised trial included, which compared the impact of backward and forward walking-based physiotherapy versus standard physiotherapy on postoperative functional status, reported an improvement in the 6-minute walking distance and standard metabolic equivalent, but had some concerns of bias.
- There is no available evidence to quantify the functional decline following AAA repair and very limited evidence to support the beneficial effect of exercise-based rehabilitation following AAA repair.

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Data availability: The data that support the findings of this review are available from the corresponding author (BR) upon reasonable request.

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PROTOCOL

The clinical effectiveness of waxing or epilation compared with other methods of hair removal in reducing the incidence of surgical site infections: a protocol for a systematic review

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Plain English Summary

Why we are undertaking this work: When you have surgery such as vascular surgery, doctors often remove hair from the part of the body where they will operate. There are different ways to do this, but some methods might increase the risk of infections after surgery. In this research we want to study two methods of hair removal: waxing and epilation. Both involve pulling hair out by the roots. We will compare these methods with other ways of removing hair to see if they are better or worse at preventing infections after surgery. Infections after surgery can be serious. They can lead to other health problems, longer stays in hospital and higher costs for your healthcare. In some cases, like after surgery to restore blood flow to the legs, infections can be so severe that they lead to major amputation. Currently there is no widespread agreement among experts about the best way to remove hair before surgery. Some think waxing and epilation might be better because they might help wounds heal and make it easier to keep the area clean. Others worry that these methods might actually increase the risk of infection.

What we aim to do: We are going to look at all the research studies that have been done on this topic and find the ones that compare waxing and epilation to other hair removal methods or no hair removal at all. Then we will look at the results of these studies to see what they tell us about the risk of infections after surgery. Our plan includes several steps: (1) search medical databases and other sources for research studies; (2) select the studies that meet our criteria and exclude ones that don't; (3) extract the details and results from the selected studies; and (4) analyse the data to see what it tells us about infections after surgery with different hair removal methods..

What this means: If you are going to have vascular surgery, this study could help you and your doctors decide the best way to prepare for your operation. If waxing or epilation is found to be better at preventing infections, it might become a common practice. If not, it might lead to other ways to reduce the risk of infections. One thing to keep in mind is that we might not find enough studies on this subject. If that happens, it will tell us that more research is needed in this area.

Key words: ankle brachial pressure index (ABPI), oscillometry, doppler, peripheral arterial disease (PAD)

Abstract

Background: Surgical site infections (SSIs) represent a significant challenge in healthcare, contributing to morbidity, mortality as well as economic burden. Traditional preoperative methods of hair removal are under scrutiny, with some methods potentiality increasing the risk of SSIs. This systematic literature review (SLR) protocol outlines the assessment of the clinical effectiveness of waxing and epilation compared with other methods of hair removal in reducing SSIs.

Methods: Using PRISMA guidelines and the Joanna Briggs Institute Evidence Synthesis Checklist, this review aims to evaluate all interventional and observational studies that compare waxing or epilation against other methods or, indeed, no hair removal. The SLR has been prospectively registered with PROSPERO (ref: CRD42023423798). A comprehensive search strategy across Medline, Embase, CENTRAL, Clinicaltrials.Gov and CINAHL is planned, complemented by handsearching references of key articles. Important inclusion criteria include adult patient population, English language studies, and SSI reporting at 30 days. Both the Cochrane Risk of Bias (RoB2) tool and Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool will be employed. Data extraction will include study characteristics, participant characteristics,

intervention and comparator details, and primary outcome data. The primary outcome is overall incidence of SSIs and, if feasible, a quantitative analysis including meta-analysis will be performed.

Discussion: This review has the potential to fill a knowledge gap around waxing and epilation as methods of preoperative hair removal, examining their impact on SSI incidence. These techniques offer theoretical advantages, such as extended hair-free periods and possible promotion of wound healing, but also have potential risks due to increased microtrauma. Due to the paucity of high-level evidence, there is a lack of consensus around their use. The outcomes of this review could reaffirm current guidelines or guide future practices. The high incidence of SSIs in areas like vascular surgery highlights the therapeutic potential of new evidence. One limitation of the study might be the small volume of literature on the subject, which could decrease statistical analysis power and make quantitative comparison challenging. If no high-quality evidence is found, this would indicate an unexplored area, potentially informing the design of primary research into waxing and epilation as SSI prevention methods.

Conclusion: This protocol lays the foundation for a comprehensive review of the clinical effectiveness of waxing and epilation in the prevention of SSIs. The insights gained could shape current clinical practice, influence guidelines or guide future research, ultimately contributing to the reduction of the substantial burden of SSIs.

Background

Hair has traditionally been removed from surgical sites preoperatively, but there is gathering evidence that some methods of hair removal can increase the risk of surgical site infections (SSIs).[1,2] The most recent Cochrane review (2021) found that, while hair removal using clippers or depilatory cream does not significantly increase the risk of SSIs, razors may increase the chance of SSI development (moderate-certainty evidence).[3] This is reflected in current NICE guidelines, which state that hair should be removed preoperatively only when its presence interferes with the operation.[4] In this situation, it is recommended that hair is removed on the day of surgery with electronic clippers with a single-use head.[4]

Epilation involves the removal of hair by the root, commonly achieved through waxing or the use of a mechanical epilator. These techniques offer a theoretical advantage over other methods of hair removal because the removal of the hair by the root causes increased disruption within the dermal microenvironment, promoting greater influx of inflammatory cells, which may assist in healing of wounds and prevent possible infection evolving into a clinically overt SSI. These methods also provide an extended hair-free period, which simplifies wound cleaning, the application of dressings, and enables clinicians to identify the signs of SSI development with greater ease. However, the increased microtrauma seen with epilatory techniques may itself increase the risk of SSI development. Due to the paucity of high-level evidence, there is no consensus around the use of waxing or epilation as methods of preoperative hair removal and their effect on SSI incidence.

The prevention of SSIs is an area of increasing research interest due to their high disease burden. SSIs account for up to one in seven hospital acquired infections in the UK and are a cause of considerable morbidity and mortality.[5] For instance, up to 30–40% of patients who develop a SSI following lower limb bypass surgery will require subsequent major amputation.[6] SSIs also prolong hospital admissions and necessitate extended antibiotic treatment, increasing psychological distress for patients and inflating healthcare costs.[1,7] Indeed, SSIs are estimated to cost the National Health Service (NHS) £700 million per year in the UK.[8]

This systematic literature review (SLR) aims to evaluate the current evidence in the preoperative removal of hair using waxing and epilating to reduce SSIs.

Methods

This systematic review will be conducted using the Joanna Briggs Institute Evidence Synthesis Checklist.[9] Findings will be reported according to the extension for Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines.[10] This SLR protocol has been constructed in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) statement,[11] which is shown in Supplementary Table S1 (see Appendix 1 online at www.jvsgbi.com). This review is prospectively registered with PROSPERO (ref: CRD42023423798).

Criteria for considering studies for review

Studies will be included if they meet the following inclusion criteria: (1) randomised controlled trials, quasi-randomised controlled trials, observational studies; (2) comparing waxing or epilation against any other method of hair removal, or against no hair removal; (3) reporting the incidence of SSI at 30 days; (4) English language studies; (5) adult patient population. These selection criteria are summarised in the recommended PICOS format (Table 1). No limitations in sample sizes or quality of study will be applied to studies that meet these criteria, in order to comprehensively assess the literature. Systematic and narrative review articles will be excluded, although references will be hand searched. A subgroup analysis of randomised studies will be performed.

Table 1 Selection criteria

	Inclusion criteria	Exclusion criteria
Population	Adult population undergoing any surgical procedure (elective or emergency)	Paediatric population (age <18 years)
Intervention	Use of waxing or epilation for preoperative hair removal	–
Comparator	Any other method of preoperative hair removal or no hair removal	–
Outcome	Incidence of SSI at 30 days according to any diagnostic criteria	–
Study design	Randomised controlled trials Quasi-randomised controlled trial Observational studies English language studies	Case reports, case series Systematic and narrative reviews Letters Non-English studies Abstract only articles

Search methods for identification of studies

Electronic searches

The search strategy will be designed in conjunction with an information specialist (TS) and will comprise a comprehensive search of Medline, Embase, CENTRAL, ClinicalTrials.gov and CINAHL. An example Medline search strategy is shown in Table 2.

Searching other sources

Additional searches will be conducted through handsearching the reference lists of included articles and excluded review articles.

Data collection and analysis

Selection of studies

Search results will be uploaded to Covidence systematic review software which automatically removes duplicated articles. Titles and abstracts will be initially screened independently by two researchers (JC and PG) to ensure they meet all selection criteria. Any disagreement that cannot lead to consensus after discussion will be discussed with a third senior researcher (RL) who will then adjudicate. All articles identified as relevant will undergo assessment of the full-length manuscript to confirm they meet all the selection criteria. As before, this will be performed independently by two researchers (JC and PG), with a third (RL) to manage disagreement on any points. The number of search hits, duplicates removed, full texts reviewed, articles excluded (with reasons), and the final number of studies included will be reported using the PRISMA flow diagram.[10]

Data extraction and management

Data will be independently extracted by two researchers (JC and PG) onto two separate Microsoft Excel spreadsheets using a bespoke data extraction form. Data to be extracted will include the following:

i Study characteristics: year of publication, country, study design, sample size, length of follow-up, setting, inclusion and exclusion criteria.

ii Participant characteristics: age, gender, smoking status, patient comorbidities and medications, operation performed, perioperative use of antibiotics, type of dressing, postoperative complications, return to theatre rates and mortality.

iii Descriptions of intervention and comparators: waxing or epilation method, details of hair removal technique, timing of intervention, comparative method used.

iv Primary outcome data: SSI incidence at 30 days, method of SSI diagnosis (eg, CDC criteria ASPESIS, or Southampton scoring system, etc.

Details of methodology relevant to risk of bias assessment such as randomisation, blinding, etc will also be extracted at this stage.

Assessment of methodological quality

The Cochrane Risk of Bias (RoB2) tool[12] will be used to assess the methodological quality of randomised controlled trials, whilst the Risk of Bias in Non-randomised Studies of Interventions (ROBINS-I) tool[13] will be used to assess non-randomised studies. Each study will be assessed by the two independent reviewers with the respective tool and any disagreement resolved by consensus from a third. These tools provide an overall score of risk of bias ('low',

Table 2 Example Medline search strategy

exp hair removal/		exp preoperative care/		exp Surgical Wound Infection/
wax*.ab,ti.		exp preoperative period/		exp Surgical Wound Dehiscence/
shav*.ab,ti.		preoperative.ab,ti.		surgical infection.ab,ti.
epilat*.ab,ti.	AND		AND	surgical site infection.ab,ti.
exp epilation/				SSI.ab,ti.
depilat*.ab,ti.				exp postoperative complication/
exp depilatory agent/				exp wound infection/
				wound infection.ab,ti.

'unclear', 'high'). Publication bias and selective outcome reporting will be explored with the use of funnel plots.

Statistical analysis and data synthesis

The primary outcome will be the overall incidence of SSIs by hair removal method (eg, comparison 1: waxing vs shaving; comparison 2: epilating vs clipping, etc). Secondary outcomes will include complication and reintervention rates. After data have been crosschecked, a narrative summary will be synthesised. If appropriate (depending on study heterogeneity), quantitative analysis will also be performed following the Cochrane guidelines for meta-analysis using the Review Manager (RevMan) V5.4 software program.[14] Possible additional analysis includes subgroup analysis by intervention and comparator method, operation type, sex, diabetes status, smoking history, use of immunosuppressants or anticoagulants. For this study, due to the expected heterogeneity, a random effects model will be employed, providing there is no indication of funnel plot asymmetry. Absolute numbers of patients and events will be presented for each trial within the meta-analyses and any/all subgroups. The summary statistics will be presented as risk ratios and their corresponding 95% confidence intervals will be estimated for each trial. Forest plots will be displayed to illustrate the effect size for each trial and the combined effect size. For each analysis, τ^2 will be presented as an estimate for the variance of true treatment effects between the trials, and the I^2 used to display the estimated proportion of variability that can be attributed to trial heterogeneity. A two-tailed significance level of 5% will be used for all statistical analyses. The overall certainty of evidence for all outcomes will be assessed in accordance with the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach.[15]

Discussion

This protocol outlines a systematic review to evaluate preoperative waxing or epilation in the reduction of SSIs. There is currently little evidence to support preoperative hair removal by any method, although waxing or epilation could reflect changes in this guidance. Should this review find evidence that waxing and epilation confer a greater risk of SSIs compared with clipping, it would reaffirm current guidelines and indicate that other methods of reducing the incidence of SSIs should be examined instead. Thus, any evidence produced from this study would provide valuable information, particularly to those areas of surgery that are at high risk of SSIs, such as vascular surgery where SSIs may complicate up to 40% of procedures.[16]

One key limitation of this study is the predicted small volume of literature surrounding waxing and epilation, which will decrease the power of any statistical analysis. Furthermore, given the lack of guidance around waxing and epilation, studies may diverge greatly in methodology, which would make any quantitative comparison unfeasible.

Should this review fail to find any studies that meet the inclusion criteria due to the lack of high-quality evidence, it would indicate that waxing and epilation encompass a relatively unexplored area of SSI prevention. The insight gained in this review could be used to inform the design of evidence-generating primary research into waxing and epilation, exploring both their feasibility and efficacy as methods of primary SSI prevention. The high incidence of SSIs in vascular surgery would stipulate that any primary evidence garnered here would have high therapeutic potential, which would make it an appealing site for further research.

Conflict of Interest: Professor Ian C Chetter holds the position of editor in chief of the JVSGBI.

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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.

British Association of Chartered Physiotherapists in limb Absence Rehabilitation. (BACPAR)

www.bacpar.org
@BACPAR_official

Again, BACPAR looks forward to holding its conference programme within the VS ASM this year and we know that its content will be of interest to the vascular and rehabilitation MDT. Our members look forward to networking with the same and find themselves presenting in the non BACPAR programme.

Celebrating its 30th anniversary year the BACPAR Executive Committee will build upon feedback gained by the Journal editors to gather membership feedback about their priorities for the Professional Network's work plan. The 30th anniversary Journal edition was published in October and pays testimony to the advances in limb absence rehabilitation and the role of Physiotherapists in those developments.

Current work continues updating the Pre- and Post-op guidelines. Volunteers from the VS and SVN have been sought to support this. The literature search has taken place and the identified papers are being reviewed by the update group. A survey of how the current guidelines have been used is underway and one for users is also being promoted.

A webinar has been held in association with the CSP Advanced Physiotherapy Practice Network and representation from Health Education England. It was an excellent introduction to the potential of the role in limb absence rehabilitation and access to training and portfolio support to gain accreditation.

Louise Tisdale
BACPAR Chair
Nov 2023

The British Society of Endovascular Therapy (BSET)

www.bset.co.uk
@BSETnews

BSET promotes education and training in endovascular treatment and procedures. Our Training Course and Annual Meeting programme is designed to enhance professional development and promote good practice through information sharing and networking. The BSET meeting is the only dedicated UK meeting for the presentation of endovascular research and is an excellent opportunity for both surgical and IR trainees to present their work.

The BSET Endovascular Training Course 2024 will be held on Thursday 7th and Friday 8th March 2024 at the De Vere Tortworth Court Hotel at Wotton under Edge, South Gloucestershire. The course is targeted at senior Vascular and Interventional Radiology Trainees and new Consultants.

This will be an exclusive in person conference with 4 separate modules on:

- IR-AAA module
- Aorto-occlusive disease
- Infrainguinal intervention
- Endovenous intervention

The course is limited to 24 places to allow faculty, along with industry, to provide in depth teaching looking at the finer points of treatment. The format is small group sessions (4 sessions in total over a two day period), with each session lasting approximately 2 hours.

In addition, there will be 3 separate expert presentations on

- IVUS
- Endovascular management of ALI
- Recovery from disaster: Case discussions

The BSET Annual Meeting will be held on Thursday 27th and Friday 28th June at Tortworth Court Hotel, Wotton under Edge, South Gloucestershire.

Abstract submission for the BSET Annual Meeting 2024 is now open. The deadline for submissions is Friday 9th February at 5pm.

A National Vascular Training Day will be held on Wednesday 26th June for surgical and IR trainees, providing an opportunity for interactive workstation experience.

Registration for the meeting includes overnight accommodation at the hotel and dinner.

Society of Vascular Nurses (SVN)

www.svn.org.uk
@vascularnurses

We are very much looking forward to this year's VSASM in Dublin, greeting new and old members and enjoying the opportunities for networking. I will be handing the

presidency role over to Jane Todhunter at the end of our day on Thursday 23rd November, having completed my 2 year term. As a result of not fulfilling our council spaces last year we opened these up as secondment positions and we have had four excellent nurses with us this year who have made valuable contributions during that time. We have 3 nominations for these outstanding spaces this year but this will still leave some empty seats to fill. Following conference these will be opened again for secondment positions alongside our staff nurse secondments, these are a good opportunity to have an insight into what we do if you are unsure about committing to a full council role immediately. For staff nurses it's an excellent opportunity to gain insight into work at a national level and open new networking opportunities.

During conference we will be launching our third publication 'Vascular Specialist Nurse Capability Framework'. This has been published as promised to support the Position Statement that was launched at last year's conference. The framework describes and sets out the range of capabilities required to be achieved by Vascular Specialist Nurses to improve patient outcomes and deliver safe effective care. Patients should receive the same level of nursing care wherever they are being cared for and the aim of this document is to help us achieve that on a national level. We are looking to also launch this on a digital platform to provide a live document that can be continuously updated and adapted to individual roles.

You may have seen the online announcement at the end of Vascular Awareness Month in September that we have now formally joined the Circulation Foundation alongside our other Vascular Societies (VSGBI, SVT and Rouleaux Club) to work collaboratively for the benefit of our patients. There will be more work on this in the New Year so if you don't already please follow the Circulation Foundation (@CircFoundation) on Twitter for news.

We have had some preliminary discussions with the Long Term Conditions and Prevention Team at Health Education England to drive forward the recognition of PAD as a standalone condition when providing education and training rather than an additional component of cardiac disease and stroke. We hope to again continue these conversations into the New Year to improve access to learning opportunities.

My final comments as I sign off for the last time are to the committee members that have truly been the best team to have alongside me on this journey, it's been a turbulent 2 years with many changes and achievements. The SVN is in the very capable hands for the future, and I look forward to the continued growth and development of the committee and our vascular nursing teams at all levels.

Gail Curran
SVN President

Society for Vascular Technology of Great Britain and Ireland (SVT)

www.svtgbi.org.uk
@svtgbi

THE SOCIETY FOR VASCULAR TECHNOLOGY OF GREAT BRITAIN AND IRELAND

The countdown to the Vascular Societies ASM 2023 in Dublin is on! The Conference team have been working hard to make sure this is a roaring success. We have an advanced skills workshop on Wednesday morning covering EVAR endoleaks and pedal vessel imaging. This workshop will showcase live demonstrations and give opportunity for some hands-on practical scanning. After lunch we start our hotly anticipated Carotid session covering a recent carotid audit of UK and Ireland practice, advances of AI and 3D ultrasound in assessing Carotid disease.

Our main Thursday session is full to the brim with scientific abstracts, keynote speakers and our invited guest speakers for the Jackie Walton memorial lecture. The Ballot results, AGM and Prize giving will conclude a busy day.

The SVT has enjoyed an exceptionally productive year, and I am immensely proud of all the progress made in pursuit of ambitious goals set out last year.

Ms Emma Waldegrave
President of the SVT GB&I
Dr Steven Rogers
Vice President Elect & Research Chair
SVT GB&I