Objective and Subjective Assessment of Physician Labor and Resource Utilization in Maintenance Percutaneous Transluminal Angioplasty of Nonthrombosed Hemodialysis Arteriovenous Fistulas versus Arteriovenous Grafts

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ABSTRACT

Purpose: To complement prior studies that have shown that arteriovenous fistula (AVF) thrombectomies require more time and equipment than arteriovenous graft (AVG) thrombectomies by measuring work via established instruments to determine whether there is also a difference in maintenance percutaneous transluminal angioplasty (PTA) of nonthrombosed AVFs versus AVGs.

Materials and Methods: PTA procedures performed on a consecutive cohort of 42 patients with AVFs and 27 patients with AVGs were prospectively compared. To quantify resource utilization, procedure time and disposable equipment were measured. Established instruments developed by the American Medical Association for *Current Procedural Terminology* code valuation were used to measure subjective "physician work," including mental effort and judgment, technical skill, physical effort, and psychological stress. These items were scored by 1 of 12 attending interventional radiology physicians performing the procedure.

Results: Mean PTA procedure time was 74 minutes (range, 18–183 minutes) for AVFs and 71 minutes (range, 28–204 minutes) for AVGs; hemostasis time was 12 minutes for AVFs and 11 minutes for AVGs. There was no significant difference in equipment use between groups. "Physician work" for AVFs scored significantly higher in four categories ($P \leq .05$).

Conclusions: Using established subjective instruments, maintenance PTA of AVFs was scored as more cognitively, physically, and psychologically demanding than maintenance PTA of AVGs. However, there was no significant difference in resource utilization between maintenance PTA of AVFs versus AVGs, as has been previously shown with thrombectomy of thrombosed AVFs and AVGs.

ABBREVIATIONS

AVF = arteriovenous fistula, AVG = arteriovenous graft, PTA = percutaneous transluminal angioplasty

Creation of native hemodialysis arteriovenous fistulas (AVFs) over arteriovenous grafts (AVGs) is recommended by the National Kidney Foundation Kidney Disease Outcome Quality Initiative (K/DOQI) because AVFs have better long-term function and lower infection rates (1–5). Consequently, the amount of fistula maintenance in interventional radiology (IR) is increasing relative to the amount of AVG work (6,7). A widespread belief among interventional radiologists and supportive data hold that thrombectomy is much more difficult in thrombosed AVFs than in AVGs (8–13); however, the current reimbursement structure does not reflect this difference. The "Fistula First" initiative, an effort led by the U.S. Centers for Medicare and Medicaid Services to increase the prevalence of AVFs for dialysis

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(over artificial AVGs and catheters), has already acknowledged this disparity for certain surgical fistula procedures, and the reimbursement structure has been modified accordingly.

Prior studies by Beathard et al (12) and Schon et al (13) have shown that AVF thrombectomies require longer procedure times and more equipment usage than AVG thrombectomies. Our aim was to provide a corollary to these studies by quantitatively determining if there is also a difference in terms of labor and resource utilization in maintenance percutaneous transluminal angioplasty (PTA) of nonthrombosed AVFs versus nonthrombosed AVGs. We hypothesized that our results might be used as a further evidence basis for reevaluation of the reimbursement structure for fistula interventions by "Fistula First," along the same lines as has been done for the surgical creation of AVFs. Doing so may help to incentivize the widespread adoption of fistula maintenance and thrombectomy procedures, something presently avoided by many IR physicians precisely because of the perceived greater effort required for identical reimbursement compared with graft interventions (8–13). Physicians already performing these procedures could potentially be reimbursed more appropriately as well.

MATERIALS AND METHODS

After obtaining institutional review board approval, we performed a prospective cohort study comparing consecutive PTA procedures performed on 46 patients with AVFs and 53 patients with AVGs from July through December 2007 at the Hospital of the University of Pennsylvania and Penn Presbyterian Medical Center. There were 42 PTAs performed on AVFs compared with 27 PTAs on AVGs. Procedure time, hemostasis time, disposable equipment use (ie, wires, catheters), and subjective "physician work" were measured in an attempt to quantify the costs of these procedures.

Questionnaires for patient procedures for each group were collected as they were performed in IR each day. The amount of time and equipment required were documented at the end of each procedure. Procedure time was defined as the period beginning with percutaneous puncture and ending with the final fistulogram after treatment, in accordance with accepted reporting standards (14). In addition, time to achieve hemostasis after sheath removal was documented. This was defined as time spent by the physician personally achieving hemostasis; this was either the time spent manually compressing the puncture site or the time spent placing temporary purse-string sutures and any additional manual compression time after suture removal.

In this questionnaire, "physician work" was numerically scored and documented at the end of each procedure. This portion of the questionnaire was adapted from a template used by the American Medical Association *Current Procedural Terminology* and Relative Value Scale Update Committee (RUC) process, an established instrument used to value physician work. "Physician work" includes mental effort and judgment, technical skill, physical effort, and psychological stress. These various components of "physician work" were clearly defined in the questionnaire. For mental effort and judgment, items to be scored included the range of possible diagnoses or management options, or both, that must be considered; the amount or complexity, or both, of medical records, diagnostic tests, or other information that must be analyzed; and the urgency of medical decision making. For technical skill, the technical skill required was scored. For physical effort, the physical effort required was scored. For psychological stress, items to be scored included the risk of significant complications, morbidity, and mortality; how much the outcome depends on the skill and judgment of the physician; and the estimated risk of a malpractice suit given a poor outcome. These items were scored on a 5-point scale by 1 of 12 board certified and certificate of added qualification certified or eligible IR physicians performing the procedure (with experience in hemodialysis access interventions following fellowship ranging from $<$ 1–16 y).

To control for factors that might contribute to differences in resource utilization and effort between the two groups, the number of lesions treated and the number of puncture sites were documented.

For statistical evaluation, the two-sample two-tailed *t* test was employed using SAS software package version 9.2 (SAS Institute, Cary, North Carolina) to compare PTA procedures in AVFs and AVGs. Diagnostic tests were performed to check for significant violations in the distribution assumptions. In addition, the nonparametric Wilcoxon rank sum test was used to validate the parametric results. Statistical significance was assigned at $P \leq .05$.

RESULTS

Mean PTA procedure time was 74 minutes (SD 42 min; range, 18–183 min; median, 65 min) for AVFs and 71 minutes (SD 39 min; range, 28–204 min; median, 61 min) for AVGs. Mean hemostasis time was 12 minutes (SD 10 min; range, 5–55 min; median, 10 min) for AVFs and 11 minutes (SD 10 min; range, 1–50 min; median, 7 min) for AVGs. Hemostasis was achieved with manual compression in 29 of 42 AVFs and 12 of 27 AVGs and with temporary purse-string sutures in 13 of 42 AVFs and 15 of 27 AVGs. A mean of two lesions were treated in both groups via a medan of one puncture site (**Table 1**). There was no

Table 1. Procedural Comparisons for Fistulas versus Grafts

Procedure Details	Fistulas	Grafts	*P* Value
Procedure time (min)	74 (SD, 42)	71 (SD, 39)	.81
Hemostasis time (min)	12 (SD, 10)	11 (SD, 10)	.50
No. puncture sites	1.4	1.4	.98
No. lesions	2.1	2.3	.58