



Bitesize Research:

Arteriovenous Fistula (AVF)

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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.

The AVF Outflow Score System			
Thrill characteristics	Pulsatile Outflow on Finger Palpation		Bruit on auscultation
	ARM REST	ARM ELEVATION	
Continuous	3	1 +	non-critical PESOS
Systolic only thrill	2	1 -	
No thrill	1	PESOS	
			Continuous PESOS
			Systolic only thrill or no thrill Critical PESOS

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-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

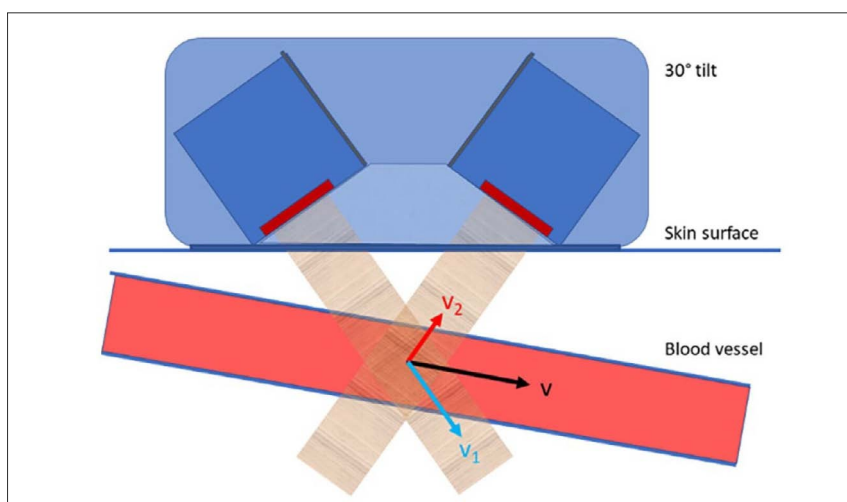
Earlybird showed high inter-rater reliability indicating a potential tool for frequent measurements, which could be useful for trend surveillance or predicting adverse outcomes.

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 time-point 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. 🚩