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Original Investigation

Association of Hemodialysis Central Venous Catheter Use With Ipsilateral Arteriovenous Vascular Access Survival

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Background: Central venous catheters frequently are used for hemodialysis vascular access while patients await placement and maturation of an arteriovenous fistula or graft. Catheters may cause central vein stenosis, which can adversely affect vascular access outcomes. We compared vascular access outcomes in patients with a history of ipsilateral and contralateral dialysis catheters.

Study Design: Retrospective analysis of a prospective computerized vascular access database.

Setting & Participants: Patients at a large medical center who initiated hemodialysis therapy with a catheter and subsequently received a fistula (n = 233) or graft (n = 89).

Predictor: History of central venous catheter placement ipsilateral versus contralateral to the arteriovenous fistula or graft.

Outcome & Measurements: Primary access failure (access never suitable for dialysis) and cumulative access survival (time from successful cannulation until permanent access failure).

Results: For patients receiving a fistula, the primary failure rate was similar for those with ipsilateral and contralateral catheters (50% vs 53%; HR, 0.94; 95% CI, 0.71-1.26; $P = 0.7$), and time to fistula maturation was similar (101 ± 41 vs 107 ± 39 days; $P = 0.5$). However, cumulative fistula survival was inferior in patients with ipsilateral catheters (HR, 2.48; 95% CI, 1.33-7.33; $P = 0.009$). For patients receiving a graft, the primary failure rate was similar for those with ipsilateral and contralateral catheters (35% vs 38%; HR, 0.92; 95% CI, 0.49-1.73; $P = 0.8$), but cumulative graft survival tended to be shorter with ipsilateral catheters (HR, 2.04; 95% CI, 0.92-5.38; $P = 0.07$).

Limitations: Retrospective analysis, single medical center.

Conclusions: The primary failure rate of fistulas and grafts is not affected by the presence of an ipsilateral catheter. However, cumulative access survival is inferior in patients with prior ipsilateral catheters. Avoidance of ipsilateral catheters may improve long-term vascular access survival.

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INDEX WORDS: Vascular access; arteriovenous fistula; arteriovenous graft; dialysis catheter.

Central venous catheters frequently are used for hemodialysis (HD) access while patients await placement and maturation of an arteriovenous fistula (AVF) or graft (AVG). Despite significant nationwide efforts to reduce dialysis catheter use, a recent analysis of Centers for Medicare & Medicaid Services data documents their use in ~80% of incident and 24% of prevalent HD patients in the United States.[1] HD catheters are associated with multiple complications, including central venous stenosis,[2,3] infection,[4,5] thrombosis,[6] and decreased patient survival.[7] Less attention has been paid to the potential negative effect of pre-existing dialysis catheters on the outcomes of subsequent permanent vascular access. In one observational study, AVFs had a higher failure rate in patients with a history of dialysis catheters,[8] an unsettling fact for the nephrology community striving to maximize AVF use. The exact role the catheter has in the pathogenesis of AVF failure has not been elucidated. One plausible hypothesis is that catheter-induced stenosis of the central vein that serves as an outflow tract for the AVF may lead to hemodynamic changes that preclude AVF maturation or induce its early thrombosis. If so, vascular access outcomes may be inferior when the dialysis catheter is ipsilateral, rather than contralateral, to the AVF or AVG.

To address this clinical issue, we retrospectively interrogated a prospective computerized vascular access database and compared the primary failure and cumulative survival of upper-extremity AVFs and AVGs placed in patients with a history of a dialysis catheter inserted through the ipsilateral versus contralateral internal jugular vein.

METHODS

Study Population

The University of Alabama at Birmingham (UAB) serves approximately 500 HD patients who receive their routine care at 5 in-center dialysis units in metropolitan Birmingham supervised by UAB nephrologists. The vast majority of these patients' hospitalizations occur at UAB Hospital, making it possible to track

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vascular access complications and outcomes. Two access coordinators employed by the UAB Division of Nephrology are responsible for scheduling all access procedures, communication between physicians and dialysis staff, and maintaining a prospective computerized access database of all vascular access procedures.[9] We studied vascular access outcomes in all patients who initiated HD therapy with a dialysis catheter in the internal jugular vein and received an AVF or AVG after starting dialysis therapy.

Standard of Care for Access Management

The usual practice at our medical center was for an interventional radiologist or nephrologist to insert a right or left internal jugular HD catheter shortly prior to the initiation of HD therapy, using fluoroscopy to ensure optimal positioning of the catheter tip in the right atrium. Subsequently, transplant surgeons created a permanent access (AVF or AVG), guided by clinical evaluation and preoperative vascular mapping.[10] The initial vascular access was placed in the nondominant (usually left) upper extremity unless mapping indicated unsuitable vessels in that extremity. The permanent access was revised percutaneously or surgically when necessary to promote access suitability for dialysis. The dialysis catheter typically was removed after 3 consecutive successful cannulations of the permanent access. A fistulogram was obtained if there was clinical suspicion of hemodynamically significant stenosis, with angioplasty performed if >50% stenosis was documented. Thrombectomy was performed surgically if the access clotted within a month of its creation and percutaneously if thrombosis occurred at later times. Elective surgical access revision was performed in patients with unsuccessful angioplasty or frequent access thrombosis. An access was deemed to have failed permanently if it could no longer be salvaged percutaneously or surgically to restore its suitability for HD.

Data Analysis

We retrospectively interrogated the prospective access database to identify 705 patients who initiated dialysis therapy using a central venous catheter during the 6-year period from January 1, 2004, to December 31, 2009. We further narrowed our search to identify patients fulfilling the following 2 criteria: (1) no vascular access procedures before HD therapy initiation and (2) creation of an upper-extremity permanent access (AVF or AVG) after HD therapy initiation in the presence of an ipsilateral or contralateral dialysis catheter. Only the first AVF or AVG placed was included in the analysis, and it was labeled as ipsilateral or contralateral relative to the side of the dialysis catheter. We excluded 63 patients with access surgery prior to the initiation of HD therapy and 319 patients who did not have a subsequent permanent vascular access created at our medical center. One patient was excluded from analysis because the catheter side was not specified in the database. The other 322 study patients included 233 patients receiving a first AVF and 89 receiving a first AVG. For the 23 patients who had serial dialysis catheters placed through both the right and left internal jugular veins prior to cannulation of the AVF or AVG, the catheter was considered to be ipsilateral to the access. The final study population included 69 patients with AVFs and ipsilateral catheters, 164 with AVFs and contralateral catheters, 27 with AVGs and ipsilateral catheters, and 62 with AVGs and contralateral catheters (Table 1).

Our preliminary analysis indicated that an ipsilateral catheter was more likely in patients receiving an AVF or AVG in the right, rather than left, upper extremity. Because the first fistula typically is placed in the nondominant (usually left) arm, patients for whom the fistula is placed in the right arm may have poor vessel quality. Thus, an inferior outcome of vascular accesses in patients with ipsilateral catheters potentially could reflect poor vessel quality rather than the presence of a catheter. To address this potential confounder, we analyzed a separate control group of patients during the identical study period who received the first AVF at least 3 months before the initiation of dialysis therapy and did not require a central venous catheter prior to use of the AVF. This control group included 224 patients, and the AVF outcome was unknown in 32. Of 192 patients with known AVF outcomes, 158 received a pre–end-stage renal disease fistula in the left upper extremity, and 34, in the right upper extremity.

We analyzed primary failure and cumulative survival rates for all AVFs and AVGs using the computerized access database. A

Table 1. Selection of Patients for Statistical Analysis and Primary Failure Rates

Access Type	Total	Unknown Outcome	Successfully Cannulated	Failed Before Cannulation	Primary Failure Rate (%)
AVF with ipsilateral catheter	69	7	31	31	50
L AVF, L catheter	28	3	14	11	44
R AVF, R catheter	41	4	17	20	54
AVF with contralateral catheter	164	13	71	80	53
L AVF, R catheter	156	12	68	76	53
R AVF, L catheter	8	1	3	4	57
AVF without catheter	224	32	87	105	55
L AVF	181	23	72	86	54
R AVF	43	9	15	19	56
AVG with ipsilateral catheter	27	1	17	9	35
L AVG, L catheter	10	0	6	4	40
R AVG, R catheter	17	1	11	5	31
AVG with contralateral catheter	62	6	35	21	38
L AVG, R catheter	61	6	34	21	38
R AVG, L catheter	1	0	1	0	0

Note: Unless otherwise indicated, values shown are number of patients.
Abbreviations: AVF, arteriovenous fistula; AVG, arteriovenous graft; L, left; R, right.