Advancing non-invasive vascular diagnostic services by promoting training and research in Vascular Science.

CSVS

THE COLLEGE AND SOCIETY
FOR CLINICAL VASCULAR SCIENCE
Great Britain and Ireland

AUTUMN
2024

IN THIS ISSUE

Welcome to the CSVS Autumn newsletter.

It has already been a few months since I took over the role of the newsletter editor for the CSVS and time has flown by! I was lucky enough to be supported by everyone in all the committees and I would like to thank our previous editor, Daniella Bond, for everything she has done in the past for the newsletter.

For my time as the newsletter editor, I would like to introduce a new segment called 'Editor's Case Of The Month' where I am hoping to publish interesting cases or case studies I get sent from our society members. So this is my call out to all of you to send me any case studies, reviews, or experiences that you would like to share in the interest of our society members.

Thank you all in advance and I hope you will enjoy the new segment!

Jeny Anton
Newsletter Editor
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President's Message

We are pleased to inform you that the CSVS online exam portal is now active, and we thank the Education committee and the website team for their efforts in getting this project off the ground. The team are now in the process of fully integrating this into the new CSVS website. Our new CSVS website design is also under way, and we hope to aim for a soft launch at some stage this year. Please bear with us through this process and any teething problems that will inevitably occur.

We have an upcoming and exciting study day covering Vascular Access and Haemodialysis at the Weston Education Centre (King's College Hospital) on the 27th of September. There will be an opportunity to have practical hands-on scanning experience with patient volunteers with expert supervision. Details of this event are on our website - be quick as places are limited and fast running out.

As some of you may remember, there was NHS England physiological sciences stocktake in September 2023. It is now nearly time for the second round of this data collection. Although there was a reasonable response rate last year, it would be beneficial to us as a group if we had more engagement and responses from centres that routinely offer vascular imaging and physiological assessment. The data will ultimately be used to support and fund services across the UK and address service inequalities across regions. Please support your Head of Service in engaging in this process.

Plans for the ASM in Brighton is well under way and we have a fantastic array of speakers already confirmed for this event as well as many submitted abstracts, there will be with the option for hands on scanning, our yearly networking event on the Wednesday evening and the ASM gala dinner on the Thursday. The Executive Committee are looking forward to meeting you all in Brighton. I am personally

Enjoy the newsletter and please look out for further updates on our website.

Yours sincerely,

Kamran Modaresi
CSVS President

EDITOR'S CASE OF THE MONTH:
Superficial Temporal Artery Aneurysm Case Reports

A 29 year old man presented to the vascular one stop clinic with a painless pulsatile mass on the left side of his forehead. He could not recall any blunt trauma but could not rule it out as he was a former rugby player. He first noticed the lump two years ago but it had recently grown in size, which is why he presented to his GP.

An ultrasound scan confirmed a 7.3 mm in AP diameter aneurysm of the frontal branch of the common superficial temporal artery *(Figure 1)*. The common superficial temporal artery and parietal branch were all of normal caliber measuring ~1.5 mm in AP diameter *(Figure 2)*.

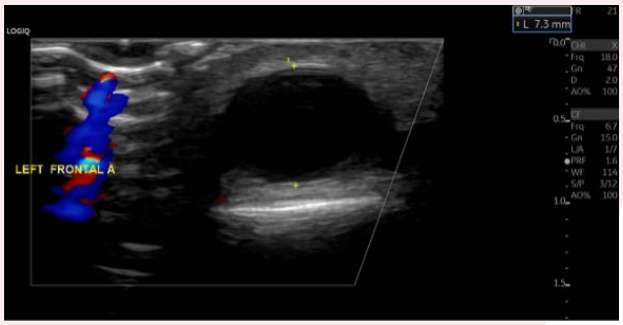

Figure 1: Aneurysm of the frontal branch of common superficial temporal artery.

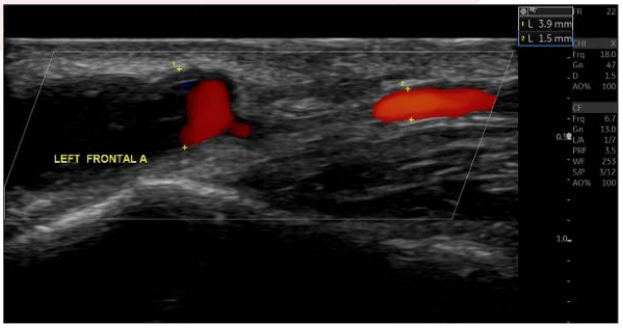

Figure 2: Aneurysmal vs normal calibre of frontal branch of common superficial temporal artery.

Following the scan, the patient was then seen by the vascular consultant and booked for surgical resection of the aneurysm.

Within the last year three patients presented to King's College Hospital with superficial temporal artery aneurysms. The second case was a female, aged 67 who also presented with a pulsatile mass on the left side of her forehead. It was difficult to obtain a history of trauma to the forehead due to a language barrier. An ultrasound scan revealed a superficial temporal artery aneurysm measuring 8.8 mm in AP diameter *(Figure 3)*. Following the scan, the patient was also booked for surgical excision.

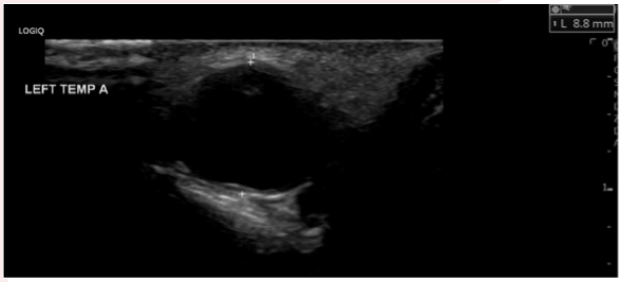

Figure 3: Common superficial temporal artery aneurysm.

The third case was a 35-year-old man who was referred by Rheumatology to us because of a mass on the left side of this forehead with no known history of trauma. The patient noticed a localised swelling on the left side of his head nearly a year prior, which was not tender but the swelling increased in size recently and he also developed minor headaches but he had never experienced any jaw or tongue claudication.

The ultrasound scan showed a dilatation of the frontal branch of the common superficial temporal artery measuring 4 mm in AP diameter with significant mural thrombus/wall thickening which resembled a halo sign *(Figure 4)*. Thus it was important to rule out GCA vs superficial temporal artery aneurysm. Despite the fact that GCA seemed unlikely given his age and lack of any GCA symptoms, a blood test was performed to check for inflammatory markers. The results came back negative for GCA with normal

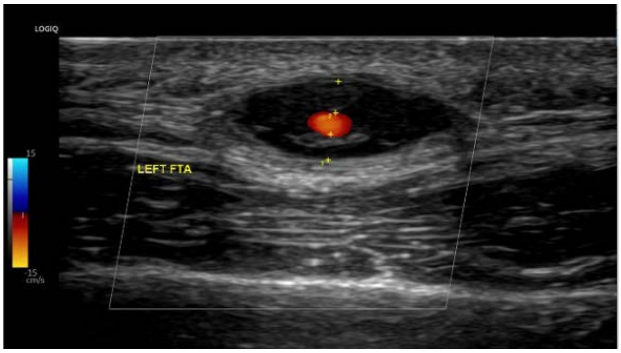

Figure 4: Aneurysmal frontal branch of common superficial temporal artery with mural thrombus/wall thickening.

ESR and the patient is currently waiting to be seen by the vascular team to discuss his treatment options.

The first case of a superficial temporal artery aneurysm was reported in 1742 by Thomas Bartholin. Since then, around four hundred cases of superficial temporal artery aneurysms have been described [1] making it a rare phenomenon.

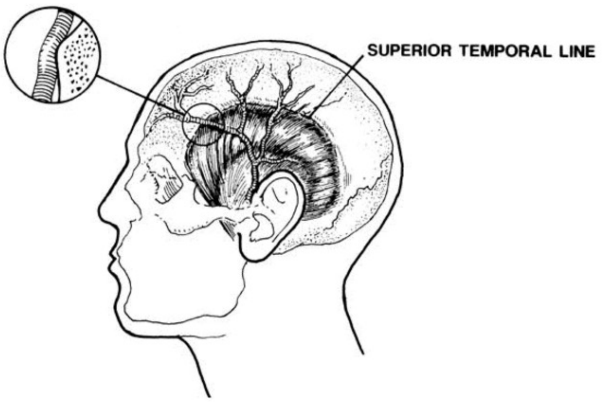

Figure 5: Aneurysms most commonly involve the frontal branch of common superficial temporal artery, which traverses the superior temporal line.

The superficial temporal artery is a branch of the external carotid artery and begins within the parotid gland and passes superficially over the posterior root of the temporal bone to supply the face and scalp [2]. It can be easily damaged by a head injury, in particular its frontal branch due to close proximity to the skin, where the skin and fat tissues remain the only protection of the artery *(Figure 5)*.

Aneurysms are defined as focal dilatations greater than 1.5 times the normal vessel diameter and typically superficial temporal artery aneurysms vary in size from 0.5 cm to 5.7 cm, with the most common size being 1 to 1.5 cm. Superficial temporal artery aneurysms can occur anywhere along the course of the superficial temporal artery, but is most frequently found in the frontal branch [3].

The typical presentation of superficial temporal artery aneurysms is a compressible, growing, pulsatile mass on the temporal area with a recent history of head trauma. Spontaneous true superficial temporal artery aneurysms are rarer at approximately 5% of cases and are linked with connective tissue disorders or atherosclerosis [4, 5]. The usual onset is approximately 2-6 weeks after the head injury but in 15- 20% of cases onset can be 6 months to 3 years after initial injury [6]. Most patients present with no symptoms while others experience minor headaches, ear discomforts, pulsations or less frequently pain, dizziness and visual disturbances. Differential diagnosis of a pulsatile mass includes arteriovenous fistula, vascular tumour, haematoma and aneurysm of an adjacent artery other than the superficial temporal artery.

Historically, a wide variety of operative and non-operative procedures have been performed for the management of superficial temporal artery aneurysms. Nonoperative methods have included observation and application of continuous pressure over the aneurysm with eventual thrombosis [7].The surgical procedure of choice is superficial temporal artery aneurysm ligation and excision as it is simple, safe, and avoids recurrence.

Treatment is recommended as the aneurysm otherwise may continue to grow over time and rupture, presenting with severe haemorrhage [8]. Endovascular management has also been described with ultrasound-guided direct thrombin injection or embolisation and coiling [9, 10]. Endovascular intervention is preferred in the case of facial nerve and parotid gland proximity [11]. Given the superficial location of the artery, surgical management can generally be performed under local anaesthesia and moderate sedation.

Written by Jeny Anton
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The Future of Vascular Imaging: AI and Ultrasound

Rarely does a day go by without hearing about new advances in Artificial Intelligence (AI). However, the viewpoint is often binarised to a utopian or dystopian standpoint, which risks reducing this important topic to generalised hyperbole. If we accept that AI is here to stay, then we should have a better understanding of how it works and how we can better integrate it into our professional lives. In this short article I hope to give a brief introduction into how AI functions, and how it might be useful to Clinical Vascular Scientists in a level headed, evidence based way.

AI - A primer

AI has been around since the 1950's and its history and ideas are intertwined with neuroscience. However, AI remained in obscurity until very recently when it started to reach human level performance for certain vision tasks. This resurgence was powered by three things: a generalised learning algorithm (which enables a network to learn, or train), hardware accelerators (commonly graphics cards, these allow larger, more powerful networks to be trained) and copious quantities of data. It is this latter part that medical imaging, and healthcare in general excels at.

What is a network? Well, simply put, an artificial neural network is a computational graph composed of nodes and edges that loosely represent populations of biological neurons and their connecting synapses. Biological neural networks learn by strengthening or weakening the connection between two neurons. Stronger synapses might release greater quantities of neurotransmitter and thus have a greater influence on the receiving neuron. This is represented in an artificial network by increasing or decreasing a value associated with a connecting edge (synapse) which in turn influences the connected node (neuron).

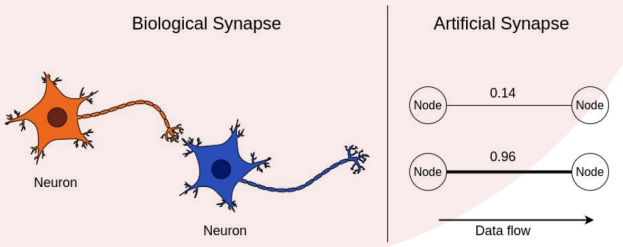

Fig 1. Comparison of biological synapses and artificial synapses. Just like in a biological neural network a synapse connects neurons together and can have different strengths.

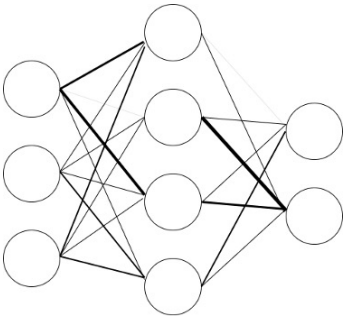

Fig 2. Diagram of a simple artificial neural network architecture

Networks are typically constructed into layers of these nodes, connected together with input and output layers surrounding some inner layers (Fig 2.).

What does this have to do with training an AI? Well, I'm glad you asked. Training proceeds when some data is fed into the network. Since data are essentially just a bunch of numbers, for example pixel intensities (Fig 3) or waveform velocities, they can be fed directly into such networks. Data then flows through the network being operated on as it goes, multiplied by the edges – that have an associated weight which represents the strength of that connection – and scaled by the nodes before being passed to the next layer. Once it reaches the final layer an output is generated. In a classification task, this would be a set of probabilities and we would likely choose the highest most probable value as the network's "answer". During training, this is compared to the known answer and the disparity between the network's result and the real answer can be calculated. This is the loss.

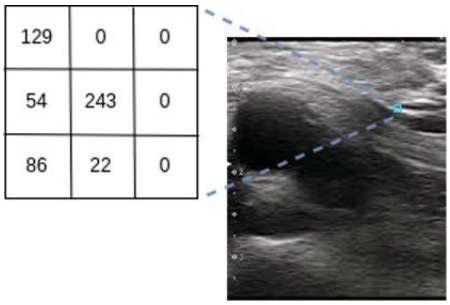

Fig 3. Ultrasound images as numbers to be input into an AI network.

Once we know this, we can use some calculus to work out how the loss changes with a change in the weight for each of the output nodes in turn. And by using the chain rule from calculus we can then work out how that weight changes with a change in the weight that precedes that node etc., all the way back to the input. We can use this information to update all the weights in the network which should slowly begin to reduce the loss. After many iterations the loss will converge at some minimal value and the network is trained.

AI in Ultrasound

There are many examples of AI being used in ultrasound in various specialties from breast cancer diagnosis to US-guided regional anaesthesia and even robotic US-guided femoral vascular access. There also are several examples of how AI has been used in a vascular context. For example, Ikeda (2021) et al trained a relatively simple network with just 649 images to assess carotid intima thickness. Their system achieved a measurement error of just 0.0106 ± 0.00310 mm. Total plaque area estimation has also been investigated. Cuadrado-Godia et al (2018) developed an ML model whose error was 19.44 mm2 which they used to estimate CVD risk. This CVD risk assessment idea was taken further by Jamthikar (2020) et al that looked at 221 patients assessing their 10-year CVD risk and concluded that their Machine Learning (ML)-based CVD/ stroke risk calculator provided a higher predictive ability of 10-year CVD/ stroke compared to the 13 different types of statistically derived risk calculators.

Now, this might sound like the robots are heading for our jobs, but improved tool capabilities rarely lead to this. What is more likely is that a single sonographer can do more in a shorter space of time due to this automation. One possible positive outcome for practitioners might be a decrease in RSI risk as a consequence of shorter scan times. Patients would also benefit from shorter scan and waiting times but this has to be done without sacrificing diagnostic accuracy. Other benefits of integrating AI were demonstrated by Narang et al (2021) who used AI for image optimisation and although this was to assist novice sonographers, it could be equally useful to reduce scanning time for experienced practitioners. This could also help in image standardisation within and between departments.

However you look at it. This will be a transformative technology and as Clinical Vascular Scientists it will probably be better for us and our patients if we strive to embrace it and integrate it into our workflow.

Written by Tim Fernandez-Hart.

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Bitesize Research:
Arteriovenous Fistula (AVF)

AUTHORS NAMES: Emily Morgan[1] and Laura Scott[2]
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PAPER 1:

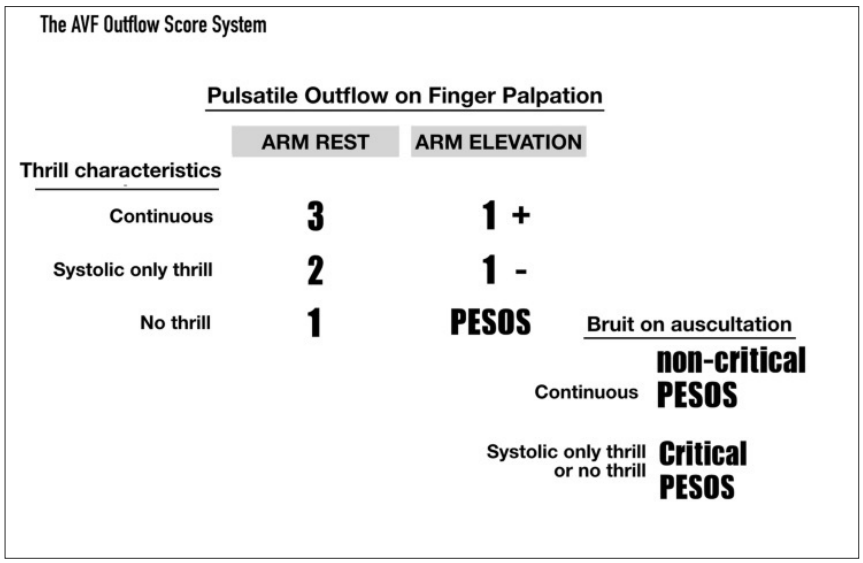
Chiung-Yu Chen, M. et al (2020). Quantification of the severity of outflow stenosis of haemodialysis fistulas with a pulse and thrill based scoring system. BMC Nephrology 21:304.

SUMMARY

Arteriovenous fistula (AVF) for haemodialysis access may be assessed for outflow stenosis by identifying hyper-pulsatility at the thrill on palpation. If the stenosis is severe, the thrill may not be detected, therefore the arm elevation test was developed for further physical assessment. Elevating the arm to the level of the heart should result in the AVF remaining distended, if there is a significant outflow stenosis, or collapsing, in the absence of a significant outflow stenosis. The absence of the thrill upon arm elevation indicates a severe outflow stenosis. The Physical Examination Significant Outflow Stenosis (PESOS) scoring system was previously developed for use with the arm elevation test (see below). In this prospective observational study, PESOS was compared with findings from duplex ultrasound (DUS) and angiogram to determine whether it could be used to quantify the severity of the stenosis.

PROS

PESOS correlates to a >75% outflow stenosis with high diagnostic accuracy (sensitivity 80% and specificity 79%) and could identify outflow stenosis in patients who were asymptomatic.



CONS

Small sample size of 84 patients over a period of 6 months. We do not routinely physically assess patients when performing DUS on AVF. More robust data would be required before clinicians adopt PESOS as part of their clinical assessment.

IMPACT ON PRACTICE

With further validation, PESOS could be introduced into haemodialysis clinics as a tool to identify AVF that are high risk of complication or failure during haemodialysis. This could benefit patients where a DUS service is not readily available.

PAPER 2:

Malik, J. et al. (2022). Arteriovenous Haemodialysis Access Stenosis Diagnosed by Duplex Doppler Ultrasonography: A Review. Diagnostics. 12(8): 1979.

SUMMARY

This recent review article highlights the importance of Duplex ultrasound (DUS) in diagnosing stenoses in arteriovenous fistula (AVF) for haemodialysis access. The types and typical sites of stenosis are described, as are the parameters used to diagnose stenosis by DUS.

DUS is a non-invasive, affordable and very precise method for diagnosing AVF stenoses. DUS is comparable, if not better, than angiography as DUS also allows for volume flow measurement (Qa). Qa is a reliable method for assessing whether the AVF is functioning adequately (i.e. >500 ml/min).

Vascular access differs considerably from natural arteries and veins, therefore finding grading criteria to define stenotic lesions can be challenging with a great deal of variation between centres. Percentage stenosis depends on what is being referenced as normal. Given the nature of AVF (vessel curves, venous valves and juxta-anastomosis) this can be challenging and is therefore a limitation of DUS and angiography. Despite these limitations, the concept of >50% stenosis is still recommended.

PROS

This is an overview of DUS for AVF and could be useful to Clinical Vascular Scientists who are training or new to performing this type of scan.

CONS

It states that there is variation in grading criteria in published literature, however the references included are limited. Practice may differ compared to CSVS guidelines as the authors are based in non-UK hospitals.

IMPACT ON PRACTICE

A combination of velocity increase at the site of stenosis and a reduction in Qa may be the most appropriate way for DUS to grade critical stenoses.

PAPER 3:

Holst-Jaeger E, et al (2024). Assessment of volume flow rate in arteriovenous fistulas with a novel ultrasound Doppler device (earlybird): Trend analysis, comparison of methods and inter-intra rater reliability. J Vasc Access (Epub): https://doi.org/10.1177/11297298241250

SUMMARY

The earlybird Doppler ultrasound monitoring device has been developed as a potential cost effective and user-friendly method to detect AVF failure. It is described as a dual Doppler device enabling volume flow rate measurements to be made regardless of the angle of insonation. This study compares the earlybird device against Duplex ultrasound (DUS) and dilution techniques to calculate volume flow rates (Qa).

DUS is a good method for monitoring AVF failure rate and is cost effective with low technical failure rates, however high levels of training are essential and more work is required to standardise grading criteria. MRA is a viable option, however costly and volume flow measurements have low reproducibility.

PROS

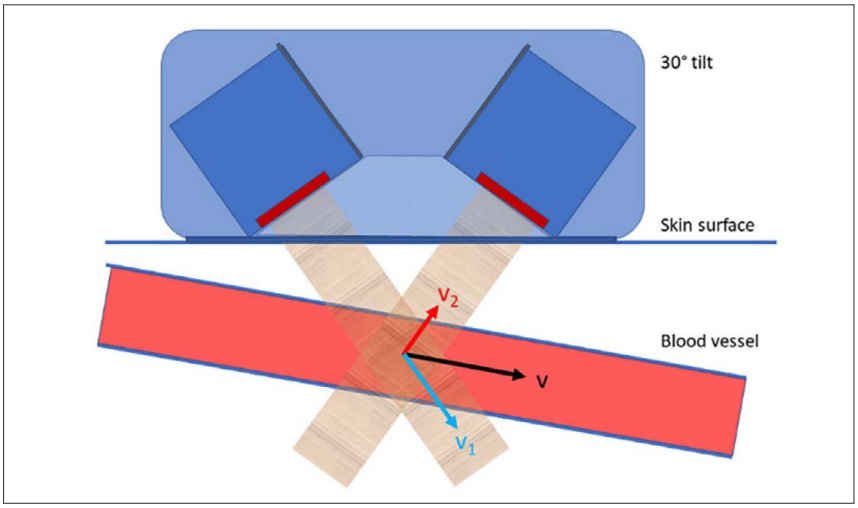
Earlybird showed high inter-rater reliability indicating a potential tool for frequent measurements, which could be useful for trend surveillance or predicting adverse outcomes.

CONS

The sample size of only 9 patients limits this study. A high percentage (33%) of early bird measurements had to be excluded from analysis (in comparison to only 3% of DUS). Earlybird demonstrated poorer reliability with deeper vessels, such as the brachial artery.

IMPACT ON CLINICAL PRACTICE

Due to the simple nature of the device, there is potential for it to be used as a screening tool in a clinic setting or bedside assessment, however a much larger scale study is required. DUS remains the most reliable method for AVF surveillance and monitoring. There remains a need for a simple and reproducible technique to assess AVF that can be performed by individuals from multi-professional teams.



PAPER 4:

Richards et al. (2024). Early ultrasound surveillance of newly-created hemodialysis arteriovenous fistula. Kidney International Reports 9, 1005-1019.

SUMMARY

The SONAR study was intended to inform a large, randomised trial to assess whether it would be possible to successfully intervene on arteriovenous fistula (AVF) that early duplex ultrasound (DUS) identify as at risk of failure. This first phase, assessed whether performing DUS scans on newly created AVF could identify those that might fail. Surveillance DUS scans were performed earlier than standard protocols: at two, four, six and ten weeks post- surgery. AVF maturation is characterised by high volume flow, an increase in the outflow vein diameter and 'arterialisation' of the vein wall. This is one of the few studies to test whether performing DUS on AVF early could impact longer-term AVF patency.

PROS

DUS was performed by appropriately trained Clinical Vascular Scientists. It was a prospective multi-centre observational cohort study with a decent sample size of 332 patients from 17 centres. AVF volume flow, venous diameter, and resistive index were used to assess AVF. This study demonstrated that DUS was good at confirming AVF maturation as early as 2 weeks post-AVF creation.

CONS

Ultrasound was less useful in identifying AVF that were not going to develop successfully. This was partly due to less AVF failing during SONAR than was predicted. Also, when AVF did thrombose the majority failed early, often before the first DUS, so there would be little opportunity for the AVF to be salvaged. Based on the findings of this study, it was concluded that it was not practical to proceed to Phase 2 of the SONAR trial.

IMPACT ON PRACTICE

Perhaps the introduction of a four week surveillance timepoint should be considered by Vascular Laboratories to identify sooner those AVF which have failed and enable redo surgery to be planned at earlier for this patient group.

Choosing A Statistical Test

Choosing the appropriate statistical test(s) for a study can be a daunting task when you are new to clinical research.

There are many, more comprehensive resources available on each statistical test, so the focus of this article will be to provide a flavour of a few statistical tests to get you started. We hope this will help you start the process of considering what type of analysis might be necessary to answer the clinical questions posed in a research study. At the end of the article, there are some brief signposts for support with planning your research statistics.

Questions to consider

What is the main study hypothesis?

If your study has a proposed hypothesis then a statistical test is likely to be required to determine the significance of the answer to the clinical question, for example "is modality B a suitable replacement for modality A for measurement X?", "does factor X influence variable Y?", or "which of modalities A, B or C is most sensitive for identifying condition X?" etc. The answer to your research question can be tested to check whether it is likely to be 'real' (i.e. statistically significant - unlikely to have occurred by chance) by using an appropriate statistical test.

What type of data is being used in the study?

In some cases, questions regarding the statistical validity of study data may need to be assessed prior to choosing a statistical test. These questions may include "what type of data are being investigated?", "are the data independent?", "are the data normally distributed?" and "what is the study power using this data group?".

What degree of statistical significance should be used?

Most clinical studies use a probability value (P-value) of $P < 0.05$ to indicate statistical significance of results, which means that there is a <5% probability that the results obtained are due chance, and a >95% probability that the results obtained are the result of a true relationship or difference between groups being compared. However, in some studies it may be appropriate to use a different P-value, for example in studies where multiple independent hypotheses are being tested it may be appropriate to use a Bonferroni correction, where the appropriate significance level is $P < 0.05/n$, where n represents the number of independent hypotheses. For example, in a study with two independent hypotheses, using a Bonferroni correction would provide a required P-value of $P < 0.025$.

Examples of statistical tests in existing studies

In this article, three clinical studies have been briefly analysed to demonstrate the appropriate statistical test for a particular clinical hypothesis, and to show how these tests are used to answer the question. Only the main statistical test used in answering the study hypothesis has been included for the sake of brevity, so this article will not cover analysing independence of study variables or normalisation of data. The aim of this article's analysis is to demonstrate how some common clinical hypotheses are answered in published research and thus provide an idea of how you might proceed with study design when proposing similar types of research.

Statistical aim: comparing the level of agreement between two different measurement modalities

Statistical test: Bland-Altman analysis

Bland-Altman analysis is a test designed to determine the level of agreement between two different modalities that are measuring the same variable. If one modality is considered the 'gold-standard' modality for this type of meas-

urement, then Bland-Altman can be used to assess the level of accuracy of the second modality by comparing it to the gold-standard method. Bland Altman analysis involves graphically plotting the measurement differences between the two modalities on the y-axis, against the mean of the two measurements on the x-axis. The average measurement difference is obtained which provides a 'bias'; the smaller the bias the higher the level of agreement between the two modalities.

Next, 'limits of agreement' are obtained by calculating ±1.96 standard deviations from the bias; 95% of the differences between modalities should ideally lie within these limits. Additionally, 'limits of acceptability' should also be agreed upon beforehand and these can also be inputted into the graph: if the limits of agreement fall within the limits of acceptability, then the two modalities can be said to demonstrate an acceptable level of agreement and could in theory be used interchangeably to obtain similar results when measuring that variable in future.

In the following study, Bland-Altman analysis was used to demonstrate that tomographic 3D-ultrasound (tUS) and duplex ultrasound (DUS) both demonstrate good agreement with fistulography for identifying and measuring the degree of stenosis within an arteriovenous fistula (AVF).

Rogers et al. (2021). Arteriovenous Fistula Surveillance Using Tomographic 3D Ultrasound. Eur J Vasc Endovasc Surg. 62(1), pp.82-88.

Study aim:

To investigate the level of agreement between tUS, DUS and fistulography for identifying and measuring AVF stenosis, with the aim of determining whether tUS is a suitable replacement for DUS in the assessment of AVF stenosis in future, as tUS is significantly less time-consuming and therefore would be beneficial for departmental workflow and reducing ultrasound-related musculoskeletal disorders.

Study summary:

97 patients with a poor-flow AVF underwent imaging with fistulography, tUS and DUS, which identified 101 stenoses for analysis. The degree of stenosis was measured and Bland-Altman analysis was performed to assess the level of agreement between each ultrasound modality and fistulography, which was considered the gold-standard measurement modality. Bland-Altman analysis demonstrated close agreement between fistulography and DUS / tUS, with tUS showing slightly better agreement, indicating that all three measurement modalities are interchangeable when measuring degree of AVF stenosis. However, tUS has the additional benefits of being non-invasive unlike fistulography, and takes less than half the time to perform compared to DUS, indicating that tUS is a promising modality for obtaining non-invasive, fast and accurate AVF stenosis measurements.

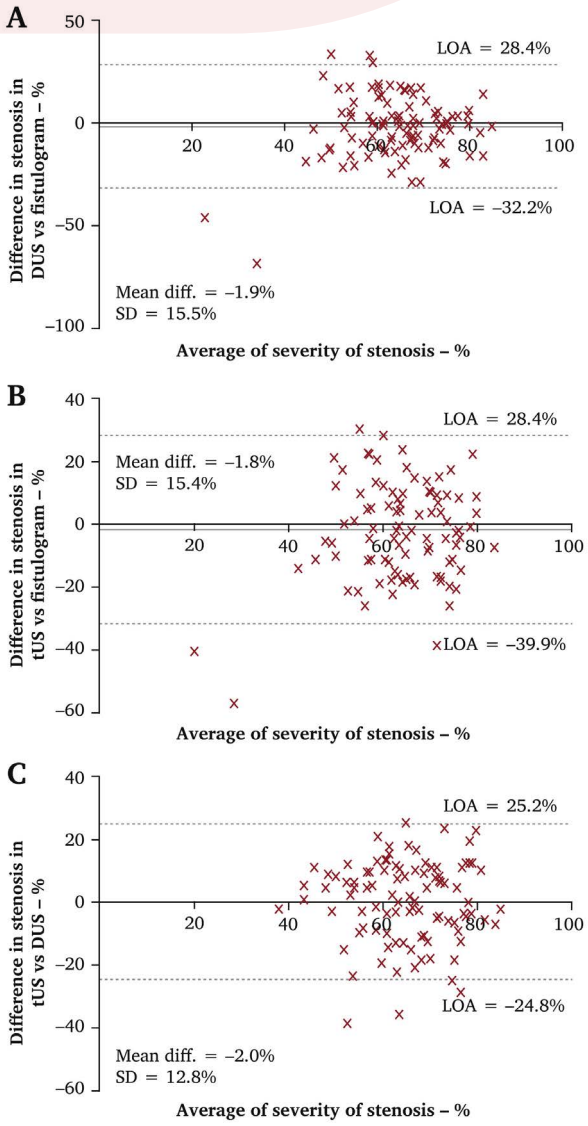


Figure 1. Bland-Altman agreement for (A) duplex ultrasound (DUS) and (B) tomographic 3D-ultrasound (tUS) compared with fistulography as the gold-standard, and (C) tUS compared with DUS as the gold-standard in the measurement of arteriovenous fistula (AVF) stenosis. D = standard deviation; LOA = limit of agreement.

Statistical aim: investigating differences in means between independent groups

Statistical test: One-way ANOVA

One-way analysis of variance (ANOVA) is a statistical test used to compare the means between independent variables in a study and determine whether any of the means are statistically significant from each other. In this study, one-way ANOVA has been used to demonstrate that there is a statistically significant increase in mean abdominal aortic aneurysm (AAA) growth rate (GR) as AAA size increases. One-way ANOVA has also been used in this study to demonstrate that there was no statistically significant difference in mean AAA GR between non-smokers and smokers or ex-smokers, between genders, and between normotensive or hypertensive patients. This shows that for this patient cohort the most significant factor affecting AAA GR is AAA size, and thus the author suggests that AAA size should be taken into consideration when determining AAA surveillance intervals.

Ian Hornby-Foster. (2023). Abdominal aortic aneurysm growth rates in patients undergoing local ultrasound surveillance. Ultrasound. 31(1), pp.23-32.

Study aim:

A retrospective analysis of AAA ultrasound surveillance in University Hospitals Bristol and Weston (UHBW), with the aim of assessing AAA GR and the concurrent impact of AAA risk factors (RFs) and associated medications, to inform whether the current UHBW AAA surveillance protocol is safe and appropriate.

Study summary:

315 patients comprising 1312 AAA scans were investigated, with exclusion criteria including aortic diameter measurements <3.0cm or >5.5cm, and patients who had fewer than 2 AAA scans. The patients were divided into groups of 0.5cm increments (3.0 – 3.4cm, 3.5 – 3.9cm, 4.0 – 4.4cm, 4.5 – 4.9cm, 5.0 – 5.5cm), based on baseline AAA size. Annual GR between groups was compared using one-way ANOVA. One-way ANOVA was also used to investigate the influence of risk factors on AAA GR.

Mean GR for all patients was 0.25cm per year, however one-way ANOVA demonstrated a significant increase in GR with increasing AAA diameter. One-way ANOVA also demonstrated that there was no statistically significant impact of age, smoking, gender, hypertension, or hypercholesterolaemia on AAA GR for this patient cohort. However, there was a significant difference between the mean growth rate of diabetic and non-diabetic patients, suggesting an inverse relationship of diabetes presence and AAA GR.

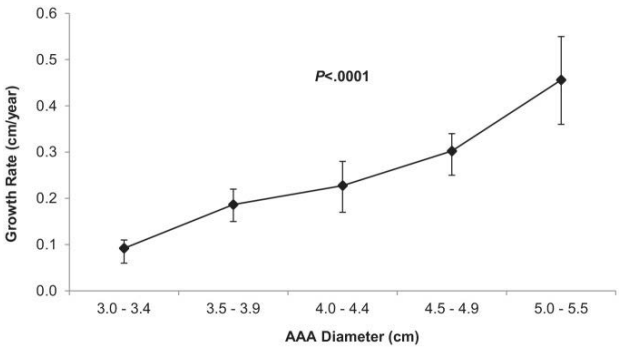


Figure 2. Mean annual AAA growth rates (cm/year) with error bars indicating top and bottom end 95% confidence intervals. AAA GR can be seen to increase with AAA diameter.

Statistical aim: investigating sensitivity and specificity of a measurement modality

Statistical test: receiver operating characteristic (ROC) curve analysis

A ROC curve is a graphical plot that illustrates the performance of a binary classifier model at varying threshold values, by plotting true positive rate vs false positive rate at each threshold. A higher area under the curve (AUC) indicates higher specificity and sensitivity for this classification model, i.e. this model is more likely to provide a true positive result and less likely to provide a false positive result. In the study below, ROC curves are used to demonstrate that intra-arterial fractional flow reserve (FFR) measurement has the highest sensitivity and joint highest specificity (with translesional pressure measurement (Pd/Pa)) for predicting presence of critical limb-threatening ischaemia (CLTI).

Albayati et al. (2024). Intra-arterial Fractional Flow Reserve Measurements Provide an Objective Assessment of the Functional Significance of Peripheral Arterial Stenoses. Eur J Vasc Endovasc Surg. 67(2), pp.332-340.

Study aim:

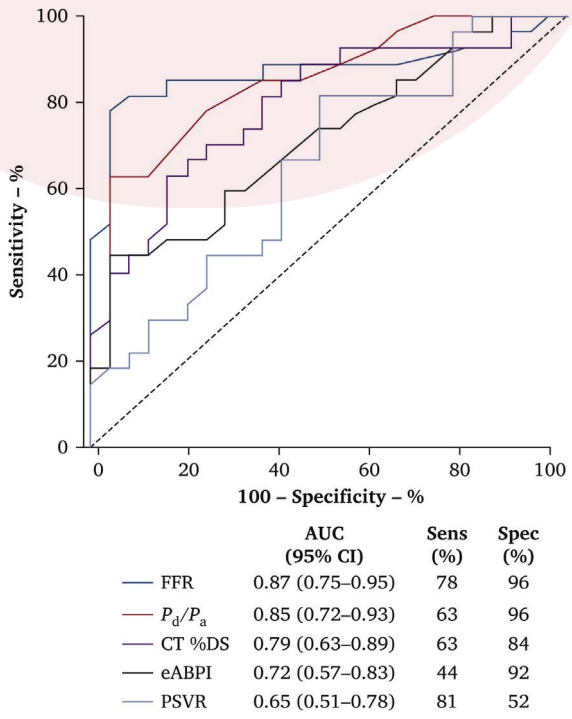
To use FFR to investigate the ischaemic potential of peripheral arterial stenoses, and compare this technique to other methods of investi-

gating stenosis: ankle brachial pressure index (ABPI), duplex ultrasound (DUS), CT angiography (CTA), and translesional pressure measurement (Pd/Pa).

Study summary:

61 isolated iliac or superficial femoral artery stenoses in 41 patients (10 patients with bilateral disease) with either short-distance claudication or CLTI were recruited prior to elective angioplasty and/or stenting. Pre-procedural investigations (resting and exercise ABPI, DUS peak systolic velocity ratio (PSVR), and CTA were performed; intravascular Doppler derived flow reserve and pressure derived FFR were obtained during angioplasty. Blood oxygen level dependent (BOLD) cardiovascular magnetic resonance (CMR) was performed before and after angioplasty to assess calf oxygenation.

Association between variables and disease severity was assessed using ROC curve analysis, which showed that a lower FFR AUC was associated with CLTI in the cohort studied. The degree of lesional stenosis measured by CTA, ABPI and PSVR had weaker associations with CLTI than FFR. FFR demonstrated the highest sensitivity and joint highest specificity for predicting CLTI in this cohort.



	AUC (95% CI)	Sens (%)	Spec (%)
FFR	0.87 (0.75–0.95)	78	96
P_d/P_a	0.85 (0.72–0.93)	63	96
CT %DS	0.79 (0.63–0.89)	63	84
eABPI	0.72 (0.57–0.83)	44	92
PSVR	0.65 (0.51–0.78)	81	52

Figure 3. Association between standard of care assessments and intra-arterial pressure-flow measurements with CLTI. ROC curve analysis with corresponding AUC, 95% confidence interval (CI) and sensitivity (Sens) and specificity Spec) values displayed. FFR demonstrates the greatest AUC for association with CLTI in this cohort.

Research support resources

Only a handful of statistical tests have been covered in this article, hopefully providing you with a starting point for how you might begin to consider testing your own research questions and data. There is a much wider range of statistical tests to choose from, which will warrant careful consideration to select the correct statistical method for your research. During the design phase of your research, it is valuable to consider the type and structure of data you intend to generate as it may impact how you use statistics during analysis. For support, try contacting your local research & development department and asking whether they have an associated statistician. Additionally, take a look at the support offered through the National Institute for Health Research (NIHR):

- NIHR Research Support Services (various)
- NIHR RSS for Public Health
- NIHR - 'I need help designing my research'

Written by Ben Warner-Michel
Kingston Hospital Foundation Trust, London

Edited by Isaac Colliver
University Hospitals Coventry & Warwickshire, Coventry

CSVS Vascular Access and Haemodialysis Study Day
27th September 2024

Scan me

09:45 -16:00	Friday 27th September 2024
Venue	WESTON EDUCATION CENTRE, KING'S COLLEGE HOSPITAL, DENMARK HILL, LONDON

Aims of Study Day

To educate Clinical Vascular Scientists and Clinical specialists on Vascular Access for haemodialysis and the use of duplex ultrasound for mapping and assessment of fistulas.

09:45	**Welcome and Coffee**	
10:00	"Discuss arteriovenous fistula/graft creation and salvage procedures from a vascular surgeon's perspective".	Prof. Domenico Valenti **Consultant Vascular Surgeon**
10:45	"Share insights on interventional radiology procedures related to vascular access and dialysis."	Dr. Jason Wilkins **Consultant Radiological Medicine**
11:30	**Coffee Break**	
11:45	"Patient pathway, challenges renal patients face, the importance of intervention, and patient outcomes."	Dr. Alexandra Rankin **Consultant nephrologist**
12.30	**Lunch**	
13:15	"Highlight the critical role of dialysis nurse spe-cialists in patient education, care coordination, and access management."	Fatima De Figueiredo **Senior Vascular Access Nurse**
13:45	"Patient Support & Advocacy Service: the ways that we can support kidney patients"	Jonathan Bartley **Patient Support and Advocacy Manager – Kidney Care UK**
14:00	"Vascular access mapping and fistula surveillance: Vascular Scientist perspective."	Ben Freedman & Tamara Walcott-Dhainy **Senior Clinical Vascular Scientist**
14:45	Hands on practical scanning session	
15:45	Conclusion to workshop **16:00 MEETING CLOSE**	

Fees

Members: £ 115 // Non-Members: £205

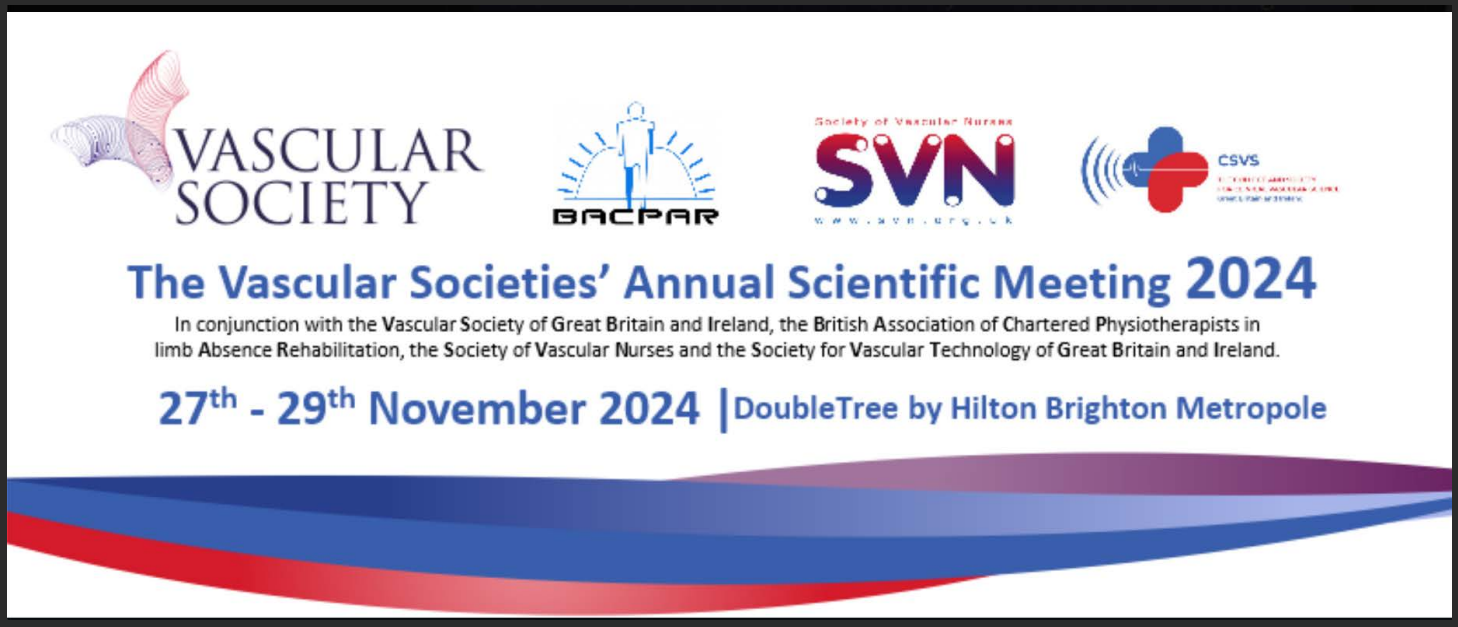
If you have any queries about the day or require further information, please email the Study Day Officer: louis.alexander@nhs.net

Calling All CSVS Members...

REGISTER NOW for the Vascular Society Annual Scientific Meeting 2024 in Brighton! To be held on Wednesday 27th to Friday 29th November 2024.

Early bird rates available until 30th September

https://execbs.eventsair.com/vascular-societies-asm-2024/asm24delreg/Site/Register



AVS Accreditation

Huge congratulations to these members for successfully passing their AVS Exams

- Katherine Chamberlain
- Alannah Morley-Brown
- Ben Warner Michael
- Liezel Asunicon
- Samar Hamad