# Arteriovenous fistula outcomes in the elderly

**Damian McGrogan, MBBChBAO, MRCS,[a] Julien Al Shakarchi, MBChB, MSc, MRCS,[a,b] Aurangzaib Khawaja, MD,[a,b] Jay Nath, MBChB (Hons), MRCS,[a] James Hodson, BSc,[c] Alexander P. Maxwell, MD, PhD, FRCP,[d] and Nicholas G. Inston, PhD, FRCS,[a,b]** *Birmingham, Dundee, and Belfast, United Kingdom*

***Objective:*** **Over several decades, there has been an increase in the number of elderly patients requiring hemodialysis. These older patients typically have an increased incidence of comorbidities including diabetes, hypertension, and peripheral vascular disease. We undertook a systematic review of the current literature to assess outcomes of arteriovenous fistula (AVF) formation in the elderly and to compare the results of radiocephalic AVFs vs brachiocephalic AVFs in older patients.**
***Methods:*** **A literature search was performed using MEDLINE, Embase, PubMed, and the Cochrane Library. All retrieved articles published before December 31, 2014 (and in English) primarily describing the creation of hemodialysis vascular access for elderly patients were considered for inclusion. We report pooled AVF patency rates and a comparison of radiocephalic vs brachiocephalic AVF patency rates using odds ratios (ORs).**
***Results:*** **Of 199 relevant articles reviewed, 15 were deemed eligible for the review. The pooled 12-month primary and secondary AVF patency rates were 53.6% (95% confidence interval [CI], 47.3-59.9) and 71.6% (95% CI, 59.2-82.7), respectively. Comparison of radiocephalic vs brachiocephalic AVF patency rates demonstrated that radiocephalic AVFs have inferior primary (OR, 0.72; 95% CI, 0.55-0.93; $P = .01$) and secondary (OR, 0.76; 95% CI, 0.58-1.00; $P = .05$) patency rates.**
***Conclusions:*** **This meta-analysis confirms that adequate 12-month primary and secondary AVF patency rates can be achieved in elderly patients. Brachiocephalic AVFs have both superior primary and secondary patency rates at 12 months compared with radiocephalic AVFs. These important data can inform clinicians' and patients' decision-making about suitability of attempting AVF formation in older persons. (J Vasc Surg 2015;62:1652-7.)**

Hemodialysis was once a treatment offered only to younger patients, but there has been a substantial increase in older patients accepted for chronic dialysis in recent times, reflecting the increased incidence of end-stage renal disease in the elderly and improved availability of dialysis.[1] Given the limited life span of arteriovenous fistulas (AVFs), the approach to access planning has been primarily to use the smaller distal arterial vessels, preserving the proximal vessels for future use. However, elderly patients commencing dialysis have a significantly higher mortality, reported to be as high as 29.1%[2] 1 year after AVF creation and >50% at 2 years after commencing hemodialysis.[3] Older patients have an increased incidence of comorbidities including diabetes, hypertension, and peripheral vascular disease.[4] DeSilva et al[5] have shown that elderly patients commencing dialysis with a central venous catheter (CVC) have a higher mortality than older patients with surgically created vascular access. They have also reported that there is no significant improvement in survival when AVFs are placed first in preference to arteriovenous grafts.[5] In addition, AVFs might have a prolonged maturation period, which would mean an increased period of CVC dependence in a frail elderly population, whereas arteriovenous grafts can be cannulated early.[6] Creation of a successful fistula at the first operation is therefore of greater importance in this cohort to reduce the need for interim dialysis through a CVC while establishing a successful AVF.

There is also an argument that elderly patients might have poorer rates of AVF maturation because of their comorbidities. Peripheral vascular disease can impair the inflow of blood to the AVF and therefore affect its maturation. This has led to a surgical preference for creating a brachiocephalic AVF rather than a radiocephalic AVF in older patients. A counterbalancing consideration is the higher rate of vascular steal syndrome with brachiocephalic AVFs.[7]

There is limited available literature describing outcomes of AVF placements in the elderly, with conflicting conclusions. The aim of our systematic review of the current literature was to assess outcomes of AVF formation in the elderly and to compare results of radiocephalic vs brachiocephalic AVF placements.

## METHODS

**Search methodology for identification of relevant studies.** Searches of PubMed, MEDLINE, Embase, and the Cochrane Library were performed using a combination

From the Department of Renal Surgery[a] and Department of Statistics, Wolfson Computer Laboratory,[c] University Hospitals Birmingham, Queen Elizabeth Hospital, Birmingham; ReDVA Research Consortium, Dundee[b]; and the Department of Nephrology, Regional Nephrology Unit, Belfast Health and Social Care Trust, Belfast City Hospital, Belfast.[d]

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Correspondence: Damian McGrogan, MBBChBAO, MRCS, Department of Vascular Access and Renal Transplantation, University Hospitals Birmingham, Queen Elizabeth Hospital, Edgbaston, Birmingham B15 2TH, UK (e-mail: damianmcg@gmail.com; damian.mcgrogan@uhb.nhs.uk).

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of the following search terms: "brachiocephalic fistula," "radiocephalic fistula," "snuff box fistula," "arteriovenous fistula," "vascular access and elderly." All resulting articles published before December 31, 2014, in English, dealing primarily with the surgical creation of dialysis vascular access for elderly patients were considered for inclusion. In addition, the references cited in selected articles were manually reviewed for any further relevant available studies. Because there is no consensus on the definition of elderly, this was defined as anyone older than 60 years according to definitions within the published literature.

We included published randomized trials and observational studies. We excluded abstracts, case reports, review articles, editorials without original data, and non-English publications. Gray literature was not searched or included. The systematic review was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[8] Therefore, all included studies were assessed for inclusion on the basis of their topic, type of study, method, number of patients included, and availability of their original results.

**Primary and secondary aims.** All studies that met the set criteria were reviewed and assessed for methodologic quality. Two reviewers (J.A., D.M.) independently extracted data using a standardized table. This was performed in duplicate to increase accuracy. If there was any discrepancy in the extracted data, we resolved it by asking for a third reviewer's opinion (A.K.). Data extracted included primary and secondary AVF outcomes as well as the year of publication, number of patients included, and their mean age. The primary aim of the study was to pool the 12-month primary and secondary AVF patency rates. The secondary aim was to compare these patency rates between brachiocephalic and radiocephalic AVFs, using the subset of studies in which outcomes for both types of AVF were reported.

**Statistical analysis.** Data were extracted from studies that quoted specific figures for analysis only. Papers that showed data in graph form were not included in the analysis so as to exclude interpretation bias. The inverse of the Freeman-Tukey double arcsine transformation[9] was applied to the primary and secondary patency rates. This is a method of normalizing and stabilizing the variance of proportions to allow them to be pooled. It is a standard approach used for this type of meta-analysis by a range of statistical software packages.[10,11] The resulting values were then pooled using random-effects (DerSimonian and Laird) models before being transformed back into proportions.

For the subset of studies reporting outcomes of both radiocephalic and brachiocephalic AVFs, Review Manager version 5.3 was used to produce a fixed effects (Mantel-Haenszel) model, comparing patency rates between AVF types.[12] This is the standard approach used by the software in cases in which the between-study variability is negligible.

All data analysis was performed under the supervision of the University Hospitals Birmingham statistician (J.H.). Pooled patency rates at 12 months are quoted with confidence intervals (CIs). Pooled comparison of patency rates of radiocephalic vs brachiocephalic AVFs are quoted using odds ratios (ORs) and CIs. An OR <1 indicates better patency in brachiocephalic than in radiocephalic AVFs.

## RESULTS

There were 199 relevant articles and abstracts identified. After screening of the contents of the abstract, 75 full-text articles underwent assessment for eligibility and quality inspection of methodology. After this, there were 15 articles eligible for the systematic review (Fig 1).

**Twelve-month AVF patency rates in elderly patients.** A total of 15 studies were included in the analysis of primary and secondary AVF patency rates as shown in the Table. The definition of elderly in the included papers ranged from >60 to >80 years of age. A total of 1889 AVFs were included in this initial analysis, and the overall mean age of the patients was 76 years. Pooled primary (Fig 2) and secondary (Fig 3) AVF patency rates were 53.6% (95% CI, 47.3-59.9) and 71.6% (95% CI, 59.2-82.7), respectively. For both outcomes, considerable levels of heterogeneity were identified, with $I^2$ values of 84.6% and 96.7% for primary and secondary patency, respectively. However, a funnel plot of the reported primary patency (Fig 4) gave no indication that this heterogeneity was due to publication bias.

**Twelve-month radiocephalic vs brachiocephalic AVF patency rates in elderly patients.** Seven studies were included in the analysis of radiocephalic AVF vs brachiocephalic AVF patency rates. Pooled primary patency rates for radiocephalic and brachiocephalic AVFs were 49.7% (38.8-60.6) and 58.5% (47.6-69), respectively. Pooled secondary AVF patency rates were 65.1% (53.7-75.8) for radiocephalic AVFs and 72.7% (59.2-84.4) for brachiocephalic AVFs. Significant levels of heterogeneity were also found in calculating these pooled patency rates. Comparison of radiocephalic vs brachiocephalic AVF primary patency rates (Fig 5) indicated significantly inferior surgical outcomes for radiocephalic AVFs (OR, 0.72; 95% CI, 0.55-0.93; $P = .01$). Similarly, secondary AVF patency rates (Fig 6) also showed inferior radiocephalic outcomes (OR, 0.76; 95% CI, 0.58-1.00; $P = .05$). We report $I^2$ values of 0% for these comparisons.

**Degree of bias.** A funnel plot was estimated on the basis of the 15 papers included in the overall 12-month primary AVF patency rates as shown in Fig 4. The plot is symmetrical, suggesting that publication bias is unlikely to have substantially influenced our results.

## DISCUSSION

This paper describes the pooled 12-month AVF patency rates in elderly patients and compares the primary and secondary AVF patencies at 12 months for radiocephalic vs brachiocephalic AVFs. Brachiocephalic AVFs show superior primary and secondary patency compared with radiocephalic AVFs at 12 months. These important results can be used to assist clinicians' and patients'

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