Int J Clin Exp Med 2020;13(3):1949-1954
www.ijcem.com /ISSN:1940-5901/IJCEM0099853

Original Article

Catheter-directed thrombolysis to treat juxtarenal aortic occlusion

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Received July 19, 2019; Accepted November 6, 2019; Epub March 15, 2020; Published March 30, 2020

Abstract: To present our initial experience with Catheter-directed thrombolysis (CDT) using urokinase for the treatment of juxtarenal aortic occlusion. This was a retrospective study of 14 patients with juxtarenal aortic occlusion treated with CDT for 2-6 days between March 2012 and March 2015 at the Department of Vascular Surgery of People's Hospital of Peking University. All patients had an occlusion of the abdominal aorta adjacent to the origin of the renal arteries and were diagnosed by computed tomography. All patients were classified as TransAtlantic Inter-Society Consensus II (TASC D). Successful thrombolysis was defined as a reduction of >50% of the thrombus volume. There were nine men (64%) and five women (36%). Mean age was 58.3±9.4 years. The main symptom was claudication in eight patients (57%), rest pain in four (29%), and ulceration in two (14%). The duration of disease was 30.8±24.7 months (range, 1-72 months). CDT lasted 6 days in 12 patients, 2 and 3 days in the other 2 patients. The use of CDT was successful in all 14 patients. Three patients complained of transient pain, but it did not need intervention. No patient experienced perioperative visceral embolization. Limb ischemia was significantly relieved in all patients. At 1 year of follow-up, two patients presented asymptomatic re-occlusion. CDT could be considered in the treatment of juxtarenal aortic occlusion.

Keywords: Juxtarenal aortic occlusion, catheter-directed thrombosis, endovascular treatment, urokinase

Introduction

Total occlusion of the infrarenal aorta is a rare disease with an estimated prevalence of 0.15%, according to an early autopsy study [1]. Surgical treatments such as aortobifemoral bypass and aortic endarterectomy have been considered the standard treatment of aortoiliac occlusive disease, achieving effective patency rates [2, 3]. The mortality and systemic morbidity rates of aortic bifurcation graft procedures have dropped over the years.

Endovascular therapy represents an attractive alternative treatment for aortic occlusive disease [4-9]. The main challenge for vascular surgeons during the treatment of aortic occlusive disease is to avoid visceral impairment. According to the TASC guideline, extensive disease (TASC types C and D) can be best treated using reconstructive surgery [10, 11]. But with the development of endovascular therapy, more studies are reporting the use of endovascular therapy. Of course, compared with surgery, endovascular therapies are associated with less surgical trauma, lower morbidity, fewer complications, and lower mortality; on the other hand, the patency rate is usually better with surgery [6, 12, 13].

Catheter-directed thrombolysis (CDT) is extensively used in the treatment of peripheral arterial occlusive disease [14-17]. Because of the high success rate and limited complications of CDT in peripheral disease, we hypothesized that CDT could be used for the treatment of aortic occlusive disease. Very few cases of the use of CDT in aortic occlusive disease have been reported [18, 19]. In addition, most endovascular methods were reported in the specific context of infrarenal aortic occlusion [4-9] and there is little literature about juxtarenal occlusion. Therefore, the aim of the present study was to describe our initial experience with CDT in the treatment of juxtarenal aortic occlusion.

Materials and methods

Patients

This was a retrospective study of 14 patients with juxtarenal aortic occlusion (both acute and chronic) treated with CDT for 2-6 days between March 2012 and March 2015 at the Department of Vascular Surgery of People's Hospital of Peking University. All patients had an occlusion of the abdominal aorta adjacent to the origin of the renal arteries and were diagnosed by computed tomography. All patients were classified as TASC D [20]. All patients during the study period were treated with CDT unless they had a contraindication to thrombolysis. The ethics committee of the People's Hospital of Peking University approved the study and waived the need for individual consent because of the retrospective nature of the study.

CDT procedure

The treatment regimen was set by the department and all surgeons followed the same standard. All procedures were performed under local anesthesia. A 6 F shuttle sheath (Cook Medical, Bloomington, IN, USA) was inserted through the left brachial artery and the tip was placed above the proximal part of the aortic occlusion. The initial attempt at crossing the occlusion was generally made with a 0.035-inch hydrophilic guidewire (Terumo, Tokyo, Japan) by an antegrade approach from above the lesion. The guidewire was passed into the most distal part of the occluded vessel, making sure the wire was in the true lumen. The occlusive thrombus was then accessed by using a 5-F straight thrombolysis catheter (Uni*Fuse, AngioDynamics, Inc., Latham, NY, USA) with multiple side holes and laced with 500,000 IU of urokinase. Urokinase was then infused through the catheter at 20,000 IU/h for 2-6 days, combined with anticoagulation treatment with low-molecular-weight heparin at 100 IU/kg. Hemoglobin and fibrinogen levels, platelet count, thrombin times, and activated prothrombin times (APTTs) were measured daily. Generally, a second arteriogram was performed 2-3 days after catheterization to check the progress of thrombolysis. To continue thrombolysis, to change the catheter position, or implant a stent was done according to the operator's experience and decision, usually because of residual wall thrombus or stenosis. Successful thrombolysis was defined as a reduction of >50% of the thrombus volume. At last, covered kissing stents were implanted in 12 patients.

Follow-up

All patients who underwent technically successful procedures were clinically monitored at 1 month and every 3 months thereafter. Follow-up CT angiography was performed 3 months after the procedure and every year thereafter or in cases of symptom deterioration.

Statistical analysis

Only descriptive statistics were used.

Results

Characteristics of the patients

From March 2012 to March 2015, 14 patients underwent CDT for juxtarenal occlusive aortic disease at the Department of Vascular Surgery of People's Hospital of Peking University. The characteristics of the patients are presented in **Table 1**. There were nine men (64%) and five women (36%). Mean age was 58.3±9.4 years. The main symptom was claudication in eight patients (57%), rest pain in four (29%), and ulceration in two (14%). Four patients were smokers. The duration of disease was 30.8±24.7 months (range, 1-72 months). No patient had a history of endovascular procedure.

Characteristics of the CDT procedure

CDT lasted 6 days in 12 patients, as per procedure protocol. CDT lasted 2 and 3 days in two patients respectively, because of hemorrhage. The use of CDT was successful in all 14 patients. There was complete lysis in two patients and they did not need stent placement in the abdominal aorta. The occlusion plane was reduced in 10 patients and they only needed a stent in the lower abdominal aorta. The last two cases were with residual thrombus at the origin of renal artery but the thrombus in the aorta was clearly reduced. In the first case, we pulled the thrombus to the aortic bifurcation with a balloon and then implanted covered kissing stents. In the other case, we implanted covered kissing stents directly at the origin of renal artery. **Figure 1** presents the angiography images of a successful procedure. Only one patient

Table 1. Clinical features of the patients treated for juxtarenal aortic occlusion with catheter-directed thrombolysis (CDT)

Patient no	Sex	Age (years)	Symptoms	Comorbidities	Cigarette	Duration of symptoms (months)	Thrombolysis time (days)
1	F	66	Rest pain	HT, AF, CVD, right femoral artery occlusion	N	6	6
2	M	71	Claudication	Left renal artery stenosis	Y	36	2
3	F	57	Claudication	AF, CVD, CHD, right renal artery stenosis	N	9	6
4	M	59	Claudication	CAD, CVD, DM, renal artery occlusion, femoral artery occlusion	N	10	6
5	M	49	Ulceration	CVD, polycythemia vera	Y	12	6
6	F	42	Claudication	HT, CHD, renal artery occlusion	N	60	6
7	M	43	Rest pain	Femoral artery occlusion	N	60	6
8	F	59	Rest pain	Takayasu ateritis, aortic stent	N	24	6
9	M	59	Ulceration	DM	Y	9	3
10	M	58	Claudication	HT, CAD	N	60	6
11	M	52	Rest pain	DM, CAD	Y	24	6
12	F	73	Claudication	HT	N	72	6
13	M	61	Claudication	CAD	N	48	6
14	M	67	Claudication	HT	N	1	6

CAD: coronary artery disease; CAD: congestive heart disease; HT: hypertension; RF: renal failure; CVD: cerebrovascular disease; AF: atrial fibrillation; DM: diabetes mellitus.

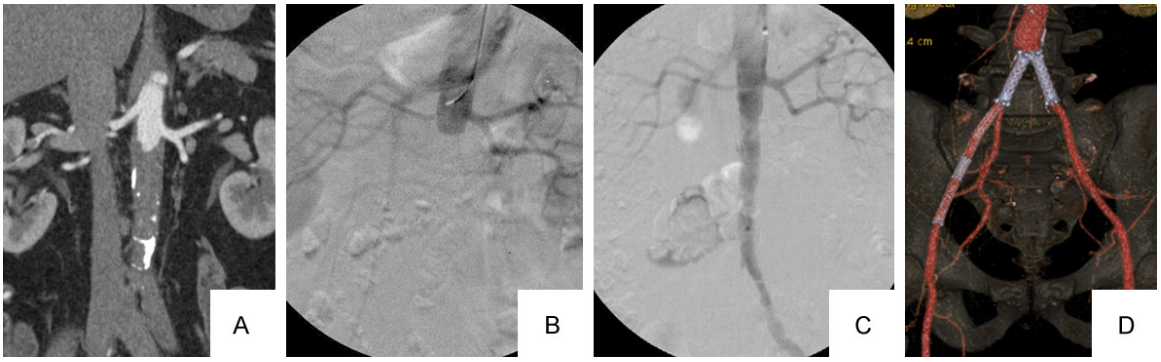

Figure 1. Case 5. A: CT demonstrating juxtarenal aortic occlusion, abdominal aortic calcification, and intraluminal thrombosis; B: Angiography indicating juxtarenal aortic occlusion; C: Complete lysis of the thrombus in the abdominal aortic artery after thrombolysis; D: CT image at 12 months after treatment.

developed retroperitoneal hematoma during CDT and was treated with covered stent. Three patients complained of transient pain, but it did not need intervention. No patient experienced perioperative visceral embolization. Limb ischemia was significantly relieved in all patients.

Follow-up

At 1 year of follow-up, two patients presented re-occlusion, probably because of poor femoral artery outflow. The patients did not show specific symptoms and no special treatment was performed at this time.

Discussion

Endovascular techniques have advantages over surgery for the treatment of aortic occlusive disease [4-9]. Very few cases of the use of CDT in aortic occlusive disease have been reported [18, 19]. Therefore, the present study aimed to present our initial experience with CDT using urokinase for the treatment of juxtarenal aortic occlusion. The results suggest that CDT could be considered in the treatment of juxtarenal aortic occlusion.

In 1923, LeRiche first described the condition of aortic occlusion [21]. In 1963, Bergan and Trippell [22] recognized juxtarenal aortic occlusion as a terminal stage of LeRiche syndrome because of continued proximal thrombosis and because of the high risk of visceral organ impairment.

The present study examined the feasibility of CDT for aortic occlusive diseases at the level of the visceral arteries. CDT offers several potential advantages over surgery [6, 12, 13]. First, thrombolysis can dissolve blood clots and clearly reduce the occlusion plane to protect the visceral arteries from emboli released during operation. In the present series, there was complete lysis in two patients who did not need stent placement in the abdominal aorta, and the occlusion plane was reduced in 10 patients who only needed a stent in the lower abdominal aorta. The last two cases were with residual thrombus at the origin of renal artery but the thrombus in the aorta was clearly reduced and covered kissing stents were implanted. Second, CDT can reduce the number of stents. In this series, only one patient received stents at the origin of renal artery. As the number of stents was decreased, it may increase the patency rate. We choose covered stent in the aorta and common iliac artery because of the better patency rate versus bare stents [23, 24] and it can prevent rupture after the procedure. Finally, surgical repair is associated with important morbidity, trauma, and complications [6, 12, 13].

Comparison of the present series with the literature is limited by the very small number of patients with aortic occlusion treated with CDT [18, 19]. Wongwamit et al. [18] showed that CDT is an effective method for the treatment of ischemic limb resulting from acute aortic embolism (n=2 patients). Nevertheless, they observed that bleeding is a major complication of this approach. Alder et al. [19] reported one case of endovascular aortic aneurysm repair occlusion using CDT, in which they achieved good results. In the present series, the treatment was effective in patients with disease duration of up to 72 months, suggesting that CDT is also effective for chronic disease.

The main technological difficulty in the CDT of juxtarenal aortic occlusion is to make sure the wire is in the true lumen distal to the occluded segment. If the aortic occlusions cannot be crossed via the true lumen because the wire keeps entering the subintimal space, we can snare the wire from the femoral artery to ensure that the wire is in the true lumen distal to the occluded segment. In the present series, the wire was in the true lumen in all patients and femoral snaring was not needed.

Severe systemic or intracranial bleeding is the most significant clinical risk associated with CDT [9, 15, 17, 18]. Most bleeding during CDT occurs at the puncture sites, but retroperitoneal or intra-abdominal bleeding may also occur spontaneously. Van den Berg [17] reviewed three large randomized trials and 14 review articles published between 1980 and 2009 to determine the incidence of hemorrhagic stroke, major hemorrhage (causing hypotension or requiring transfusion or other specific treatment), and minor hemorrhage. The overall risk of hemorrhagic stroke was 1-2.3% and major and minor hemorrhage occurred in less than 5.1% and 14.8% of patients, respectively [17]. In the present series, only one case showed retroperitoneal hematoma.

Acute deterioration of the limb due to increasing ischemia is common during thrombolysis [8, 14-16, 25]. Thrombolysis causes distal embolization Small emboli may be clinically silent or cause transient pain only, but sometimes thrombus aspiration or surgery may be required if Ischemia aggravated. In the present series, three patients complained of transient pain, but the symptoms improved quickly and they did not require surgery.

The Thrombolysis or Peripheral Arterial Surgery (TOPAS) study evaluated the efficacy and safety of urokinase doses ranging from 2000 to 6000 IU/min and found no significant difference in the rate of successful lysis or bleeding complications [14]. Continuous infusion is the standard method used for intrathrombus CDT, but there are no scientific data that specifically address the potential advantages or disadvantages of heparinization during thrombolysis. At our center, the therapeutic schedule was 500,000 IU of urokinase as a bolus and continuous infusion of 20,000 IU/h, combined with low-molecular weight heparin. The curative effect was good and is associated with a low complication rate, but no comparisons of different regimens were made.

The importance of the duration of the ischemic interval on the long-term success of thrombolysis has been previously recognized [25], but in the present series, the duration was from 6 to 72 months. Nevertheless, good results were achieved in all cases. Wongwamit et al. [18] also achieved good results in patients with study duration of up to 6 weeks. Additional studies should be performed to assess the impact of disease duration on thrombolysis results.

The present study is not without limitations. The sample size was small and from a single center. In addition, a single regimen of a single thrombolytic agent is routinely used. Additional studies should be performed to address those issues.

In conclusion, CDT could be considered in the treatment of juxtarenal aortic occlusion.

Disclosure of conflict of interest

None.

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