Comparison of Forearm Swelling After Loop Forearm Arteriovenous Graft between Distal Vein Ligation and No Ligation

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Abstract

Purpose: *Forearm loop arteriovenous grafts (AVGs) are an effective way to grant permanent vascular access in end-stage renal disease patients undergoing hemodialysis. A common postoperative complication with this procedure is forearm swelling. Distal vein ligation is believed to reduce postoperative venous hypertension and forearm swelling. There have been no previous randomized controlled trials comparing the efficacy of AVGs with and without distal vein ligation.*

Methods: *A pilot study was performed as a randomized controlled trial. End-stage renal disease patients who required AVG construction were recruited and randomly assigned to either the distal vein ligation group or the nondistal vein ligation group. Forearm swelling, graft patency, and graft thrombosis were recorded and compared.*

Results: *The nonligation and ligation groups consisted of 30 and 31 patients, respectively. Forearm swelling at both the proximal and distal areas was nonsignificantly higher in the nonligation group than in the ligation group. The success rate of cannulation of the graft was 77% in both groups. The first cannulation time was somewhat shorter in the ligation group than in the nonligation group (57 vs 63 days;* $P = .282$*). There was no difference in graft thrombosis between the 2 groups (8 and 6 patients, respectively, in the nonligation and ligation groups).*

Conclusions: *AVGs can be performed with or without distal vein ligation.*

Keywords: *end stage renal disease, hemodialysis, vascular access, arteriovenous graft*

Introduction

The numbers of end-stage renal disease (ESRD) patients who require renal replacement therapy in clinical practice are increasing. In the United States, the number of ESRD patients was 40,000 in 1988 and may rise to as many as 160,000 in 2020.[1] There is a similar trend in Thailand.[2] Because of a shortage of organ donation, the most common renal replacement therapy is hemodialysis, which accounts

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for 54.6%.[1,2] The best method to gain vascular access is arteriovenous fistula, as advocated by the Fistula First Breakthrough Initiative.[3,4] However, for patients with small veins or occluded veins, an arteriovenous graft (AVG) is an alternative. There are several complications that could arise from AVGs such as infection, stenosis, thrombosis, pseudoaneurysm, poor long-term outcomes, and postoperative extremity edema.[5-11]

Extremity edema after AVG placement can cause delays in first-time cannulation, difficulties for the cannulator, and discomfort for the patient. Surgery at venous anastomosis with distal vein ligation is a possible solution to reduce postoperative edema. An end-to-side venous anastomosis without distal ligation is a commonly used AVG method. End-to-end venous anastomosis or end-to-side with distal vein ligation is used to reduce venous congestion and postoperative edema.[12-14] There have been no clinical studies that have used a randomized controlled trial to compare the efficacy of either surgical procedure.

Materials and Methods

This study was a pilot study performed at the Faculty of Medicine's Department of Surgery at Ramathibodi Hospital, Mahidol University, Bangkok, Thailand. The study period was between March and December 2014. The inclusion criteria were ESRD patients who required a new polytetrafluoroethylene forearm loop graft. Patients were excluded if they had a history of central vein stenosis or if follow-ups were unable to be conducted. The study design was a randomized, controlled trial. All eligible patients were randomly assigned end-to-side venous anastomosis either with or without distal vein ligation by block randomization, patients and the data analyst were blinded as regard to the procedure (surgeons know after opening a sealed envelope in the operating theatre). The study protocol was approved by the Ethical Clearance Committee on Human Rights Related to Research Involving Human Subjects of Mahidol University (ID: 03-57-13). All patients gave informed consent before participation in the study.

Baseline characteristics, details of operative procedures, outcomes, and cases of graft failure were recorded. The outcomes of the study included forearm swelling (primary) and patency of the vascular access (secondary). The forearm was divided into 3 parts as shown in Figure 1. The circumferences of the proximal and distal points were recorded immediately after the operation and at 1, 2, 4, and 6 weeks postoperation. Each point was measured by a vascular surgeon and reported as a mean of the 3 measurements. Patency of the AVG was defined by patent passage of the AVG and ability to perform hemodialysis. Failure of the AVG was defined as graft thrombosis, graft removal and ligation, or inadequate graft function that requires revision. Primary patency was defined as AVG never failed before, whereas secondary patency was defined as patency of the AVG after revision. All patients underwent follow-up examinations for up to 6 months.

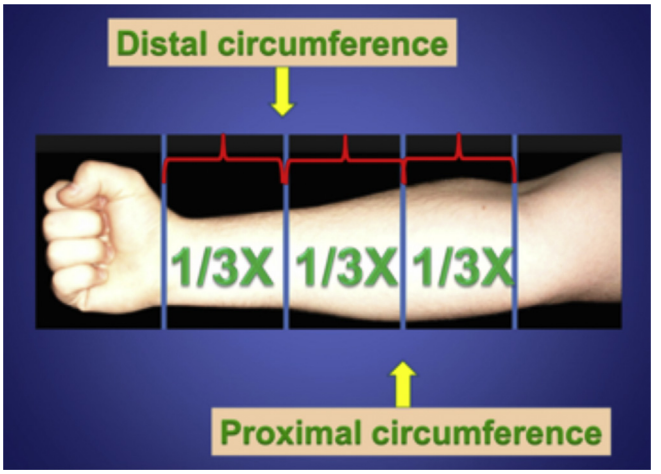

Figure 1. **Proximal and distal forearm circumference to measure.**

Statistical Analyses

An unpaired *t* test or rank test was used for comparing quantitative variables between groups, and a χ^2 or Fisher exact test was used for comparing categorical variables. Forearm circumferences were measured several times and were compared between the 2 groups using both random effects and generalized estimating equation approaches, assuming exchangeable correlation between repeated measurements. Probabilities of thrombosis were estimated using the Kaplan-Meier method. Two-sided P values $< .05$ were considered statistically significant. All statistical analysis was conducted using Stata version 12 (StataCorp, College Station, TX).

Results

There were 64 eligible patients who participated in the study. Of those, 3 were excluded due to an inability to follow-up (1 in the ligation group and 2 in the nonligation group). In total, there were 30 and 31 patients, respectively, in the nonligation and ligation groups. Baseline characteristics (eg, brachial artery diameter and venous diameter) were comparable between the 2 groups, as shown in Table 1.

The amount of forearm swelling at both proximal and distal areas were higher in the nonligation group than in the ligation group (Table 2). However, the differences were not statistically significant. The amount of forearm swelling was highest at the first week after the operation at both the proximal and distal points (275 and 272 cm at the proximal point).

Regarding the graft patency, the rate of successful cannulation of the graft was 77% in both groups. The first cannulation time was somewhat shorter in the ligation group than in the nonligation group (57 vs 63 days; $P = .282$). There was also no difference in graft thrombosis between the 2 groups (8 and 6 patients, respectively, in the nonligation and ligation groups). There was also no difference in the secondary patency rate between the 2 groups (85% and 90% at 8 months in the nonligation and ligation group, respectively; $P = .543$), as shown in Table 3.