From the Society for Vascular Surgery

The influence of cephalic vein diameter and diabetes on primary maturation and patency of autogenous radiocephalic arteriovenous fistulas

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Objective: **This study identified predictors affecting maturation and patency of autogenous radiocephalic arteriovenous fistulas (RCAVFs).**

Methods: **We retrospectively reviewed the prospectively collected clinical data of all patients who underwent primary RCAVF creation and evaluated the effect of clinical variables and findings of preoperative duplex ultrasound mapping on primary maturation and patency rates of RCAVFs.**

Results: **From August 2008 to December 2010, 383 vascular access procedures were performed in 371 patients; of these, 331 (86.4%) were autogenous AVFs, 283 (85.5%) were primary first AVFs, and 186 (65.7%) of these were RCAVFs. The primary maturation rate was 88.2% at a mean of 39 ± 24.1 days after the operation. By multiple logistic regression analysis, minimum cephalic vein (CV) diameter >2 mm was an independent predictor of RCAVF maturation (odds ratio, 3.672; 95% confidence interval, 1.394-9.673; $P = .008$), which was more easily achieved in nondiabetic patients. During the mean follow-up of 47.2 ± 23.1 months, primary patency of RCAVFs was 80.3% at 1 year and 76.5% at 2 years. A Cox proportional hazard model showed diabetes was the only independent risk factor of primary patency (hazard ratio, 2.008; 95% confidence interval, 1.022-3.945; $P = .043$). Nondiabetic patients with a CV diameter >2 mm had significantly higher primary maturation rate and higher primary patency than diabetic patients with a CV diameter ≤2 mm.**

Conclusions: **There were different risk factors affecting RCAVF primary maturation and primary patency. A CV with a small-diameter of ≤2 mm combined with diabetes was an independent risk factor of failure not only of primary maturation but also of primary patency in RCAVF. (J Vasc Surg 2015;62:1003-9.)**

The National Kidney Foundation Kidney Disease Outcome Initiative (NKF K/DOQI)[1] recommends that the first choice for native arteriovenous fistula (AVF) is a wrist radiocephalic AVF (RCAVF) rather than a brachiocephalic AVF (BCAVF) or a transposed brachial-basilic vein AVF or a forearm arteriovenous graft (AVG). Despite the known higher incidence of failed maturation for RCAVF,[2] many advantages, including the ease of placement, lower rates of thrombosis, infection, need for secondary intervention, and the preservation of proximal vessels for future access, outweigh the disadvantages. Therefore, the Fistula First Breakthrough Initiatives proposed enhancing native AVF rates from 32% to 66% by the year of 2009.[3] However, high failure rates to mature the AVF still remain as one of the most important unsolved problems.

Our group continues to follow-up the NKF K/DOQI recommendation and tries to be aggressive in performing AVFs in all suitable patients. We also continue to use a combination of routine preoperative duplex ultrasound (DUS) vein mapping and physical examination to promote maturation rates of autogenous AVFs in all patients. In addition, our policy is to use routine DUS and a physical examination to judge AVF maturation at the first postoperative clinic visit. We have also established surveillance or monitoring program for the patients with vascular access using the regular postoperative DUS for early diagnosis and prompt intervention for the failing fistula.

Although previous reports have suggested many predictors of early failure of RCAVF, including advanced age, female gender, diabetes, small diameters of radial artery and vein, and distensibility of vein, the most important factors affecting failure remain poorly defined.[4-7] Hence, in this study, we attempted to find predictors that affect initial primary maturation as well as long-term patency of autogenous hemodialysis access in patients with end-stage renal disease.

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Author conflict of interest: none.

Presented at the 2012 Vascular Annual Meeting of the Society for Vascular Surgery, National Harbor, Md, June 7-9, 2012.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the JVS policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

0741-5214

http://dx.doi.org/10.1016/j.jvs.2015.04.451

METHODS

We performed a retrospective review of the prospectively maintained database for clinical data of patients who underwent a first primary autogenous AVF operation from August 2008 to December 2010 at Samsung Medical Center in Seoul, Korea. The Institutional Review Board approved the study protocol, and patient informed consent was waived because of the retrospective and descriptive nature of the study and the absence of any intervention that carried more than a minimal risk to the patient.

Data collection. We have established a database for all vascular access operations, which is maintained prospectively by one main vascular surgeon (Y.J.P.) and a coordinating nurse. We extracted the patients' clinical informations from this database and the electric medical records. We have also collected the data about preoperative and postoperative follow-up DUS of all patients from a database maintained by our vascular laboratory. The follow-up results of long-term patency were obtained from the medical records, and in patients with insufficient information, we used a telephone interview for the identification of any possible history of intervention or revision for the fistula at another hospital to maintain the functionality.

We excluded patients who received a prosthetic AVG and those who underwent a revision operation for failing or failed AVF. We also excluded patients who needed a restoration of AVF for dialysis due to allograft failure after kidney transplantation. However, the study included patients with a prior hemodialysis access operation if the operation was performed on the opposite extremity of the prior site.

Demographic data, such as age, gender, and body mass index, in addition to comorbidities, such as diabetes, hypertension, hyperlipidemia, smoking history, congestive heart failure (CHF), coronary artery disease (CAD), and cerebrovascular disease (CVD) were documented. The etiology of chronic renal failure was noted along with the history of a prior central catheter. Hypertension was considered as diastolic blood pressure >90 mmHg or under control with one or more antihypertensive medications. Diabetes was defined as adult onset, controlled with diet, oral agents, or insulin. CAD was defined as a history of myocardial infarction or coronary revascularization by stenting or bypass surgery. CHF was defined as the condition with pathognomic symptoms, such as shortness of breath limiting ordinary activity, and diagnosed and managed by cardiologist. CVD was defined as a history of stroke or transient ischemic attack.

Preoperative evaluation. All patients underwent a physical examination for the arterial and venous status of both arms to select the proper type and site of access. Arterial assessments included pulse examination in both upper extremities and the Allen test for continuity of the palmar arch. Venous assessments included gross assessment of the veins by first placing the arm in a dependent position and waiting for the veins to fill naturally. Visual enhancement of the veins was provoked by placing a tourniquet in the upper arm. Vein diameter was not estimated from the physical examination.

In addition, the arterial and venous systems of both arms of all patients was evaluated with preoperative DUS imaging using a 10-MHz to 12-MHz scanning probe by the one of six registered vascular technologists in an accredited vascular laboratory. They evaluated the arterial and venous diameter and flow volume, and the presence of stenosis, valvular structure, thrombosis, or calcification to affect vascular flow. The arterial diameter, flow volume, and velocity waveforms were checked on the midbrachial artery and at the wrist for the radial and ulnar artery. If proximal stenosis or occlusion was suspected, the subclavian and axillary arteries were also examined.

After the initial evaluation of the entire venous system of the upper extremity from the distal to proximal direction with a vascular tourniquet on the upper arm, the venous diameter was recorded for the cephalic vein (CV) (wrist, forearm, upper arm), antecubital vein, basilic vein, and brachial vein. The examination was performed in a vascular laboratory at room temperature with the patient supine. Results were recorded on a standardized data sheet, and illustrations of the vessels were also drawn.

After the physical examination and DUS, following the K/DOQI and Society for Vascular Surgery guidelines,[1,8] the surgeon chose the best type and location for the vascular access procedure. We usually used the arterial and venous diameter >2 mm for the acceptable threshold for AVF creation, but if the physical examination showed the arterial pulse was good compared with the diameter on DUS, we often performed AVF instead of AVG.

Operation and follow-up. All operations were performed in a single institution by one of three surgeons (two vascular surgeons and one transplant surgeon) under local or regional anesthesia combined with intravenous sedation. After the patient was sterilely prepared and draped, surgeon once again evaluated the patient's venous status, with a tourniquet inflated, by digital palpation. All anastomoses were performed using nonabsorbable monofilament polypropylene running sutures without administration of systemic heparin. The selection criteria for vein were ≥2 mm in diameter with continuity to the proximal site and no significant valvular stenosis or thrombosis. For the donor artery, we use radial artery of >2 mm in diameter and no significant stenosis >50% in DUS as well as a well-palpable pulse on physical examination. Even if the radial artery has some calcifications in the wall (medial calcinosis), we explore that artery first and decide whether to proceed with the operation depending on the intraoperative finding.

The patients were seen in 4 to 6 weeks postoperatively to assess the maturation status for the first needling. If the fistula was not mature, we waited until 3 months, and then a fistula that was not ready to use was considered as a primary maturation failure. We prefer to assess the newly created AVF with a physical examination as well as a routine postoperative DUS scan at the first postoperative