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REVIEW

Regional Versus Local Anaesthesia for Haemodialysis Arteriovenous Fistula Formation: A Systematic Review and Meta-Analysis

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WHAT THIS PAPER ADDS

Arteriovenous fistulas (AVF) are the preferred vascular access modality in patients with end stage renal disease (ESRD) requiring haemodialysis. However, no consensus exists over the optimal mode of anaesthesia for AVF creation. This systematic review and meta-analysis, by pooling data from four randomised trials, demonstrates better short-term patency rates in autologous, mainly radiocephalic, AVFs when fashioned under regional compared with local anaesthesia.

Background: Arteriovenous fistula (AVF) formation is the most common vascular access procedure for patients requiring haemodialysis. However, it is associated with high failure rates, influenced by vessel diameter and arterial inflow. Mode of anaesthesia may affect these factors, and subsequently AVF maturation rates.

Objective: To perform a systematic review and meta-analysis to assess the effect of anaesthesia type for autologous primary radiocephalic or brachiocephalic AVF creation on subsequent fistula failure rates.

Methods: The online databases of Medline, EMBASE, CINAHL, The Cochrane Database of Systematic Reviews, ClinicalTrials.gov, and Google Scholar as well as vascular and anaesthesiology conference abstracts were searched on August 1, 2016. Randomised control trials (RCTs) that reported the effect of anaesthesia type on subsequent failure rates during autologous AVF creation were included. Two independent reviewers performed methodological assessment and data extraction. Random effects models were used to calculate pooled effect size estimates. A sensitivity analysis was also carried out.

Results: Four RCTs (286 patients) were identified with 286 autologous AVFs. There were 48 fistula failures. Most of the studies suffered from significant methodological flaws. There was a significantly lower failure rate among patients undergoing regional (12/143) compared with local (36/143) anaesthesia (OR 0.28, 95% CI 0.14–0.57). On sensitivity analysis, having excluded the most heavily weighted study, the results remained significant (OR 0.20, 95% CI 0.05–0.75).

Conclusions: The use of regional anaesthesia is associated with lower AVF failure rates when compared with local anaesthesia in patients undergoing primary forearm AVF formation for haemodialysis.

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INTRODUCTION

End stage renal disease (ESRD) is increasing worldwide, representing a significant economic burden, with estimated annual medical costs per patient reaching $180,000.[1] The mainstay of ESRD treatment is renal replacement therapy (RRT), either by haemodialysis or peritoneal dialysis or ultimately renal transplantation. Haemodialysis is the most common form of RRT and arteriovenous fistula (AVF), the preferred vascular access modality. Compared with tunnelled central venous catheters and prosthetic grafts, AVFs have a lower risk of systemic sepsis and both all-cause and cardiovascular mortality.[2–4] A significant proportion of initially fashioned radiocephalic AVFs fails at an early stage[5] because of thrombosis, inadequate blood flow, and/or insufficient maturation. Interventions to maintain the dialysis access site (i.e. fistula revisions and declotting procedures) cost $600 million annually in the USA.[6]

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Fistula maturation is related to pre-operative (arterial and venous diameter), post-operative (blood flow through the AVF), patient, and surgeon related factors.[7] Research efforts have targeted these factors to improve fistula patency rates. It has long been postulated that anaesthetic techniques may affect the rate of blood flow through AVFs and the subsequent success rate.[8–10] Although local, general, or regional anaesthesia are all acceptable modalities for AVF creation, accumulating evidence suggests that regional anaesthesia in the form of a brachial plexus block is associated with significantly increased AVF blood flow as well as higher primary patency rates at 3 months, compared with local anaesthetic infiltration.[11,12] A systematic review and meta-analysis was performed to assess the effect of anaesthesia type for autologous primary radiocephalic or brachiocephalic AVF creation on fistula failure rates.

MATERIALS AND METHODS

This systematic review and meta-analysis was conducted according to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines.[13] There was no published protocol for this review.

Eligibility criteria

A search was conducted for randomised controlled trials (RCTs) that commented on regional versus local anaesthesia for creation of primary autologous AVFs in patients scheduled to undergo haemodialysis. Studies were required to have an outcome, such as fistula failure/success or patency rate, for inclusion. Observational studies, case series, and review articles were excluded from this review. Trials that evaluated anaesthetic techniques for other types of fistulas such as transposed brachio-basilic AVF or AVF creation using a graft were not included, as these are associated with increased operative time, a long surgical incision, and most of the time local anaesthesia is not sufficient.[8,14]

Search strategy

The online literature was searched using the following medical subject heading (MeSH) terms [“Fistula” OR “Arteriovenous” OR “Access”] AND [“Anaesthesia” OR “Anesthesia”]. The online databases of Medline, CINAHL, EMBASE, Cochrane Central Register of Controlled Trials as well as Google Scholar and vascular and anaesthesiology conference abstracts were searched for relevant articles. There were no language or publication date restrictions. The search was performed between November 1963 and August 2016, with the latest search performed on August 1. Two authors (RC and SMS) independently examined the title and abstract of citations, and full texts of potentially eligible studies were obtained. Disagreement was resolved by discussion, and if remaining unsettled, the opinion of the senior author (SRW) was sought. The bibliographies of retrieved studies were further screened for potential additional studies for inclusion. The primary endpoint for this review was fistula failure rate. This was an umbrella term that included any thrombosed, non-matured, or non-patent AVF for whatever reason (i.e. inadequate blood flow, infection, thrombosis, haematoma, etc.). There were no secondary endpoints.

Data extraction

RC and SMS independently extracted data from the included studies into a Microsoft Excel spreadsheet. The following information regarding each eligible trial was recorded: authors’ names, journal, year of publication, gender, mean age, sample size, presence of comorbidities, anaesthesia treatment modality, type of fistula created, fistula patency/failure/occlusion rates, mean initial artery and vein diameters, reasons for fistula failure, and length of follow-up. These can be found in Table 1.

Quality assessment for risk of bias in individual studies

The risk of bias was assessed using the Cochrane “Risk of bias” tool, which evaluates randomisation method, allocation concealment, blinding of participants and personnel, blinding of outcome assessor, risk of incomplete outcome data, risk of selective reporting, and other sources of bias (ethical approval, informed consent, and funding).[15] Each item was rated as “low”, “unclear”, or “high” risk of bias. Disagreement was resolved through discussion. Details of the quality assessment can be found in Table 2.

Data analysis

All pooled outcome measures were determined using the random effects model as described by DerSimonian and Laird, and the OR was estimated with its 95% CI.[16] The random effect analysis weighted the natural logarithm of each study’s OR by the inverse of its variance plus an estimate of the between study variance in the presence of between study heterogeneity. The existing heterogeneity between ORs for the same outcome between different studies was assessed by the I^2 inconsistency test. The I^2 inconsistency test describes the percentage of total variation across studies, which is a result of heterogeneity rather than chance. A value of 0% indicates no observed statistical heterogeneity, while larger values signify increasing heterogeneity.

A sensitivity analysis was also performed without the study of Aitken et al.[11] (most heavily weighted study in favour of regional anaesthesia), to compare outcomes. Analyses were conducted using Review Manager software (RevMan, version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2012).

RESULTS

Study selection

The study selection process is outlined in the PRISMA flow diagram (Fig. 1). The initial search yielded 327 articles, but after screening of titles and abstracts, 18 studies remained. Of these, 10 were excluded as they failed to meet the eligibility criteria: two were reviews, three did not directly compare regional with local anaesthesia, three did not

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