

expanding and balloon-mounted stents. A representative balloon-mounted stent-assisted remodeling of an occluded Optease (Cordis, Inc) IVCF placed 3 years before is shown in the Fig. Self-expanding stents were deployed distally from the IVCF site to treat the entire obstructed segment. Technical success, clinical outcome, and duplex ultrasound assessment are reported throughout follow-up. Patients were maintained on chronic anticoagulation therapy.

**Results:** Five patients (average age, 68; range, 60-77 years) had long-standing IVCF (average duration, 6.25 years; range, 3-10 years) and debilitating venous outflow obstruction with ulceration or venous claudication despite conservative management. Immediate technical success was achieved in all patients. There was no perioperative morbidity. All patients noted marked clinical improvement and duplex documentation of stent patency to date (average, 4.25 months; range, 1-7 months).

**Conclusions:** Endovascular recanalization of chronically occluded IVCFs is technically feasible. Early results suggest the safety and efficacy of this approach to complex, iatrogenic venous outflow obstruction caused by chronic IVCF occlusion.

### The HeRO Experience: Midterm Report on a Difficult Dialysis Population

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**Objective(s):** The Hemodialysis Reliable Outflow (HeRO) catheter has provided an innovative means to obtain hemodialysis access for patients with severe central venous occlusive disease. The outcomes of this novel treatment modality in a difficult population have yet to be clearly established.

**Methods:** A retrospective review of HeRO catheter placement from June 2010 to present was performed. Patient hemodialysis access history, clinical complexity, complications, and outcomes were analyzed.

**Results:** HeRO catheter placement was attempted 21 times in 19 patients (52% female), with an 86% success rate (three unsuccessful attempts). All but one was placed in the upper extremity. Mean follow-up after placement has been  $6.8 \pm 5.5$  months (range, 0.0-17.5 months). The primary indication for all HeRO catheter placements was central vein occlusion(s) and need for arteriovenous access. Patients averaged 2.0 previous (failed) accesses and multiple catheters. Seven patients had significant arterial issues in one or both upper extremities. Four HeRO catheters (23.5%), all in women, required ligation and removal for severe steal symptoms in the immediate postoperative period ( $P = .01$  vs men). Two deaths not thought to be related to HeRO occurred in the postoperative period. Three HeROs were placed above fistulas for rescue. All thrombosed  $\leq 4$  months, although fistulas remained open. Average time to initial failure, including thrombosis or explantation due to steal or infection, was  $4.6 \pm 4.5$  months (range, 0-14.2 months). Of 12 HeROs that functioned  $>30$  days, average functional time has been 9 months. Two HeROs were removed for infection at 3.5 and 7.5 months after placement. Secondary patency was maintained in four patients for a mean duration of  $10.4 \pm 4.9$  months (range, 6.4-17.5 months), with an average of  $4.0 \pm 2.2$  thrombectomies (range, 1-6 months) per catheter.

**Conclusions:** HeRO catheter placement, when used as a last-resort measure, has been able to provide upper extremity access in patients who otherwise would not have this option. There is a high complication rate, however, including a very high incidence of steal in women. HeRO catheters should continue to be used as a last resort.

### How Often Is Inflow Stenosis a Contributing Factor in the Etiology of Arteriovenous Access-Induced Ischemic Steal?

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**Objective(s):** To determine how frequent inflow stenosis is a contributing factor in the etiology of arteriovenous access-induced steal (AVAIS).

**Methods:** Between October 2001 and December 2011, 17 patients (47% men) with severe AVAIS (Rutherford stage 2-3) were evaluated in our center with complete vascular imaging (aortic arch plus upper extremity imaging). Patient demographics, access history, time to steal symptoms, preoperative angiographic imaging, and interventions performed were analyzed. Hemodynamically significant stenosis was defined as  $>50\%$  reduction in the diameter of the vessel lumen.

**Results:** The 17 patients were an average age of  $61.9 \pm 10.4$  years, and 47.1% were African Americans. The average time to presentation of steal symptoms was  $158 \pm 246$  days. All accesses were placed were in the proximal

arm, and 65.7% were with native vein. Imaging studies consisted of angiography in 14 patients and computed tomography angiography in three. Five of the 17 patients (29.4%) had imaging evidence of significant inflow stenosis. The location of stenosis was the subclavian artery in three and the brachial artery in two. The interventions subsequently performed were distal revascularization and interval ligation in 12, ligation in three, and angioplasty and stenting in two.

**Conclusions:** Hemodynamically significant inflow stenosis contributing to AVAIS is a very prevalent etiologic factor that should not be ignored. Preoperative angiography should be an important step in the evaluation and treatment of this condition. Endovascular treatment by itself may not be curative for patients with steal, but the correction of the inflow stenosis is important as an adjunct for any other of the corrective measures.

### Outcomes of Arteriovenous Fistula Creation by Location: Does Gender Matter?

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**Objective(s):** Prior work suggests that fistula failure is more likely in women; however, this work has not stratified outcomes by fistula location. This study seeks to compare the outcomes of men and women with suitable vessel diameters on preoperative ultrasound mapping after creation of radiocephalic (RCF), brachiocephalic (BCF) and brachioaxillary arteriovenous fistulas (BBF).

**Methods:** This retrospective study evaluated 580 patients aged  $<70$  years with regular follow-up after creation of arteriovenous fistula. Within this group, 188 (73 women and 115 men) underwent RCF creation, 233 (113 women and 120 men) underwent BCF creation, and 159 (77 women and 82 men) underwent BBF creation. Medical records were analyzed for preoperative ultrasound results, fistula patency, central venous catheter days, and fistula-related procedures.

**Results:** The difference in vein diameter among men and women in the RCF, BCF, and BBF access cohorts was not statistically significant. Sex did not influence the site of access creation ( $P = .72$ ). Primary functional and cumulative (primary assisted and secondary) patency of RCFs at 1 year for women and men was 32% vs 51% ( $P = .02$ ) and 64% vs 77% ( $P = .03$ ), respectively. Women vs men had a greater number of catheter days (88 vs 58,  $P = .01$ ) and more fistula-related procedures (1.4 vs 0.8,  $P = .01$ ). Primary functional and cumulative patency for BCFs at 1 year for women and men was 44% vs 58% ( $P = .04$ ) and 72% vs 85% ( $P = .03$ ), respectively. Women vs men had a greater number of catheter days (74 vs 61,  $P = .05$ ) and more fistula-related procedures (1.6 vs 0.7,  $P = .04$ ). Primary functional and cumulative patency at 1 year for BBFs in women and men was 61% vs 68% ( $P = .51$ ) and 78% vs 87% ( $P = .21$ ), respectively. Women had no difference in the number of catheter days ( $P = .38$ ) or fistula-related procedures ( $P = .52$ ).

**Conclusions:** These data suggest it is possible to achieve functional arteriovenous fistula in women regardless of fistula location. However, there exist statistically significant differences in fistula-related outcomes between men and women undergoing creation of RCFs or BCFs. There appears to be no difference in sex-related outcomes for BBFs.

### Readmission Rates of Tunneled Dialysis Catheters Compared to Permanent Arteriovenous Access

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**Objective(s):** The current methodology in treating patients with end-stage renal disease (ESRD) includes dialysis via arteriovenous fistulas (AVF), arteriovenous grafts (AVG), and tunneled dialysis catheters (TDCs). The standard treatment is to obtain permanent hemodialysis access (AVF and AVG) during that admission. TDCs can be placed quickly for emergency dialysis, but hospital stays are sometimes lengthened to place permanent access as an inpatient. Current practice may increase hospital length of stay, cost, and associated nosocomial comorbidities. We propose that permanent access placement in every patient presenting with ESRD on initial admission is not necessary. The TDC should be placed and the permanent access created as an elective, outpatient operation. We were interested in comparing outpatients dialyzed via permanent access with patients dialyzed with TDCs to assess whether it is safe and cost-effective to discharge a patient with a TDC. Our objective was to observe the readmission rates, reasons for readmission, and problems in the two groups associated with access.

**Table I.** Access vs number readmissions per access group

Access	Patients (No.)	Days			Total
		1-15	16-30	31-90	
AVF + AVG	175	10 (3) <sup>a</sup>	24 (3)	54 (5)	88 (11)
TDC	125	11 (2)	12 (1)	49 (6)	62 (9)

<sup>a</sup>Parenthesis for admissions directly related to access (ex: failure, thrombosis, infection).

**Methods:** This was a retrospective analysis of 300 patients between March 2009 and July 2010 already undergoing hemodialysis via TDC, AVF, or AVG for readmissions at 15, 30 and 90 days.

**Results:** There was no statistically significant difference in the 15-, 30-, and 90-day readmission rate in the patients with TDCs compared with permanent access (Table I and Table II).

**Conclusions:** TDCs were shown to be as safe and cost-effective as permanent access during these time periods. Shortening hospital stay by discharging patients with TDCs and electively placing permanent access could result in better outcomes and significant cost savings.

**Table II.** Negative binomial regression analysis of readmissions of TDCs vs permanent access

Time period	RR (95% CI)	P
1 to 15 days	1.38 (0.56-3.37)	.482
16 to 30 days	0.67 (0.33-1.35)	.261
31 to 90 days	1.24 (0.81-1.91)	.316
Overall	1.09 (0.75-1.58)	.637

CI, Confidence interval; RR, risk ratio.

**Early and Late Clinical Outcome of Percutaneous Transluminal Stenting of the Celiac and Superior Mesenteric Arteries: Our Experience Over the Past Decade**

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**Objective(s):** Several authorities have proposed stenting of the superior mesenteric artery (SMA)/celiac arteries (CA) as the primary treatment for patients with chronic mesenteric ischemia. However, most of these reports had a small sample size and short follow-up period. This is one of the largest studies to date to analyze early and late outcomes of stenting of SMA/CA stenosis.

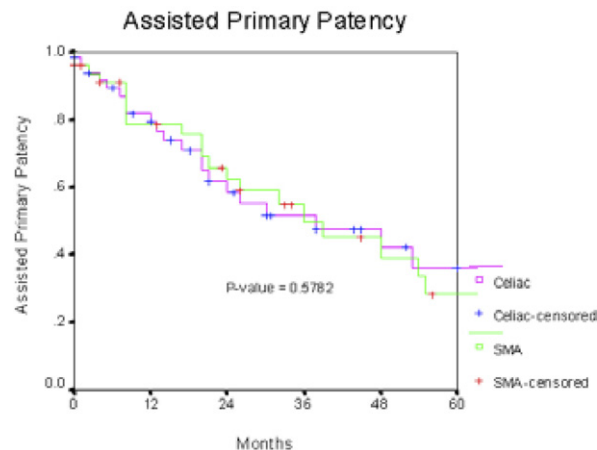


Fig.

**Methods:** During a 10-year period, 83 patients were treated and underwent clinical follow-up and duplex ultrasound examinations to evaluate long-term patency. A Kaplan-Meier life-table analysis was used to estimate freedom from in-stent stenosis and late symptoms and survival rates.

**Results:** Outcomes for 54 SMAs and 51 CA were analyzed. The initial technical and clinical success rates were 97% and 96%, respectively, with 2% perioperative morbidity and 2% mortality. The primary late clinical success rate was 59% and the late  $\geq 70\%$  in-stent stenosis rate was 54% at a mean follow-up of 31 months (range, 1-124 months). Rates for freedom from late recurrent symptoms were 83%, 77%, 70%, 70%, and 65% at 1, 2, 3, 4, and 5 years, respectively. Primary patency rates of the whole series were 68%, 48%, 36%, 26%, and 18% at 1, 2, 3, 4, and 5 years, respectively, and the assisted primary patency rates were 79%, 60%, 51%, 41%, and 32%. The primary patency rates for SMA at 1, 2, 3, 4, and 5 years were 68%, 45%, 31%, 24%, and 16%, respectively, and the assisted primary rates were 79%, 62%, 50%, 39%, and 28%. The primary patency rates for CA were 68%, 50%, 40%, 29%, and 21%, and the assisted primary rates were 79%, 58%, 52%, 42%, and 36% for 1, 2, 3, 4, and 5 years, respectively. There were no significant differences in primary or assisted primary patency between SMA ( $P = .5605$ ) or CA ( $P = 0.5782$ ; Fig). Secondary intervention was done in 30% of the series.

**Conclusions:** Stenting of SMA/CA stenosis has a high technical and early clinical success rates, with a satisfactory late clinical outcome; however, it is associated with high rates of late in-stent stenosis and intervention.

**Table.**

Time, months	SMA			Celiac		
	At risk	Cum APP	SE	At risk	Cum APP	SE
0	51	0.9608	0.0272	54	0.9815	0.0183
1	38	0.9608	0.0272	46	0.9601	0.0277
6	33	0.9074	0.0448	39	0.8926	0.0456
12	26	0.7864	0.0684	32	0.7926	0.0621
24	19	0.6209	0.0852	19	0.5845	0.082
36	11	0.4975	0.0943	13	0.5158	0.0856
48	8	0.3918	0.0998	9	0.4232	0.0925
60	3	0.2799	0.0978	6	0.3627	0.0971

**Endovascular Aneurysm Repair in the Elderly: Trends and Outcomes From the National Inpatient Sample**

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**Objective(s):** This study used the a nationwide data set to identify trends in endovascular abdominal aortic aneurysm (AAA) repair (EVAR) utilization and outcomes during a 5-year period.

**Methods:** The Nationwide Inpatient Sample database was queried for the years 2005 to 2009. Number of EVAR cases, ratio of EVAR/open repair (OR), major clinical outcomes, hospital costs and discharge status were analyzed by decade. Interval data were compared with analysis of variance and proportions via  $\chi^2$  tests.

**Results:** There were 174,714 AAA repairs (124,869 EVAR) identified. The ratio of EVAR/OR increased with increasing age. Between 2005 and 2009, the number of AAA repairs in the elderly increased by 21% (7179 vs 8554), and EVAR in patients aged  $\geq 80$  years increased by 50% (5057 vs 7650  $P < .05$ ). In 2009, 85% of AAA repairs in patients aged  $\geq 80$  years were EVAR, and 25% of EVAR were performed in patients aged  $< 80$  years, equivalent to age 60-69 years. The in-hospital mortality rate remained acceptable in all age groups. EVAR-associated mortality, length of stay, hospital costs, and discharge to skilled nursing facility increased with each successive decade of life ( $P < .05$ ). Postoperative myocardial infarction and acute renal failure also increased with increasing age ( $P < .05$ ). EVAR results by decade are presented in the Table.

**Conclusion:** One-quarter of EVAR are performed in patients aged  $\geq 80$  years based on low mortality rates. There is an age-dependent increase in death, complications, hospital costs, and discharge to extended care facilities. Such factors and long-term risk of aneurysm-related death should be considered when evaluating the appropriateness of elective aneurysm repair in the elderly.