Prospective multicenter study with a 1-year analysis of a new vascular graft used for early cannulation in patients undergoing hemodialysis

Marc H. Glickman, MD,[a] Jason Burgess, MD,[b] David Cull, MD,[c] Prabir Roy-Chaudhury, MD, PhD,[d] and **Harry Schanzer, MD,[e]** *Norfolk, Va; Charlotte, NC; Greenville, SC; Cincinnati, Ohio; and New York, NY*

Objective: **More than 85% of patients with end-stage renal disease start dialysis through a tunneled dialysis catheter (TDC) for long periods while their arteriovenous fistula or vascular access graft (arteriovenous graft [AVG]) matures. Because TDCs are associated with a high risk of complications, including death and infection, use of an AVG that can be cannulated safely immediately after implantation may reduce morbidity in these patients by allowing earlier TDC removal. We report a prospective multicenter study of a new early-cannulation AVG (Gore ACUSEAL Vascular Graft; W. L. Gore & Associates, Flagstaff, Ariz).**

Methods: **Patients requiring creation of a prosthetic vascular access for hemodialysis were enrolled between July 2010 and February 2012 and observed for 12 months. Data were collected on the patients' baseline characteristics; location, position, loss of patency, and revisions of prior AVGs; dialysis sessions using the AVG; and major adverse events related to graft implantation or cannulation. Cumulative and primary unassisted graft patency rates were calculated. A subgroup analysis compared outcomes in patients in whom the AVG was first cannulated within 72 hours after implantation with outcomes in patients in whom the initial cannulation was performed >21 days postoperatively.**

Results: **The population of this study was formed by 138 patients who received an ACUSEAL graft. During follow-up, 17 patients died and the AVG was abandoned in 27. The median value for follow-up was 360 days for all patients (variance 15,387). The overall mean time to initial cannulation was 15 days, with 54 grafts (40%) first cannulated within 72 hours after graft implantation and 33 grafts first cannulated >21 days afterward. The reason for late cannulation in some patients was dependent on the implanting surgeon's decision and the surgeon's personal experience with early cannulating grafts. The 1-year overall cumulative patency rate was 79% (95% confidence interval, 71%-85%); the primary unassisted patency rate was 35% (95% confidence interval, 27%-44%). Adverse events included 6 hematomas (two of which were related to cannulation and occurred 107 and 169 days, respectively, after AVG implantation), 15 graft infections, and 15 cases of steal syndrome requiring intervention. Patients in the early- and later-cannulation groups had similar characteristics and no significant differences in rates of cumulative or primary unassisted patency or adverse events.**

Conclusions: **This study demonstrated that the new, early-cannulation AVG graft can be cannulated soon after implantation without a significant difference in patency and complication rates compared with rates associated with standard cannulation of expanded polytetrafluoroethylene grafts in the literature. This new AVG may allow early removal or avoidance of TDC use in patients undergoing hemodialysis, potentially reducing or eliminating the number of days of catheter-dependent dialysis, but further studies will be needed to demonstrate this potential. (J Vasc Surg 2015;62:434-41.)**

In patients with end-stage renal disease (ESRD), the number of new hemodialysis patients starting their first treatment through a tunneled dialysis catheter (TDC) has not changed appreciably during the past decade. The percentage of incident hemodialysis patients with a TDC ranges from 78% to 81%.[1-3] Possible reasons for this continued high rate of TDC use include a lack of early referral, the patient's noncompliance, and an inability to obtain appropriate, timely surgical intervention. Efforts have been made to decrease the use of TDCs in the United States, but the incidence rate remains high. TDCs have been observed to be associated with high rates of morbidity and mortality within the first 90 days of starting hemodialysis.[4] Infection, a frequent adverse effect of TDC use, is the second most common cause of death in patients undergoing hemodialysis, after cardiac events.[5,6] Therefore, introduction of an early-cannulation graft for hemodialysis is an attractive alternative because it may reduce TDC contact time or avoid TDC use entirely, either of which has the potential to decrease infections and, possibly, the occurrence of central venous stenosis.

Most patients who require a permanent prosthetic vascular access for hemodialysis are given an expanded polytetrafluoroethylene (ePTFE) graft. Early cannulation of standard ePTFE grafts has been reported, but these devices

From the Sentara Vascular Specialists, Norfolk[a]; the Surgical Specialists of Charlotte, Charlotte[b]; the Department of Vascular Surgery, Greenville Hospital System, Greenville[c]; the Department of Medicine and Nephrology, University of Cincinnati, Cincinnati[d]; and the Department of Vascular Surgery, New York Vascular Laser Center and Mount Sinai Hospital, New York.[e]

This study was sponsored by W. L. Gore & Associates.

Clinical Trial registration: NCT01173718.

Author conflict of interest: All authors have served as consultants to W. L. Gore & Associates. M.H.G. and P.R.C. are on the speakers bureau for W. L. Gore.

Correspondence: Marc H. Glickman, MD, Sentara Vascular Specialists, 397 Little Neck Rd, Virginia Beach, VA 23452 (e-mail: mmec@aol.com).

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.2015.03.020

were not designed for that purpose, and excessive bleeding and hematoma formation are possible when they are cannulated within hours or days after implantation.[7]

In April 2013, a new, multilayer ePTFE arteriovenous graft (AVG; Gore ACUSEAL Vascular Graft; W. L. Gore & Associates, Flagstaff, Ariz) was cleared for marketing by the U.S. Food and Drug Administration (FDA). The FDA-accepted instructions for use for this device state that it can be cannulated for hemodialysis within 24 hours of implantation. Early results with this AVG in small, single-center, early-cannulation series were encouraging with respect to patency and complication rates.[8,9] Tozzi's experience in Europe demonstrated good patency rates and low complication rates with early cannulation of this graft.[9] The FDA clearance of the AVG was based on some of the data from the FDA-authorized clinical study reported here.

The principal purpose of our multicenter study was to evaluate the safety and efficacy of the new AVG when cannulated in the early postoperative period (≤72 hours after implantation). We therefore determined the 1-year cumulative and primary unassisted patency rates for the AVG in a cohort of patients undergoing hemodialysis and documented any adverse events related to cannulation or dialysis. In addition, because the time to first cannulation of the graft was observed to vary considerably in our cohort, we elected to assess whether early cannulation might reduce the number of days of TDC-dependent dialysis by comparing outcomes in patients in whom cannulation of the AVG was first performed early after implantation (≤72 hours) with outcomes in those in whom the initial cannulation occurred at a time commonly used for standard hemodialysis grafts (>21 days).

METHODS

Patients. The study was approved by the Institutional Review Board for each of the 10 study centers, and all enrolled patients or their legally designated representative provided written consent to their participation. Patients with ESRD were considered for enrollment if they presented between July 29, 2010, and February 29, 2012; were currently undergoing hemodialysis or expected to begin hemodialysis within 30 days; were not considered candidates for creation of an arteriovenous fistula (AVF); and were able to have the AVG placed in an upper extremity. This determination was made by the surgeon and based on vein mapping at each institution.

Patients were excluded from the study if they had previously had more than two vascular accesses in the arm in which the AVG was to be implanted or they had a known or suspected systemic infection, a hypercoagulable or bleeding disorder, or a sensitivity to heparin. Also excluded were patients who were receiving maintenance immunosuppression therapy or extended-release dipyridamole plus aspirin.

Graft. The AVG used in this study is a 6-mm by 40-cm trilayer device (Fig 1). It has an inner layer of ePTFE bonded with heparin (CBAS Heparin Surface, W. L. Gore & Associates), a middle elastomeric layer, and an outer layer of ePTFE. The heparin is bound to the inner ePTFE surface by means of an end-point covalent attachment that allows it to remain bioactive for several months.[10] The middle layer of the graft is intended to act as a sealant, possibly reducing blood loss and the time to hemostasis at cannulation sites. The cost of this graft is around $200 more than a standard heparin-bonded ePTFE graft.

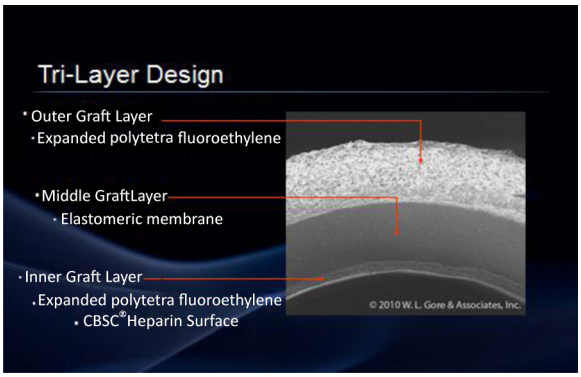

Fig 1. The vascular access graft used in the study (Gore ACUSEAL Vascular Graft; W. L. Gore & Associates, Flagstaff, Ariz) has inner and outer layers of expanded polytetrafluoroethylene (ePTFE) separated by a layer of medical-grade elastomer.

Graft implantation and cannulation. The patients' physicians made all decisions about preoperative assessment of veins in the upper extremity, the site of AVG implantation, the time of first cannulation of the AVG, the need for intervention to maintain or to restore AVG patency and the type of intervention performed, and the treatment of any adverse events. Patients were scheduled to be examined by their clinicians 1, 3, 6, and 12 months after graft implantation. Routine scanning was not part of the protocol. Clinicians examined the patient, looked at the wounds, and listened to the bruit of the graft. In accordance with the instructions for use for the graft, staff members at hemodialysis centers were encouraged to maintain pressure on needle exit sites for 10 to 15 minutes to achieve hemostasis after decannulation of grafts implanted <14 days earlier.

Data collection and definitions. Data included patients' baseline characteristics (demographic information, comorbid conditions, and vascular access history); location, position, loss of patency, and revisions of the AVG; time of first AVG cannulation; and major adverse events related to graft implantation or cannulation. Data were collected prospectively at each study site by using a web-based data-capture system. Data collection in the study ended on February 12, 2013.

Patients were referred for evaluation for a possible AVG thrombosis when neither a thrill nor a bruit was detected. Cumulative patency was defined as freedom from complete loss of the access regardless of whether interventions were done to restore or to maintain patency or to manage hematoma, infection, or steal syndrome during the 12-month study period. Primary unassisted patency