Review Article

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Outcomes of the treatment of contralateral iliac venous thrombosis after stenting across the iliocaval confluence

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Abstract

Among the complications related to the endovascular treatment of the left common iliac vein obstruction, the contralateral deep venous thrombosis consists in a late complication of the procedure. This case series describes the endovascular treatment of four patients with right iliofemoral deep venous thrombosis caused by jailing of the inferior vena cava confluence, due to previous stents implanted in the left common iliac vein. All the four patients were admitted with pain and swelling of the right lower limb, and one patient presented with phlegmasia cerúlea dolens. The patients were evaluated with duplex-scan and angioCT-Scan that confirmed extensive right iliofemoral and femoropopliteal deep venous thrombosis, except for one patient, whose DVT propagated to superficial femoral vein, without popliteal involvement. All patients were submitted to endovascular treatment with pharmacomechanical thrombectomy, previous stent recanalization and stent deployment in the iliocaval confluency. Regarding the post-operative complications, one patient presented with hemoglobinury, which evolved with anuria, and in the first day post-operative with acute kidney failure and necessity of hemodialysis for 8 days, after that evolved with total renal function recovery. During the hemodialysis period, this patient received non-fractioned heparin, instead of enoxaparin. All patients presented with satisfactory improvement on limb edema, in the first day and thereafter in the first week post-operative. The pharmacomechanical thrombectomy technique followed by angioplasty and kissing stenting was a safe and efficient procedure in this case series report.

Introduction

Lately, the left common iliac vein angioplasty associated with stenting deployment, either by isolated iliac vein compression or associated with deep venous thrombosis, or even caused by post-thrombotic syndrome became very common and very widespread, leading to long-term satisfactory results, with completely resolution of the symptoms [1]. Among the complications related to the endovascular treatment of the left common iliac vein obstruction, the contralateral deep venous thrombosis is poorer described in the overall literature, despite the incidence of 4-9%, consisting in a late complication of the procedure.1,2 The main factors related to this very dreadful complication are venous intimal hyperplasia, "jailing", acute deep venous thrombosis, non-compliance with the prescribed 6 months anticoagulation, pre-operative contralateral internal iliac vein thrombosis , pre-existing inferior vena cava filter placement and previous common iliac vein stents overextended to the inferior vena cava [2, 3].

Methods

Between september of 2016 and may of 2020, we have performed the endovascular treatment of four patients with right iliofemoral deep venous thrombosis caused by jailing of the inferior vena cava confluence, due to previous stents implanted in the left common iliac vein. The main objective of this paper is to report the endovascular technique used to treat those patients, the post-operative evolution, their follow-up and outcomes.

Cases description

There were four female patients admitted with right iliofemoral deep venous thrombosis, whose demographic characteristics are described on (**Table 1**). All the four patients were admitted with pain and swelling of the right lower limb, and one patient presented with phlegmasia cerúlea dolens (**Figure 1**). The patients were evaluated with duplex-scan and angioCT-Scan, that confirmed extensive right iliofemoral and femoropopliteal deep venous thrombosis, except for one patient, whose deep venous thrombosis propagated to superficial femoral vein, without popliteal involvement. Another pattern observed on angioCT-Scan was a thrombus evolving the inferior vena cava (**Figures 3** & **4**). All patients received enoxaparin

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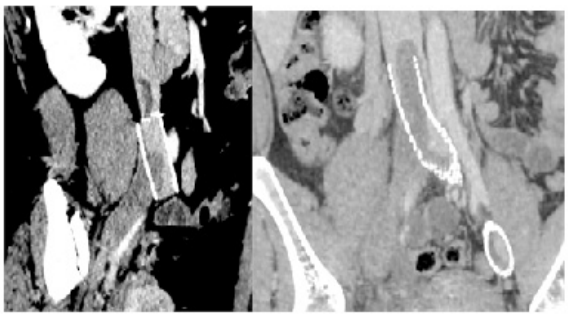
12/12 hours and totally bed rest.

Table 1: *Patient's Demographic characteristics.*

PATIENT	CASE 1	CASE 2	CASE 3	CASE 4
AGE (YEARS)	23	55	34	52
ANTICOAGULANT/ ANTIAGREGANT	none	absent	Rivaroxaban (stoped the medication 30 days before the event)	Rivaroxaba and Clopidogrel
TIME AFTER THE FIRST PROCEDURE	15 months	24 months	28 months	24 months
CAUSE OF THE FIRST PROCEDURE	Left Iliofemoral deep venous thrombosis	May-Turner Syndrome	Left Iliofemoral deep venous thrombosis	Left Iliofemoral deep venous thrombosis
STENTS CARACTHERISTICS	Zilver vena 16x100	Sinus (venous)	Sioxx 16x100	Wallstent

Figures 1 and 2: *Important leg swelling and distal cyanosis.*



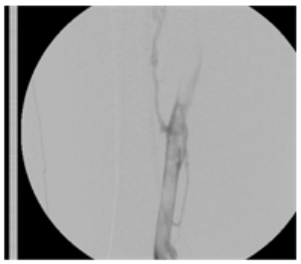
Figures 3 and 4: *AngioCT-Scan: Stents jailing the inferior vena cava, with extensive inferior vena cava, intra-stent and right iliac vein thrombosis.*

Endovascular Treatment

Under general anesthesia and bladder catheterization the patients were submitted to three vein cannulations: one for blood test collection, one for drugs infusion and one for saline solutions infusion. This routine is made due to eventual necessity of fibrinolysis, avoiding intraoperative vein cannulation and unnecessary haemorragic events. All patients were anticoagulated with endovenous non fractionated heparin 5000UI in bolus.

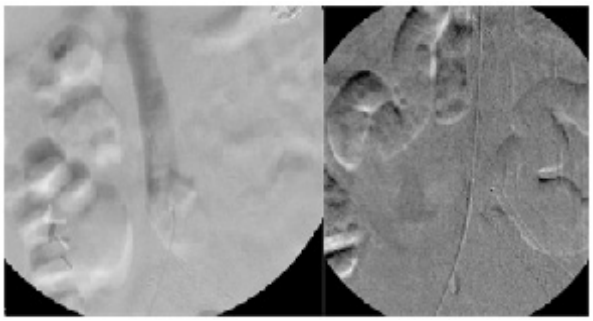
At first, we performed a right jugular internal vein puncture, Doppler ultrasound guided, in order to deploy a vena cava filter, above the vena cava thrombus-3 cases supra-renal and one case infra-renal. After, with the patient in the supine position, a left femoral vein puncture and a right popliteal vein puncture was realized (in one case was necessary to realize an external saphenous puncture, due to saphenouspopliteal junction above the knee (**Figure 5**). After the venous accesses, a diagnose phlebography catheter was performed in the inferior vena cava through the left limb venous access (**Figure 6**).

Figures 5: *Venous access through the right external saphenous vein and left common femoral vein.*



Figures 6: *Phlebography showing massive femoropopliteal deep venous thrombosis.*

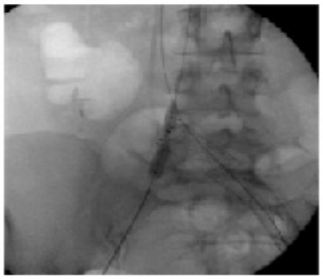
The right venous axis recanalization is realized through an usual pharmacomechanical thrombectomy. It was used to execute mechanical thrombectomy and remove a large amount of thrombus. The stent recanalization could be performed both parallel (outside) and through the stent mesh; 2 of our cases were with the first technique and the other two with the second (**Figures 7** and **8**).



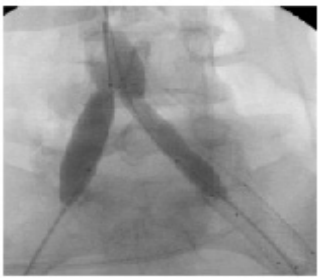
Figures 7 & 8: *Recanalization through parallel (outside) and through the stent mesh.*

Once the venous recanalization was performed with the guidewires properly positioned, the pharmacomechanical thrombectomy was initialized. The AngioJet Solent Omni Thrombectomy Catheter™ (Boston Scientific Corporation Marlborough, MA, US) was the device of choice. Procedures with the AngioJet Solent® were performed using two thrombectomy passes of the arterial thrombotic occlusion by advancing the device by 2 to 3 mm per second. During the thrombectomy procedure, the rotation hub at the catheter shaft was rotated by

270 degrees back and forth to ensure circumferential thrombus removal. An intraclot injection of 10 mg of recombinant tissue plasminogen activator (r-tPA; total injected volume 30 mL) using the PowerPulse® technique was performed. After 20 minutes of dwell time, another two thrombectomy passes were performed as described, not exceeding a total device activation time of 280 seconds. However, there was 1 case in whom it was necessary to maintain catheter-directed thrombolysis (Fountain MERIDITMEDICAL) with Alteplase 1mg/h in the post-operative, due to residual thrombus higher than 50%. Through a popliteal vein access with a sheath, non-fractioned heparin infusion was administered. The patient is moved to an intensive care unit for better laboratorial and vital signs control. Blood tests are performed, especially fibrinogen every 6 hours, and in case of fibrinogen < 100mg/dl, alteplase infusion is discontinued. There was only 1 case in whom alteplase was not administered, a patient submitted to mechanical thrombectomy with ASPIREX 10F. Mechanical thrombectomy technical success was achieved with the presence of less than 50% of residual thrombi in the phlebography, and then the iliocaval confluency should be submitted to angioplasty. At first, we perform a right iliac vein angioplasty with catheter balloon 10-12mm. When performing the angioplasty, it is possible to detect a vein segment resistant, suggesting the exact place of the vein jailing, with limited vein flow (**Figure 9**). After this, we perform a Kissing balloon in the iliocaval confluency, with catheter balloon 14x40mm (**Figure 10**).

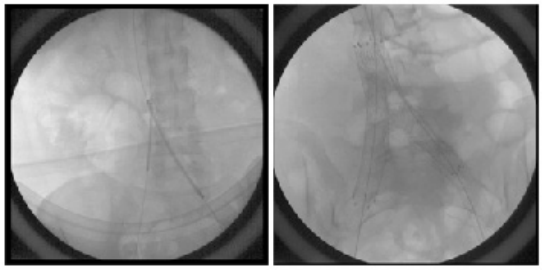


Figures 9: *Iliocaval confluency angioplasty, where it is possible to detect the vein segment with jailing.*

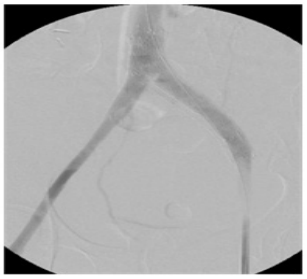


Figures 10: *"kissing balloon" of the iliocaval confluency.*

After the catheter balloon pre-dilatation, we proceed with the iliocaval confluency kissing stent (**Figure 11**), using a stent with considerable radial force and the same type bilateral, to avoid one stent promoting compression through the other. Post-stenting dilatation was performed through kissing balloon 14x40mm. Phlebography control was performed (**Figure 12**). In 2 cases, after the phlebography, the Intravascular Ultrasound (IVUS) was used (**Figure 13**). Types and materials featured are summarized on (**Table 2**).



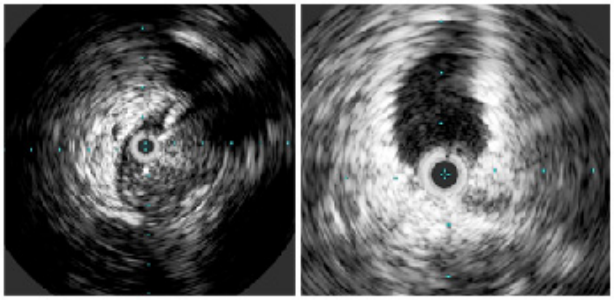
Figures 11: *kissing stents. In the Left stents pre-deployment. In the right, post deployment image.*



Figures 12: *Post-operative phlebography.*

Table 2: *Endovascular procedures details.*

PATIENT	1LU	2NO	3AL	4MS
VEIN ACCESS	Right Popliteal vein / Left common femoral vein	Right External saphenous vein and left common femoral vein	Right popliteal vein/ Left common femoral vein	Right popliteal vein / left common femoral vein
IVUS	no	yes	no	yes
STENT CONFLUENCIA ILIACO-CAVAL	Sioxx 14x100/ 14x100	Sioxx16x100/ 18x100	Sioxx 14x70/14x100	sioxx14x100/ 14x100
DISTAL STENT EXTENSION	No	Sinus 16x64	No	No
THROMBECTOMY DEVICE	Angiojet 8F(Zelant)	Angiojet 8F(Zelant)	Angiojet 6F(Solent)	Aspirex 10F
FIBRINOLYSIS	Pulse Spray 20mg rTPA	Pulse Spray 20mg rTPA	Pulse Spray 20mg rTPA + catheter 1mg/h rTPA/23 h	No



Figures 13: *Iliocaval confluency IVUS image. On the left, pre-deployment stenting, on the right post-deployment stenting.*

Table 3: *Post-operative demographics.*

PATIENT	1LU	2NO	3AL	4MS
DAYS OF HOSPITALIZATION	17	29	8	7
INTENSIVE CARE UNIT	2	10	2	1
COMPLICATIONS	No	Acute renal failure	No	No
ANTICOAGULATION	Warfarin	Warfarin	Rivaroxaban	Rivaroxaban
ANTIAGREGATION	Aspirin	No	Plavix	No

Figures 14: *Follow-up angioCT-Scan showing bilateral kissing stents.*

Post-Operative

After the surgery, all patients were forwarded to the intensive care unit, receiving enoxaparin 1mg / kg / 12/12 hours. Regarding the post-operative complications, one patient presented with hemoglobinury, which evolved with anuria, and in the first day post-operative with acute kidney failure and necessity of hemodialysis for 8 days, after that evolved with total renal function recovery. During the hemodialysis period, this patient received non-fractioned heparin, instead of enoxaparin. All patients presented with satisfactory improvement on limb edema, in the first day and thereafter in the first week post-operative. Post-operative data, including days of hospitalization, complications, anticoagulation are summarized on (**Table 3**).

Follow-up

After discharge, all patients are evaluated at the officers appointment, with clinical signs and symptoms, anticoagulation therapy compliance and image exams, such as Duplex Ultrasound and angioCT-Scan. Only 1 patient has lost appropriate follow-up. The other three remaining patients received appropriate follow-up and none of them developed post-thrombotic syndrome.

Discussion

Lately, the left common iliac vein angioplasty associated with stenting deployment, mainly in the iliocaval confluency, has caused some concerns, specially due to the risk of right common vein jailing, which can promote contralateral deep venous thrombosis. There is some discussion in the literature if the contralateral deep vein thrombosis post left common iliac vein stenting may occur due to a progression of the disease, or really may be caused by jailing. The incidence of contralateral deep vein thrombosis after left common iliac vein angioplasty ranges from 1, 1%-9, 7%, according to studies published in overall literature [5, 6, 7]. During the procedure of stent recanalization, it is possible to note a difficulty to perform a proper vein recanalization, associated with a low outflow in the right iliac vein during phlebography, all those conditions suggest that under iliocaval confluency contralateral stenting, there is a situation of blocking of right iliac vein outflow due to contralateral stenting. Gloviczki et al [8], published a case report where they described an open surgery performed to remove a wallstent deployed at the left common iliac vein, with iliocaval extension, leading a contralateral jailing; a complete pseudointima was identified through the stent, with small porosity areas in which the right common iliac outflow occurred, suggesting a real blocking to right iliac vein outflow through the iliocaval stenting. Raju et al [9], in a previous publication have reported a jailing provoked by a stent deployed at the iliocaval confluency. Le et al [2] have evaluated 111 patients who had common iliac vein stent implantation for symptomatic May-Turner Syndrome and have found an incidence of contralateral deep venous thrombosis (DVT) of 9%. Potential causes for contralateral DVT were venous intimal hyperplasia (VIH) (n = 7), "jailing" (n = 2), and indeterminate (n = 1). All patients with VIH had previous common iliac vein (CIV) stents overextended to the inferior vena cava (IVC). Overextension of CIV stent was associated with contralateral DVT (P < .001). Another study by Khairy et al [3] have found the following factors related to contralateral DVT: Acute DVT (p=.001), non-compliance with the prescribed 6 months anticoagulation (p = 0.05), pre-operative contralateral internal iliac vein (IIV) thrombosis (p = 0.001), and pre-existing IVC filter placement (p = 0.003). In this present paper, we consider that all cases of contralateral deep vein thrombosis were caused by an inadequate stenting positioning inside the inferior vena cava, leading to jailing, inadequate right iliac vein outflow and thrombosis.

Some other devices and techniques were developed in order to prevent this dreadful complication. One of this techniques and devices describes the use of Gianturco Z stents at the iliocaval confluency. This stent has open cells through its device and reduces the probability of blocking the right iliac vein outflow and reduces the pseudointima development through the stent. Murphy et al [10], published a paper comparing 982 limbs treated with Gianturco Z stents deployments with 755 limbs with wallstent usage. The incidence of contralateral deep venous thrombosis in 5 years follow-up was higher in wallstent group than the Gianturco Z stents usage (10% versus 1%; p = 0,001, respectively).

Another options, such the dedicated stents developed to this proper segment, such as Sinus Obliquus Stents are also an option, once its conformation, 35 degrees, allows an adequate deployment, without causing contralateral jailing, however there are only short and mid-term results in overall literature [11]. Due to lack of long-term results, we do not know the real application of those devices usage in preventing jailing and contralateral deep venous thrombosis.

The presence of stents at iliocaval confluency, with contralateral deep vein thrombosis, leads us to consider that the thrombotic disease does not affect only the iliac common vein, nevertheless is much more extensive than this, with the concerning of affecting the iliocaval confluency. Regarding

situations where the post thrombotic syndrome affects the inferior vena cava segment, and mainly its bifurcation, some other techniques have been developed, varying according to the cava diameter and length of the disease [12]. In situations whereas the inferior vena cava disease is restricted to the iliocaval confluency or less than 5cm length, the kissing stenting technique shows to be a very adequate solutions. In all cases performed at this case report series the kissing stenting technique was the chosen one. It is important to reinforce the necessity of using the same device stents, avoiding stents with different radial force, situation that can cause one stent exercising compression through the other. In most of cases of this present case series report, the nitinol Sioxx stent was the device of choice, due to the extremity of the stents comprised with closed-cells, and the mid-segment of the stent comprised with open cells conformation, allowing an adequate outflow. This study has some limitations, mainly it is a case report, with a very small sample of patients. Larger trials should be performed in order to confirm those findings of this present paper.

Conclusion

In this present case serie reports, in patients with contralateral deep vein thrombosis after a left iliac vein stenting, the pharmacomechanicalthrombectomy technique followed by angioplasty and kissing stenting was a safe and efficient procedure.

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