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Clinical Research

Post-General Anesthesia Ultrasound-Guided Venous Mapping Increases Autogenous Access Placement Rates

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Background: This study investigates the impact of introducing a post-general anesthesia ultrasound (PAUS) mapping on the type of vascular access chosen for hemodialysis in patients without previous accesses.

Methods: Two hundred three of 297 consecutive patients met inclusion criteria and were reviewed. Within-subjects analysis was performed on patients with both an outpatient ultrasound-guided vein mapping and a PAUS using sign tests and Wilcoxon signed rank tests. Furthermore, a between-subjects analysis added patients with only the outpatient vein mapping; demographic and comorbidity data were analyzed using *t*-tests and chi-squared tests. An ordinal logit regression was run for the type of access placed, while a bivariate logit regression was used to compare rates of autogenous access maturation.

Results: One hundred sixty-five (81%) patients received both a standard outpatient vein mapping and a PAUS. At the outpatient vein mapping, 130 (79%) patients had suitable veins for an autogenous access, whereas 35 (21%) patients did not have suitable veins for an autogenous access and were planned for a prosthetic access. During PAUS, all 165 (100%) patients were found to have suitable veins for autogenous access formation ($P < 0.001$). When comparing specific autogenous access configurations, Wilcoxon signed rank testing showed significantly more preferable access configurations in the PAUS group than the outpatient mapping ($P < 0.001$); outpatient mapping resulted in 81 (47%) radiocephalic accesses, 10 (6%) radiobasilic accesses, 20 (12%) brachiocephalic accesses, 19 (12%) brachiobasilic accesses, and 35 (21%) prosthetic accesses planned, in contrast to 149 (90%) radiocephalic accesses, 3 (2%) radiobasilic accesses, 10 (6%) brachiocephalic accesses, 3 (2%) brachiobasilic accesses, and 0 prosthetic accesses when the same patients were analyzed using PAUS. With the analysis expanded to include the 38 (19%) patients with only the outpatient vein mapping (without-PAUS), the Wilcoxon-Mann-Whitney test showed no significant differences between the groups in terms of outpatient vein mapping plans ($P = 0.10$); however, when comparing the PAUS plans to the outpatient vein mapping plans, there was again a significantly increased proportion of preferred access types in the PAUS group compared with the outpatient group ($P < 0.001$). In the ordinal logit multivariate analysis, the only significant variable was the postanesthesia ultrasound, which positively correlated with more favorable access configurations (coefficient = 2.61, $P < 0.001$). The bivariate logit regression for autogenous access maturation rates found no significant difference between the without-PAUS group and the PAUS group ($P = 0.13$).

Conclusions: Introducing a postanesthesia ultrasound mapping to guide vein-finding significantly increases the quality and quantity of suitable veins found, subsequently leading to increased proportions preferred access placement (autogenous versus prosthetic and forearm versus upper extremity).

Presented at the Society for Vascular Surgery 2017 Annual Meeting, San Diego, CA.

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Ann Vasc Surg 2018; ■: 1–9
https://doi.org/10.1016/j.avsg.2018.02.015

Manuscript received: September 18, 2017; manuscript accepted: February 1, 2018; published online: ■ ■ ■

INTRODUCTION

Three options for chronic dialysis are widely used in patients with kidney failure—autogenous accesses (traditionally referred to as fistulae), prosthetic accesses (grafts), and central venous catheters. Because autogenous accesses are associated with decreased mortality, decreased rates of access infection, lower first-year costs,[1] and increased rates of postoperative patency, they are the first choice for most patients,[2] with the current target of the Kidney Disease Outcomes Quality Initiative being fistula placements in over 65% of patients on chronic dialysis.[3]

With that in mind, several guidelines have been designed to increase the rates of autogenous accesses placement, subject to avoiding an increase in catheter placement rates.[4,5] These include early education of who are chronic kidney disease (CKD) stage 4 and above about kidney replacement therapy so as to expedite, if indicated, dialysis access planning and subsequent placement.[3] By placing an autogenous access before dialysis is required, catheter placement can be avoided. Another recommendation is to avoid any venipuncture in the upper extremities that could preclude autogenous access construction. These include subclavian vein catheterization and the placement of peripherally inserted long-term catheters, as they have been associated with high rates of central venous stenosis and upper extremity thrombosis.[6,7]

Another more recently developed approach is using preoperative ultrasound vessel mapping to find vessels suitable for autogenous access placement. Studies have shown not only significantly increased rates of autogenous access placement[8] but also better outcomes in terms of failure rates and thrombosis when duplex ultrasound was used preoperatively.[9,10] Although there are practice guidelines for adequate arterial diameter at 1.5 mm to 2 mm,[11] there are no equivalent ones for venous vascular mapping, though some have suggested a venous diameter of at least 2.5 mm should be considered adequate.[12] There are many techniques to increase the success rates of preoperative vessel mapping through venous dilatation, such as percussion in the region of the wrist after tourniquet placement for 2 to 3 min,[13] warming the room, having the patient in a sitting position with the arms dependent,[14] and preoperative handgrip training.[15] Even with all these adjustments, there is still a segment of patients for which suitable veins cannot be found, and national autogenous access placement rates range between 50 and 70%.[4,10,16]

One aspect of vessel mapping that has not been investigated thoroughly is the timing of the ultrasound-guided vein mapping; almost all practices currently routinely perform it electively before scheduling the patient for the operating room, and it is from this mapping that the surgeon determines the type and level of access that can be achieved. At the same time, it is known that patients under anesthesia experience certain hemodynamic processes, including bradycardia, elevated central venous pressure,[17] and varying changes to mean arterial pressure.[18] Both general and regional anesthesia has been found to produce vasodilation through decreased sympathetic tone.[19,20] Because many patients with indications for dialysis access placement have multiple comorbidities and general anesthesia is known to confer higher perioperative risk, most surgeons prefer regional anesthesia. Correspondingly, there is an abundance of literature supporting the use of regional anesthesia for access placement procedures.[21–23] However, there are patients for whom general anesthesia may be a better option, such as in the case of allergy, cutaneous infection, and overwhelming anxiety. For such patients, there lack outcomes data both in terms of fistula placement and postoperative access maturation.

We hypothesize that patients under general anesthesia are in more optimal conditions for vessel mapping in part due to increased venous dilatation from decreased sympathetic tone. Thus, rates of autogenous access placements would further increase, even when keeping to the same standards, by performing a preoperative post-general anesthesia ultrasound (PAUS).

METHODS

Patient Population

A retrospective review was performed on 297 consecutive procedures for dialysis access placement between December 2004 and August 2015 at either St. Elizabeth's Hospital or Memorial Hospital, both in Belleville, Illinois. Of these procedures, 89 were performed on patients who had previously obtained accesses; these patients were excluded from the study. An additional 5 patients were operated on under either regional anesthesia or local anesthesia; these patients were also excluded. The remaining 203 procedures were performed on patients who were obtaining an access for the first time under general anesthesia; all these patients were included in the study. Every patient was educated on the risks and benefits of the procedure and gave informed consent. The Institutional Review Board approval was waived for this purely retrospective study.