◆ CLINICAL INVESTIGATION ◆

Endovascular Management of Chronic Infrarenal Aortic Occlusion

Mireille A. Moise, MD; Javier A. Alvarez-Tostado, MD; Daniel G. Clair, MD; Roy K. Greenberg, MD; Sean P. Lyden, MD; Sunita D. Srivastava, MD; Matthew Eagleton, MD; Timur S. Sarac, MD; and Vikram S. Kashyap, MD

Department of Vascular Surgery, The Cleveland Clinic Foundation, Cleveland, Ohio, USA.

Purpose: To review our experience with the endovascular treatment of chronic infrarenal aortic occlusion with regard to technical success and midterm patency, as well as perioperative mortality and morbidity.

Methods : A retrospective review was performed of patients who presented from January 1, 2000, to December 31, 2005, with a diagnosis of chronic infrarenal aortic occlusion (TASC D) treated with endovascular techniques. In this time period, 31 patients (22 women; mean age 63 years) underwent attempted recanalization of the occluded aorta and iliac arteries. Claudication was the most common presenting symptom (14, 45%). Patients were treated solely with angioplasty and stenting or thrombolysis followed by angioplasty/stenting based on surgeon preference.

Results: Technical success was 93%. The 2 failures were individual cases of wire-induced iliac artery perforation and failed access; both patients were treated with bypass grafting. Nine (29%) patients had thrombolysis prior to angioplasty. There were no perioperative deaths. Postoperative ankle-brachial indexes increased significantly from preoperative values ($p<0.0001$). There were 3 technical complications: 1 (3%) iatrogenic iliac artery injury and 2 (6%) perioperative limb thromboses requiring intervention. Other complications included 6 (19%) access site events and 5 (16%) episodes of acute renal dysfunction, 2 requiring permanent dialysis. Over a mean follow-up of 12 months, there was no limb loss. At 1 and 3 years, the primary/secondary patency rates were 85%/100% and 66%/90%, respectively.

Conclusion: Endovascular therapy for chronic infrarenal aortic occlusion has a high technical success rate, with good midterm primary and secondary patency rates. However, renal dysfunction can occur; the etiology is likely multifactorial from contrast volumes, embolization, and/or renal arterial disease.

J Endovasc Ther. 2009;16:84–92

Key words: aorta, iliac arteries, aortic occlusion, aortoiliac disease, thrombolysis, balloon angioplasty, stent

Chronic infrarenal occlusion was first described in 1923 by Rene Leriche.[1] Despite the extensive collateral circulation that can develop to perfuse the lower extremities in patients with chronic infrarenal aortic occlusions, critical limb ischemia (CLI) can still develop, as well as suprarenal propagation of the thrombus leading to visceral artery ste-

Daniel G. Clair discloses that he is a consultant to Cordis; a member of the speakers' bureau for W.L. Gore, Cook, FoxHollow, and Omnisonics; an unpaid consultant to Timna and Minnow Medical; and on the advisory board of Boston Scientific and Medtronic. Roy K. Greenberg is a consultant to Cook; receives grant/financial support from Cook, W.L. Gore, and Terarecon; and has licensed intellectual property to Cook. Sean P. Lyden has associations with Medtronic, Boston Scientific, ev3, and Cook. The other authors have no commercial, proprietary, or financial interest in any products or companies described in this article.

Address for correspondence and reprints: Mireille A. Moise, MD, S-40, Dept. of Vascular Surgery, 9500 Euclid Avenue, Cleveland, OH 44195 USA. E-mail: *moisem@ccf.org*

nosis or occlusion.[2] Before the emergence of aortic surgery, management of this disease was limited to sympathectomy. Over time, surgical options for the management of infrarenal aortic occlusion were developed and refined, including aortobifemoral grafting, aortic endarterectomy, and extra-anatomical bypass. Of these, aortobifemoral bypass grafting is considered the standard of care based on its long-term durability and universal applicability.[3]

Endovascular management of aortic disease emerged in the 1980s and 1990s, with reports of successful angioplasty and stenting of aortic stenosis.[4,5] In more recent times, these techniques have been used increasingly for TASC (TransAtlantic InterSociety Consensus) D aortic and iliac lesions, with high technical success rates.[6–10] We sought to examine our short- to midterm outcomes with endovascular repair of infrarenal aortic occlusions.

TABLE 1
Demographics and Characteristics of the 31 Treated Patients

Age, y	63
Female gender	22 (70%)
Comorbidities	
Coronary artery disease	14 (45%)
Chronic obstructive pulmonary disease	4 (13%)
Diabetes mellitus	1 (3%)
Hypertension	23 (74%)
Hyperlipidemia	16 (52%)
Chronic renal insufficiency	4 (13%)
Tobacco use	28 (90%)
Actively smoking	16 (57%)
Malignancy	5 (16%)
Preoperative ankle-brachial indexes	0.38, 0.39
Symptoms	
Claudication	14 (45%)
Rest pain	9 (29%)
Tissue loss	6 (19%)
Infected axillobifemoral bypass graft	2 (7%)

Continuous data are presented as means; categorical data are given as counts (percentages).

METHODS

Study Design

A retrospective review was performed of patients who presented to the Cleveland Clinic Foundation from January 1, 2000, to December 31, 2005, with a diagnosis of chronic infrarenal aortic occlusion treated with endovascular techniques. Only patients with a chronic occlusion of the aorta below the level of the renal arteries were included. Patients presenting with acute aortic occlusion, aortic stenosis, and a diseased but patent aortoiliac tree (TASC A–C) were excluded.

Demographic and clinical data were obtained through review of electronic and written medical records. Symptomatology at presentation was also recorded. One patient in this series was included in a case report of 2 patients presenting with infected prosthetic grafts who underwent successful recanalization of their occluded native arterial system.[11]

Patient Sample

In the observation period, 31 patients (22 women; mean age 63±12 years, range 40–81) were identified as meeting the study criteria. Most patients had a history of smoking (28, 90%), and more than half (16, 57%) were still actively smoking (Table 1) at the time of treatment. All patients were symptomatic, with buttock/thigh claudication as the most common reason for intervention (14, 45%), followed by rest pain (9, 29%), tissue loss (6, 19%), and infection (2, 7%). Of the 6 patients with a history of peripheral vascular procedures, 3 had an axillobifemoral bypass to treat their aortic occlusion. Two of those patients subsequently developed infection of the graft, prompting referral to our institution. The other bypass patient presented with rest pain secondary to graft thrombosis. Two patients had previous endovascular interventions, iliac artery angioplasty in conjunction with a femorofemoral bypass graft and bilateral kissing iliac artery stents, respectively. Lastly, 1 patient had undergone a previous femorofemoral bypass in conjunction with an ipsilateral femoropopliteal bypass graft.

The mean preoperative ankle-brachial index (ABI) was 0.38±0.19 on the right and 0.39±0.2 on the left. Eleven (35%) patients had preoperative computed tomography and 2 had magnetic resonance imaging, which revealed the presence of 2 small abdominal

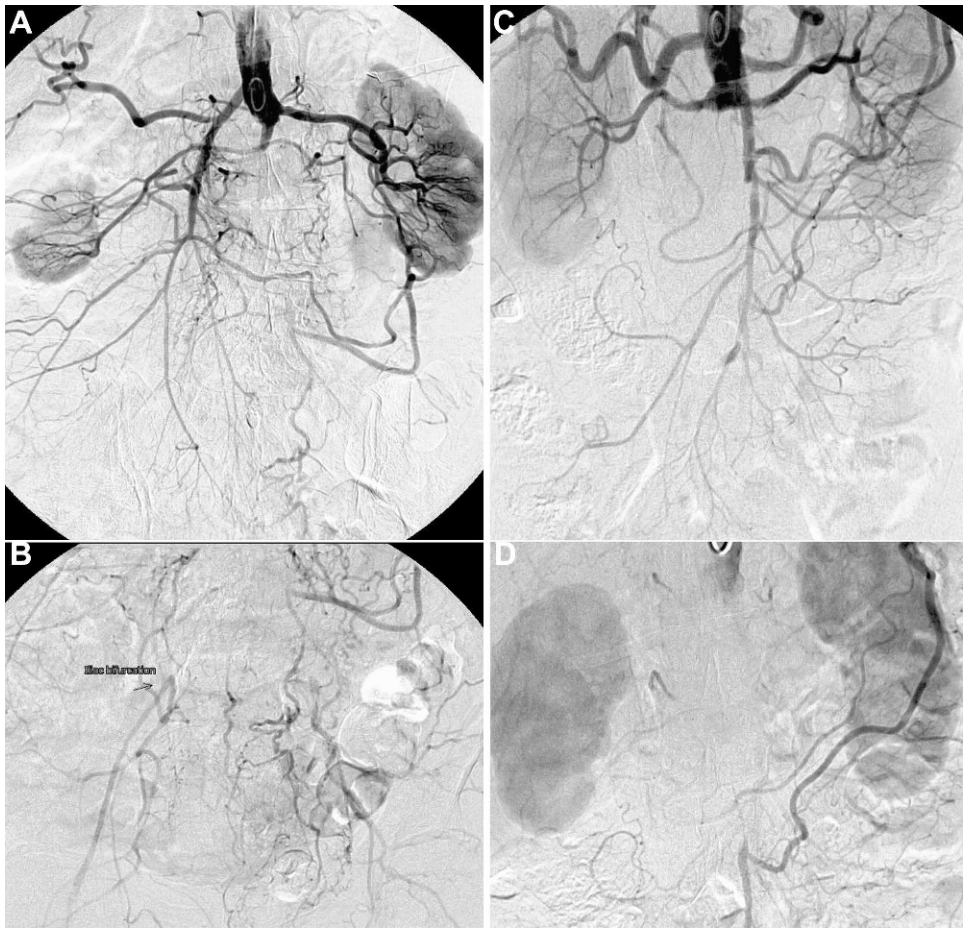

Figure 1 ◆ On the left, the minimal extent of aortic occlusion treated in this series: the occlusion starts proximally at the level of the infrarenal aorta (**A**) and extends distally to the common iliac artery bifurcations (**B**) bilaterally. On the right, the maximum extent of occlusion treated: the occlusion starts proximally at the level of the infrarenal aorta (**C**) and extends distally to the infrainguinal region (**D**).

aortic aneurysms (<3.5 cm). The remaining patients went straight to angiography and intervention. No patient had a preoperative angiogram; rather, diagnostic angiograms were performed followed by an attempt at endovascular intervention in the same setting. Representative examples of the minimum and maximum extent of distal disease treated are shown in Figure 1.

At the time of intervention, angiograms with bilateral lower extremity runoff demonstrated reconstitution of distal vessels at the suprainguinal level in 13 (41%) patients and at the infrainguinal level in 18 (59%). The average infrarenal aortic stump length was 2.9±3.1 cm; 13 (42%) of the patients had an infrarenal aortic stump <1 cm. Eight (25%) patients had visceral artery stenosis or occlusion in addition to the aortic occlusion.

Recanalization Procedures

The majority of the cases were performed in 2004 and 2005, with <4 cases performed per year between 2000 and 2003 inclusive. Nine surgeons were involved: 1 performed 12 of these cases, another 5. Among the remaining, 1 surgeon performed 4 cases, 4 surgeons treated 2 patients, and 2 surgeons executed individual procedures. Patients were treated solely with angioplasty and stenting or thrombolysis followed by angioplasty/stent-

ing based on surgeon preference. The presence of thrombus in proximity to the renal arteries was the most common indication for thrombolysis, which involved infusion of either urokinase (1000 IU/h; Abbott Laboratories, Abbott Park, IL, USA) or recombinant tissue plasminogen activator (0.25–0.5 mg/h; Genentech Laboratories, San Francisco, CA, USA) through an infusion catheter or wire placed in the recanalized aorta and 1 iliac artery.

While this series involved multiple surgeons using a variety of techniques, the most common technique used is described. Access was gained into the left brachial artery, and a pigtail catheter was advanced into the aorta at the level of the renal arteries to perform the initial arteriogram. Heparin (500 units) was administered through the sheaths to prevent development of pericatheter thrombus. Using an angled glide catheter, such as an MPA catheter (Cook, Bloomington, IN, USA) over a guidewire, recanalization of the aorta and one iliac artery system was carried out either intraluminally or subintimally. The aorta and iliac system were dilated with a balloon and stented if necessary. Recanalization of the contralateral iliac artery was performed via the brachial artery. Balloon angioplasty followed by stenting, if needed, was then completed. If recanalization of either iliac artery system could not be achieved or the kissing stent technique was employed, then access was gained into the ipsilateral femoral artery, most often using ultrasound guidance. The iliac artery was recanalized in a retrograde fashion. Once the glidewire was advanced into the aorta, a snare was introduced from the brachial artery to capture the wire; balloon angioplasty and stenting could then be done.

Stenting was performed on the common iliac arteries (CIA) bilaterally in every case. A wide variety of commercially available stents were used in the aorta and the iliac arteries. The decision to use balloon-expandable versus self-expanding stents was based on the length of the occlusion. Longer occlusions extending into the external iliac arteries (EIA) were more often treated with self-expanding stents, which are more flexible and are available in longer lengths (their use when dealing with long occlusions can minimize placement of multiple overlapping stents).

Stenting was performed selectively for residual stenosis $>$30%. Severely calcified iliac vessels were in some instances treated with covered stents to avoid arterial rupture from balloon inflation. When an aortic stent was placed, it was positioned in close proximity ($<$1 cm) to the renal arteries. If there was little to no residual disease in the aorta after raising the iliac bifurcation, stenting was not performed.

Definitions and Statistical Analysis

Acute renal failure was defined as a rise in serum creatinine $>$1.5 times the baseline value. Loss of patency was defined as a drop in the ABI by $>$0.15,[12] loss of palpable pulses, or development of ischemic symptoms. Postoperative follow-up intervals varied; however, all patients had ABI measurements performed with each office visit, which were normally on an annual basis.

Results were expressed as the mean and standard deviation. Periprocedural data, complications, and 30-day mortality rate were analyzed. The Kaplan-Meier product limit method was used to estimate the overall cumulative patency rates during follow-up [with 95% confidence intervals (CI)]. $P<0.05$ indicated a significant difference. All statistical analyses were performed using InStat software (Graph Pad, San Diego, CA, USA).

RESULTS

Of the 31 attempted endovascular reconstructions of aortic occlusion, 29 (93%) were successful. One failure was secondary to an inability to traverse the occluded aorta via a left brachial approach; the procedure was aborted, and the patient had an axillobifemoral bypass implanted in the same setting. The second patient had an iatrogenic wire-induced EIA perforation early during recanalization without hemodynamic instability. Proximal balloon inflation was done for several minutes, but as the vessel was thrombosed, there was no further extravasation noted. Further attempts at recanalization were aborted, and the patient subsequently

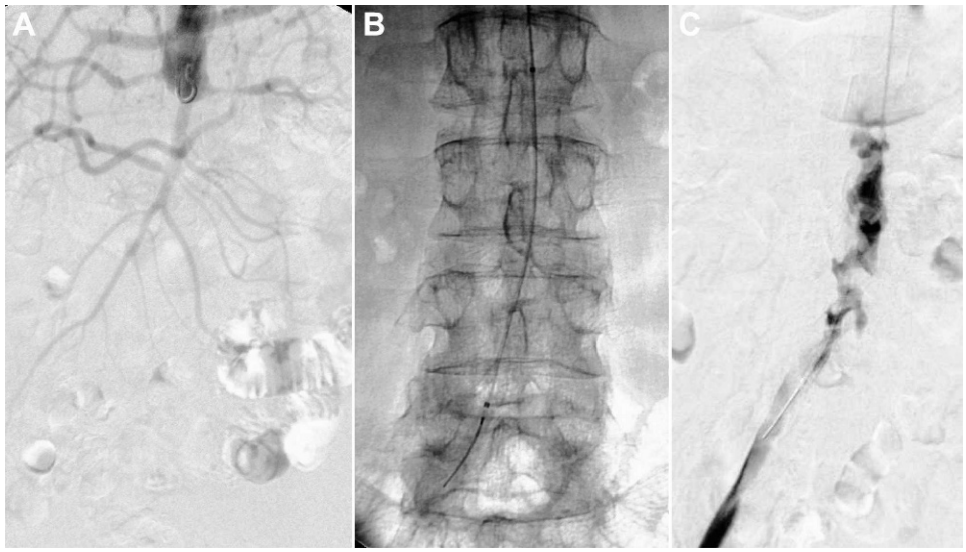

Figure 2 ◆ (A) An infrarenal aortic occlusion treated with thrombolysis. (**B**) Placement of an infusion catheter after successful recanalization of the infrarenal aorta and right iliac artery. (**C**) Flow channel achieved after 24 hours of thrombolysis.

underwent an aortobifemoral bypass. Other intraprocedural complications that did not interfere with a successful outcome were an iliac artery rupture (likely secondary to aggressive balloon dilation) treated with a covered stent and a right lower extremity embolism immediately after the procedure. Mechanical thrombectomy of the popliteal and tibial vessels was performed with successful resolution of the limb ischemia.

All but 2 of the 29 patients were done under local anesthesia with sedation. Multiple access sites were needed for all patients, the most common being initial brachial artery access with at least 1 femoral artery additionally accessed. Nine (29%) patients had preliminary thrombolysis that lasted a mean 34.5 ± 16.0 hours (range 12–60). Thrombolytic therapy was discontinued after 12 hours in 1 patient due to the development of an expanding hematoma at the brachial puncture site. Percutaneous mechanical thrombectomy was used adjunctively in 3 of the 9 patients. A flow channel was achieved in all 9 lytic cases (Fig. 2); however, there were no patients in whom complete resolution of occlusive disease was achieved with thrombolysis; there was always significant residual stenosis that required intervention.

All patients underwent angioplasty and selective stenting of the distal aorta and iliac system, primarily with self-expanding stents (75%). The aorta was stented in 55% of the cases. For the CIAs, self-expanding stents were used 60% of the time. Finally, the EIAs were stented only 38% of the time, exclusively with self-expanding devices. The patients with small aneurysms were treated in a similar fashion to the other patients in the cohort; stent-grafts were not used. Data on contrast volumes were not available for all patients, but ranged from 125 to 330 mL.

Postoperative ABIs increased to a mean of 0.88 ± 0.17 on the right and 0.89 ± 0.15 on the left ($p < 0.0001$). Average length of stay was 8.5 days (median 3, range 1–41). In several patients, hospital stay was prolonged for a variety of reasons, including the need for adequate anticoagulation prior to discharge, the use of thrombolysis, and follow-up of postprocedural renal dysfunction.

There were no mortalities in the 30-day postoperative period, and no patient required any amputation. Access site complications occurred in 6 (19%) of 31 patients; however, many of these patients had multiple access sites for this complex intervention. Five of the 6 events occurred at the brachial artery,

TABLE 2
Characteristics of Patients with Postoperative Renal Dysfunction

	Renal Artery Stenosis	Preoperative Cr/Peak Cr, mg/dL	Thrombolysis	Dialysis
1	No	0.9/5.5	Yes	Yes
2	Yes	2.7/4.8	Yes	No
3	No	1/2.1	Yes	No
4	No	1/7.8	No	Yes
5	No	1.1/2.2	No	No

Cr: creatinine.

including the patient with a hematoma during thrombolysis. The other patient had an expanding groin hematoma following manual compression; the hematoma was drained on return to the operating room. Of the 2 brachial artery pseudoaneurysms, 1 was managed with ultrasound-guided thrombin injection and the other with direct repair. Two brachial thromboses, both of which were noted within 24 hours of the procedure, were treated with surgical thrombectomy.

Two limb occlusions occurred on postoperative days 1 and 7. One patient had diminished right femoral pulses the morning after the procedure; an intraoperative angiogram revealed that the entire right iliac was occluded. After endovascular thrombectomy, repeat angioplasty, and stenting, the flow to the right lower extremity still appeared sluggish. A femorofemoral bypass was then performed to re-establish adequate flow to the limb. The second patient was also diagnosed with limb occlusion by an absent femoral pulse on the affected side. The occlusion was successfully treated with suction thrombectomy and angioplasty of the CIAs and EIAs. Two (6%) patients developed acute renal failure requiring permanent dialysis. One patient with a history of severe ischemic cardiomyopathy (ejection fraction 15%) and mitral regurgitation went into cardiogenic shock post procedure. She had been scheduled for an outpatient cardiac catheterization to address a known right coronary artery lesion. Her cardiologist, however, wanted the aortic occlusion treated prior to performing a percutaneous coronary intervention. At the conclusion of the endovascular procedure, which was performed under conscious sedation and local anesthesia, she developed shortness of breath, which rapidly progressed to cardiogenic shock. Secondary to global hypoperfusion, she developed progressive renal insufficiency and was placed on dialysis. The other dialysis patient had a solitary kidney with normal renal function. Post procedure, his serum creatinine began to rise, necessitating dialysis. Table 2 presents some pre- and intraoperative features of the 5 patients who developed postoperative renal dysfunction.

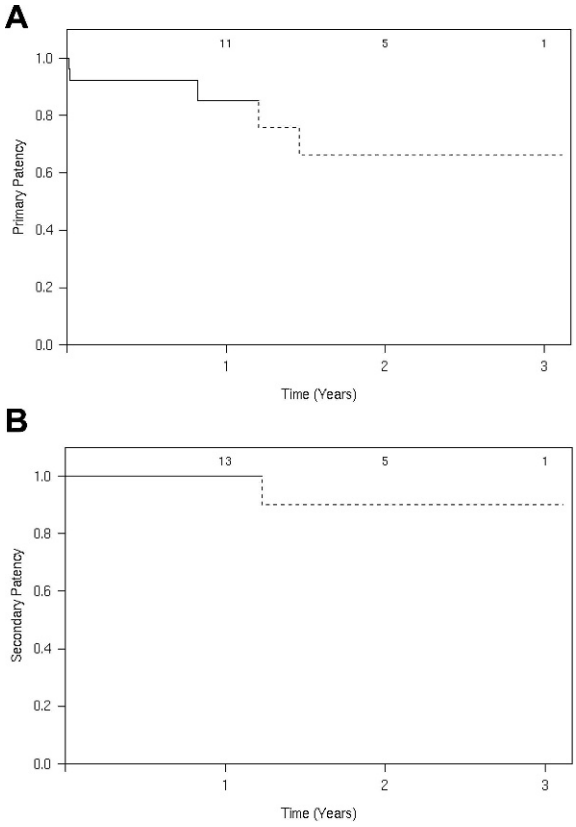

Figure 3 ◆ Kaplan-Meier estimates of (**A**) primary and (**B**) secondary patency. Dotted lines represent 95% confidence intervals.

Mean follow-up was 12 months (range 1–37); 7 patients had ≤1 month of follow-up. Primary and secondary patency rates were 85% (95% CI 70% to 100%) and 100%, respectively, at 1 year and 66% (95% CI 45% to 99%) and 90% (95% CI 73% to 100%) at 3 years (Fig. 3). The limb salvage rate was 100%. Four people required secondary interventions to maintain patency of their stents

TABLE 3
Characteristics of Patients Requiring Secondary Interventions

	Active Smoker	Level of Runoff	Thrombolysis	External Iliac Artery Stenting
1	No	Infrainguinal	Yes	Bilateral
2	Yes	Infrainguinal	Yes	Bilateral
3	Yes	Suprainguinal	No	No
4	Yes	Infrainguinal	No	Bilateral

(Table 3). Two were in the perioperative period as discussed above; the remaining 2 were at 14 and 17 months. The first patient had a drop in the ABI from 0.9 to 0.7; angiography revealed a high-grade stenosis of the left EIA, which had not previously been treated. The second patient presented with severe claudication due to in-stent restenosis of the aortic stent. This was treated with a covered stent. At last follow-up, 30 of 31 patients had patent stents; the single failure occurred at 10 months. The patient underwent a subsequent axillobifemoral bypass graft since she was considered too high risk for open surgery.

DISCUSSION

The characteristics of our patient cohort were consistent with other series. Patients with infrarenal aortic occlusion tend to present in their 60s and have a long smoking history. In addition, there is a strong female preponderance. As with previous series, buttock and thigh claudication was the most common presenting symptom.[6–9,13–17] In particular, however, 2 of the patients treated had small aortic aneurysms noted upon preoperative imaging studies. While normally this would be viewed as a contraindication to endoluminal revascularization, both patients had severe comorbid medical conditions that prevented them from being considered for standard open surgery (severe ischemic cardiomyopathy and severe obstructive pulmonary disease, respectively).

Aortobifemoral bypass grafting is the established treatment for patients with infrarenal aortic occlusive disease. Previous series reported mortality rates of 4.5% to 5% and morbidity rates of 18% to 20%.[13–17] Five- and 10-year patency rates for aortobifemoral bypass range from 79% to 85%.[3,13–17] Over the last decade, however, endovascular surgery has proven to be an excellent alternative to open surgery, especially for short stenoses of the aorta and iliac arteries, providing patency rates very similar to those obtained with open surgery.[6–9,18] Outcomes after endovascular treatment of more complex aortoiliac disease are less well-defined, and this complex problem remains a more difficult situation to approach with an endovascular solution. As our data and other previously published series demonstrate, however, aortoiliac recanalization is technically feasible. As new endovascular tools and techniques develop and vascular interventionists gain experience, endovascular surgery is likely to play a larger role in this disease process. The zero 30-day mortality in the current series is similar to others with TASC A–C aortoiliac disease[6–9,10,18] and compares favorably to the 5% mortality seen with open surgery. The endovascular procedure, however, is not free of complications; in our series, the majority of complications were technical, such as limb thrombosis, iliac artery injury, and access site complications. As experience grows with endovascular management of aortoiliac occlusive disease in general and aortic occlusions in particular, this complication rate is likely to go down.

Access site complications were relatively frequent in this series, with the majority involving the brachial artery. This access was favored in this series because of the ease of engaging both iliac systems via this route. One method to reduce the incidence of brachial artery pseudoaneurysm and thrombosis includes operative exposure of the brachial artery followed by direct repair; however, this is not without risk as well in a complex patient population with diffuse vascular disease.

While technical issues can be overcome with operator experience and device design, a troublesome revelation of our series was the high incidence of renal dysfunction. Acute renal failure was observed in 5 patients. In 2, the renal failure progressed to the point of permanent dialysis. Both of them had normal preoperative creatinine, although one had a

solitary kidney. One of the 3 patients with transient renal dysfunction had pre-existing renal insufficiency. It is unclear whether or not the renal dysfunction was related to contrast volumes, embolism, or renal arterial disease. We were unable to find any technical factors or patient characteristics that conferred a protective effect against renal function deterioration. There were not enough patients in this series to make any meaningful conclusions. There was no consideration given to providing embolic protection to the renal arteries prior to stenting simply because we were unaware of the high rate of renal dysfunction that could occur. Given the fact that we cannot clearly identify a causative factor for this sequela, it would be premature to recommend routine renal embolic protection at this point.

The question of applying thrombolysis in this patient population remains to be answered. There were no patients in whom thrombolysis achieved complete resolution of the occlusion, but thrombolytic therapy alone was able to provide a flow channel through the previously occluded segments in all cases. However, there was always significant residual stenosis that required intervention. Thus, this therapy did not decrease the length of vessel treated nor the need for stenting, but there was significant resolution of proximal thrombus in several patients, making treatment of the aortic occlusion near the renal arteries theoretically safer. It is clear, though, that treating this disease process does not always necessitate the use of thrombolytic agents and the time and risk they entail.

Our patency rates are not quite as good as other series with longer follow-up but smaller numbers of patients. The difference can be accounted for by the fact that these series included patients with TASC A–C lesions and fewer (no more than 25%) patients with flush infrarenal aortic occlusions. In the 24 cases of aortic stenting reported by Martinez et al.,[7] the 6 with total occlusion maintained a cumulative 5-year patency of 100%. Lagana et al.[8] reported 89% and 100% for primary and secondary patency rates, respectively, after a mean 19.6-month follow-up in 19 patients, 5 of whom had complete aortic occlusion.

While endovascular surgery is currently not viewed as the gold standard treatment for infrarenal aortic occlusion, its use should be considered based on the clinical scenario, the patient's operative risk, operator experience, and available interventional equipment. This approach may prove particularly appealing in patients with severe comorbidities and/or significantly advanced age. High surgical risk patients are normally managed with extra-anatomical bypass, which is associated with shorter patency and high morbidity and mortality rates even in contemporary series.[13,14,16,17]

Finally, this series reinforces the usefulness of this technique in patients with aortic occlusion previously treated with an extra-anatomical bypass. Erzurum et al.[11] first described the approach of native artery recanalization in the setting of graft infection. Three of our patients had a previous extra-anatomical bypass: 2 presented with infected graft and 1 with a thrombosed graft. All 3 were successfully managed with recanalization of their native aorta and iliac arteries, negating the need for more prosthetic material.

Limitations

There are several limitations to this study, including its retrospective nature, inconsistent follow-up data, and the varied practice patterns of the surgeons involved in these cases. In addition, roughly one third of patients had $\leq$1 month of follow-up, limiting our data on long-term patency of endovascular management of chronic infrarenal aortic occlusions.

Conclusion

Endovascular therapy for chronic infrarenal aortic occlusion has a high technical success rate, with good short-term primary and secondary patency rates. However, renal dysfunction can occur; the etiology is likely multifactorial from contrast volumes, embolization, and/or renal arterial disease.

REFERENCES

1. Leriche R, Morel A. The syndrome of thrombotic obliteration of the aortic bifurcation. *Ann Surg*. 1948;127:193–206.

2. Deriu GP, Ballotta E. Natural History of ascending thrombosis of the abdominal aorta. *Am J Surg*. 1983;145:652–657.
3. Rutherford RB. Aortobifemoral bypass, the gold standard: technical considerations. *Semin Vasc Surg*. 1994;7:11–16.
4. Charlebois N, Saint-Georges G, Hudon G. Percutaneous transluminal angioplasty of the lower abdominal aorta. *AJR Am J Roentgenol*. 1986;146:369–371.
5. Hedeman Joosten PP, Ho GH, Breuking FA, et al. Percutaneous transluminal angioplasty of the infrarenal aorta: initial outcome and long-term clinical and angiographic results. *Eur J Vasc Endovasc Surg*. 1996;12:201–206.
6. Rosset E, Malikov S, Magnan PE, et al. Endovascular treatment of occlusive lesions in the distal aorta: mid term results in a series of 31 consecutive patients. *Ann Vasc Surg*. 2001; 15:140–147.
7. Martinez R, Rodriguez-Lopez J, Diethrich EB. Stenting for abdominal aortic occlusive disease: long-term results. *Tex Heart Inst J*. 1997;24:15–22.
8. Lagana D, Carrafiello G, Mangini M, et al. Endovascular treatment of steno-occlusions of the infrarenal abdominal aorta. *Radiol Med (Torino)*. 2006;111:949–958.
9. Klonaris C, Katsargyris A, Tsekouras N, et al. Primary stenting for aortic lesions: from single stenoses to total aortoiliac occlusions. *J Vasc Surg*. 2008;47:310–317.
10. Leville CD, Kashyap VS, Clair DG, et al. Endovascular management of iliac artery occlusions: extending treatment to TransAtlantic Inter-Society Consensus class C and D patients. *J Vasc Surg*. 2006;43:32–39.
11. Erzurum VZ, Clair D. Endovascular native vessel recanalization to maintain limb perfusion after infected prosthetic vascular graft excision. *J Vasc Surg*. 2005;41:332–336.
12. Rutherford RB, Baker JD, Ernst C, et al. Recommended standards for reports dealing with lower extremity ischemia: revised version. *J Vasc Surg*. 1997;26:517–538.
13. Ligush J, Criado E, Burnham SJ, et al. Management and outcome of chronic atherosclerotic infrarenal aortic occlusion. *J Vasc Surg*. 1996;24:394–404.
14. Nevelsteen A, Wouters L, Suy R. Long-term patency of the aortofemoral Dacron graft. A graft limb related study over a 25-years period. *J Cardiovasc Surg (Torino)*. 1991;32:174–180.
15. Szilagyi DE, Elliot JP, Smith RF, et al. A thirty year survey of the reconstructive surgical treatment of aortoiliac occlusive disease. *J Vasc Surg*. 1986;3:421–436.
16. Mavioglu I, Dogan O, Ozeren M, et al. Surgical management of chronic total occlusion of abdominal aorta. *J Cardiovasc Surg (Torino)*. 2003;44:87–93.
17. Sugimoto T, Ogawa K, Asada T, et al. Leriche syndrome: surgical procedures and early and late results. *Angiology*. 1997;48:637–642.
18. Stoeckelhuber BM, Stoechkelhuber M, Gellisen J, et al. Primary endovascular stent placement for focal infrarenal aortic stenosis: long term results. *J Vasc Interv Radiol*. 2006;17:1105–1109.