The Effect of Anastomosis and Graft Geometry on Arteriovenous Graft Patency in Hemodialysis Patients: a systematic review and meta-analysis

Pamir Sawo1,2, Andrew Mouflerrej3, Tammo Delhaas4, Jan Tordoir1, Barend Mees1,3
1 Department of Vascular Surgery, Maastricht University Medical Center and CARIM School for Cardiovascular Diseases, Maastricht University, Maastricht - The Netherlands
2 Department of Biomedical Engineering, Maastricht University, Maastricht - The Netherlands
3 European Vascular Center-Ascan Maastricht, Ascan Maastricht - The Netherlands and North - Germany

Background
Arteriovenous grafts (AVG) are the second best option for hemodialysis access after arteriovenous fistula (AVF). The major problem with AVG is that their prosthetic nature leads to the process of neointimal hyperplasia (NIH), leading to thrombosis, which is linked to a high morbidity and revision rate. Considering the important role of hematologic changes in the pathogenesis of NIH, reduction of the unfavorable hematodynamics appears to be a promising alternative approach to counteract NIH development and thereby improve graft patency. This meta-analysis aims to evaluate the effect of geometrically modified AVGs on graft patency and NIH in patients requiring hemodialysis not eligible for AVF.

Research Question
1. Do geometrically modified AVGs have a higher patency and are less prone to NIH development compare to standard ePTFE AVGs?
2. What is the most effective approach of geometric AVG modification based on current scientific literature?

Methods
• The MEDLINE electronic database was systematically searched for relevant articles
• Two authors independently conducted all searches to reduce risk of bias
• Included randomized-controlled trials (RCT) studying:
  - Primary & secondary patency
  - Graft outlet stenosis (NIH)
  - Geometrically modified AVG versus standard ePTFE AVG

Data Extraction
• The authors extracted the data from the included articles based on the authors’ judgment of relevant data
• The differences of opinion between the authors were resolved by discussion

Results
Risk of Bias
• The included articles risk of bias was deemed to be “high”, “low”, or “unclear”
• Rating suggest a moderate risk of bias of the included studies

Meta-analysis
• Relative risks (RR) were pooled from each trial using the Mantel-Haenszel random effects model
• The 95% confidence intervals (CIs) were estimated for each outcome
• Outcomes were reported as cumulative incidence of loss primary or secondary patency (ie, event rate)
• A RR < 1.0 indicates benefit from modified AVG versus standard AVG

Forest plot represents the number of patients with loss of primary patency (events) and associated 95% confidence intervals of 1-year primary patency for each study.

Forest plot represents the number of patients with loss of secondary patency (events) and associated 95% confidence intervals of 1-year secondary patency for each study.

Conclusion
This meta-analysis clearly shows that geometric modifications can positively influence patency. However, the heterogeneity and low number of available RCTs limits the rigidity of the results. Despite of these limitations this meta-analysis shows the potential of geometrically modified grafts and should stimulate further clinical and fundamental research on improving graft geometry.

Discussion
• The results obtained from the included articles indicate the potential of geometrically modified AVG to increase AVG patency
• The results also enable distilling the most promising designs from the less promising ones
• The significant beneficial effects observed with the Venaflo® AVG design indicate a potential benefit of this graft type if compared to the standard AVG.
• The Tyrell Vein Patch AVG seemed to have a negative effect on primary patency rates

References