

# Surgical Venous Thrombectomy for Phlegmasia Cerulea Dolens and Venous Gangrene of the Lower Extremities

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**Objective:** Phlegmasia cerulea dolens (PCD) and venous gangrene are limb and life-threatening conditions of iliofemoral acute deep vein thrombosis (DVT).

**Material and Method:** The authors retrospectively evaluated surgical management of 15 patients from 125 patients with acute iliofemoral DVT (6 PCD and 9 venous gangrene) between January 1991 and August 2002 with long-term follow-up.

**Results:** All of our 15 patients underwent surgery within 10 days of the onset of symptoms. Six patients with impending gangrene and failure for initial management with bed rest, extremity elevation, fluid resuscitation, and systemic anticoagulation for six to 12 hours underwent iliofemoral venous thrombectomy and distal arteriovenous fistula (AVF) can preserve limbs. In nine patients with venous gangrene that underwent iliofemoral thrombectomy below knee had transmetatarsal amputation done after decreasing leg edema. All patients underwent caval filter insertion before venous thrombectomy. There was no pulmonary embolism (PE) or immediate mortality. Anticoagulation treatment was given for at least six months. The distal arteriovenous fistula was closed as a secondary operation six weeks after initial operation.

On the follow-up, 10-year period, seven patients died from the advanced carcinomas 7, 9, 9, 12, 14, 18, and 20 months after an operation. The remaining eight patients have regularly followed-up over 120 months. Three patients (37.5%) had recurrence of DVT; the rate of recanalization in common iliac veins on duplex scan was 100%. Three patients (37.5%) developed reflux in at least one deep venous segment without signs and symptoms of postphlebotic syndrome.

**Conclusion:** Surgical Venous thrombectomy with distal AVF are safe method and should be reserved to treat PCD and venous gangrene patients with contraindications to thrombolysis or in condition that thrombolytic therapy is not available. There is no postphlebotic syndrome on the long-term follow-up (>120 months) of all surviving patients.

**Keywords:** Phlegmasia cerulea dolens, Venous gangrene of the lower extremities

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Phlegmasia Cerulea Dolens (PCD) is an acute total or near total massive thrombotic occlusion of the venous drainage of an extremity including the microvascular collaterals; PCD is characterized by pain, edema, and cyanosis of the affected extremity. A potentially reversible phase of the ischemic venous occlusion may progress to venous gangrene in 40 to 60% of cases<sup>(1)</sup>. Venous gangrene is always preceded by phlegmasia cerulea dolens starting distally and spreading proximally and may involve skin and subcutaneous tissue, muscle, or both. A significant percentage requires extremity amputation, and mortality has been reported to be 25 to 41%<sup>(2)</sup>.

Therapeutic options in the treatment of PCD have included conservative anticoagulation,

thrombolytic therapy, endovascular intervention, and surgical venous thrombectomy. Treatment of uncomplicated early case is bed rest, extremity elevation, and heparin therapy. The failure of clinical response in six to 12 hours should be followed by iliofemoral venous thrombectomy, endovascular intervention, or thrombolysis. For patients presenting with severe ischemia or impending venous gangrene, venous thrombectomy was recommended as the primary intervention. In this report, the authors described our experiences using this treatment algorithm and thrombectomy for clinical progression and advanced case of PCD from the 125 consulted cases of acute deep vein thrombosis during 140 months period between January 1991 and August 2002.

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#### Material and Method

Between 1991 and 2002, 15 patients (19 extremities) with PCD and venous gangrene were evaluated. Eleven patients were women and

**Table 1.** Number of the patients during 1991-2002 (140 months period)

Year	1991-1995	1996-1999	2000-2002	Total
DVT	30 (90.9%)	38 (90.5%)	42 (84.0%)	110 (88.0%)
Venous gangrene	2 (6.1%)	3 (7.1%)	4 (8.0%)	9 (7.2%)
PCD	1 (3.0%)	1 (2.4%)	4 (8.0%)	6 (4.8%)
Total	33	42	50	125

Mean age was 56 years, with a range of 38 to 81 years

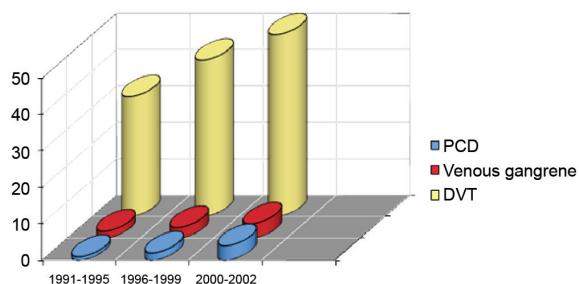
DVT = deep vein thrombosis; PCD = phlegmasia cerulea dolens

**Table 2.** Demographic data

Gender	
Male:female	4:11
Age	
Range	38 to 81 years
Mean	56 years
Median	56.3 years
Affected side	
Left:right	13:6
Unilateral:bilateral	11:4
Risk factors	
Hypercoagulability state	15 (100%)
Cancer	9 (60%)
Prolonged bed rest	9 (60%)
Previous DVT	6 (40%)

four were men. Mean age was 56 years, with a range of 38 to 81 years (Table 1, 2, Fig. 1).

Associated conditions known to predispose to thrombotic events were present in all 15 patients. Malignancy was the most common, being present in nine. Documented primary sites included ovary (three), cervix (two), colon (two), pancreas (one), and lung (one). A prior history of lower extremity deep vein thrombosis was elicited in six patients. Nine patients had prolonged bed rest (more than 30 days) from the illness before PCD occurred. Diabetes mellitus was present in three patients. Other associated conditions are COPD, renal failure, pneumonitis, gastroenteritis,



**Fig. 1** Prevalence of DVT, PCD and venous gangrene during 1991-2002.

atrial fibrillation, and coronary heart disease. More than one-associated conditions were present in all nine patients. All of the patients were in hypercoagulable state (Table 2).

All patients had pain, massive edema, and cyanosis of the affected extremity at the time of initial evaluation. Disease was present bilaterally in four patients. Venous gangrene was present at the initial evaluation in nine patients (thirteen extremities). Pedal pulse deficit was present in six patients. There were 13 left sided and six right-sided thrombosis. The mean duration of symptoms was 8.1 days (range 1-12 days) (Table 2).

A presumptive diagnosis of PCD and venous gangrene was made on clinical presentation in all patients confirmed by continuous Doppler venous examination in 19 extremities, venous color-flow duplex scan in 10, and phlebography in two. Abdominal CT scan documented extensive IVC and iliac vein thrombosis in 11 patients.

All patients were initially managed with bed rest, extremity elevation, fluid resuscitation, and systemic anticoagulation. Anticoagulation was established by an initial intravenous bolus of 5,000 units of heparin, followed by a constant infusion to maintain the activated partial thromboplastin time (APTT) at least twice the control value. Six patients, presenting with severe ischemia or impending venous gangrene that failed to respond in 6 to 12 hours following initial therapeutic maneuvers, underwent venous thrombectomy as the primary intervention. Nine patients with venous gangrene underwent iliofemoral thrombectomy to decrease leg edema and severe pain. Surgical iliofemoral venous thrombectomy was done in all patients (19 extremities), with distal arteriovenous fistula. Caval filter insertion was done in all patients.

The authors have used a surgical venous thrombectomy to operate on 15 patients of who had DVT in the lower extremity. The indications for surgery were persistent skin turgescence and severe

pain caused by phlegmasia cerulea dolens and venous gangrene. The authors performed surgery within 10 days of the onset of symptoms. Intraoperative management was designed to prevent pulmonary thromboembolism (PTE): the patient was placed in the supine anti-Trendelenburg position, and general anesthesia was induced under endotracheal intubation with positive pressure ventilation (10 cm H<sub>2</sub>O). A small femoral skin incision was made to expose the common femoral vein. Systemic heparinization was started with an intravenous bolus injection and continued with controlled infusion to maintain an anticoagulation time of 200 to 250 seconds. The cutdown technique was used to insert a 35-cm 8-Fr balloon catheter via the femoral vein; about 30 mL of normal saline solution was injected into the balloon to occlude the inferior vena cava. In cases of iliofemoral occlusion, a second 7- or 8- Fr balloon catheter was inserted parallel to the occlusion catheter for optimal thrombectomy (Fig. 2, 3). A 4- or 5-Fr balloon catheter was also used in cases of thrombus of the lower extremity. An Esmarch bandage was then applied for hemostasis, and the milking maneuver was performed by hand.

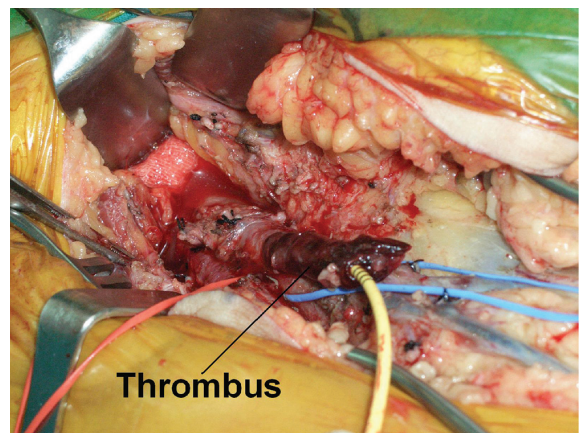
Intraoperative venography of the pelvic veins was performed before closure of the skin incision. An arteriovenous fistula (A-V fistula) was necessary to prevent reocclusion and promote collateral perfusion. Our A-V fistulas were constructed with a branch of the greater saphenous vein in the U-shaped (Fig. 4).

On postoperative day 3, the continuous heparin infusion was gradually tapered and replaced with oral warfarin. Prophylaxis with warfarin was maintained for 6 to 12 months. The patients were recommended to wear elastic stocking for 6 months after surgery. The A-V fistulas were closed surgically under local anesthesia in the six weeks after the first operation.

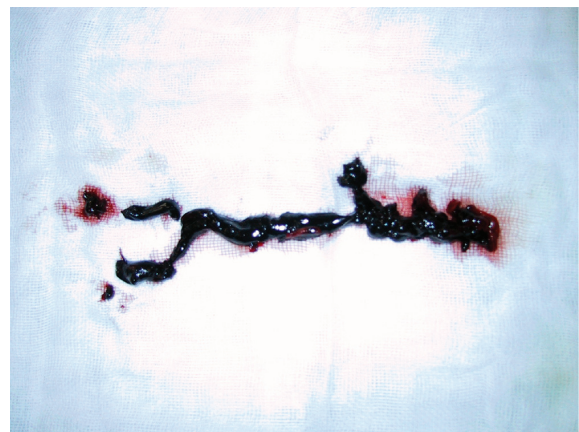
Calf and thigh fasciotomy was done in 12 extremities (8 patients) due to massive edema and elevated compartment pressure (Table 3). Amputation was done in 12 extremities with seven transmetatarsally and five below knee. Heparin therapy was continued for 10 days, after which long-term oral anticoagulation therapy was instituted. Anticoagulant therapy was given for at least six months. The present study was approved by the Ethical Committees under the Research 10: 1626/ Study Code: SUR-2556-01626.

## Results

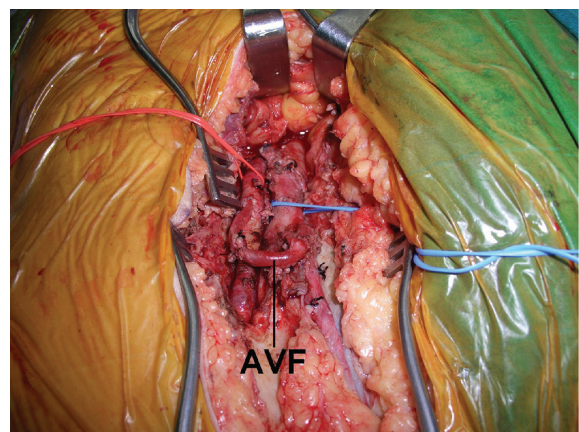
The prevalence of PCD in our DVT patients between 1991 and 2002 was 12% (15/125) and



**Fig. 2** Fogarty balloon catheter was inserted through the venotomy incision on femoral vein for venous thrombectomy.



**Fig. 3** Fresh thrombus from Iliofemoral venous thrombectomy.



**Fig. 4** Distal arteriovenous fistula (AVF) was created in U-shaped with side branch of greater saphenous vein anastomosed with superficial femoral artery.

**Table 3.** Surgical treatment of 15 patients

Surgical procedures	No. (%)
Venous thrombectomy with distal AVF	19 (100%)
Fasciotomy	12 (80.0%)
Amputation	12 (80.0%)
Transmetatarsal	7 (46.7%)
Below knee	5 (33.3%)
Caval filter insertion	15 (100%)

Surgical procedure in 15 patients with PCD and venous gangrene

AVF = arteriovenous fistula

progression to venous gangrene was 60% (9/15). Six patient with impending gangrene and failure for initial management with bed rest, extremity elevation, fluid resuscitation, and systemic anticoagulation for six to 12 hours underwent iliofemoral venous thrombectomy and distal arteriovenous fistula (AVF), all of these patients we can preserve limbs. In nine patients with venous gangrene undergoing iliofemoral thrombectomy, inevitable below knee and transmetatarsal amputation were done after decreasing leg edema. All patients underwent caval filter insertion before venous thrombectomy. Among nine patients with venous gangrene, the procedure was successfully carried out and there was no pulmonary embolism (PE) or perioperative (30 days) mortality.

Anticoagulation treatment was given for six months. The distal arteriovenous fistula was closed as a secondary operation six weeks after initial operation.

On the follow-up, 10-year period, seven patients died from the advanced carcinomas 7, 9, 9, 12, 14, 18, and 20 months after an operation. The remaining eight patients have regularly followed-up over 72 months. Two patients (25%) had recurrence of DVT; the rate of recanalization in common iliac veins on duplex scan was 100%. Three patients (37.5%) developed reflux in at least one deep venous segment without signs and symptoms of post-phlebotic syndrome of a 10-year follow-up.

### Discussion

Phlegmasia cerulea dolens (PCD) is an acute massive thrombotic occlusion of the venous drainage of an extremity including the microvascular collaterals, PCD is characterized by pain, edema and cyanosis of the affected extremity. A potentially reversible phase of the ischemic venous occlusion may progress to venous gangrene in 40 to 60% of cases<sup>(1)</sup>. Underlying

malignancy is present in 20 to 40% of patients with PCD and venous gangrene. Coagulopathy occurs in up to 95% of cancer patients although clinically apparent thrombosis occurs in only 5 to 15%<sup>(2)</sup>.

A significant percentage requires extremity amputation, and mortality has been reported to be 25 to 41%<sup>(1,2)</sup> in this clinical problems. Therapeutic options in the treatment of PCD have included anticoagulation, fasciotomy, venous thrombectomy and thrombolysis. Treatment of uncomplicated early case is bed rest, extremity elevation and heparin therapy. The failure of clinical response in six to 12 hours should be followed by iliofemoral venous thrombectomy or thrombolysis<sup>(3)</sup>. For patients presenting with severe ischemia or impending venous gangrene, venous thrombectomy was recommended as the primary intervention<sup>(3,4)</sup>.

Prior to the introduction of intravenous heparin, surgical thrombectomy was the only effective means for treating a symptomatic lower extremity DVT<sup>(3)</sup>, but the reported outcomes of open surgical venous thrombectomy for acute lower extremity DVT have been mixed<sup>(5,6)</sup>. The 2004 American College of Chest Physicians consensus statement on the treatment of thromboembolic disease recommended against the routine use of venous thrombectomy in acute DVT except in cases of phlegmasia cerulea dolens<sup>(7)</sup>. The disadvantages are seen with conventional open venous thrombectomy. Firstly, open surgical thrombectomy is associated with significant blood loss during the procedure. Owing to the need to remove clot while preventing pulmonary emboli, venous flow is reversed externally and the attendant blood loss is high, particularly in the iliofemoral segments and inferior vena cava. Secondly, rethrombosis occurs in many patients despite postoperative anticoagulation. This complication occurs owing to the damage to the venous endothelium, either from the clot itself or from the mechanical damage done in an effort to remove the thrombus. The success of open surgical thrombectomy depends on the complete removal of thrombus from the affected veins. This will require multiple lower extremity incisions and multiple procedural maneuvers, such as balloon embolectomy, milking of thrombus with sequential wrapping of the lower extremity, copious irrigation, and the creation of an arteriovenous fistula<sup>(4,8,9)</sup>. Venous thrombectomy is aimed at preventing propagation of the thrombosis and subsequent gangrene, preventing pulmonary embolism, and avoiding serious postphlebotic sequel<sup>(3-5)</sup>. Early descriptions of thrombectomy for

simple iliofemoral thrombosis claimed at an 85% patency rate if the procedure was done within 10 days of the thrombotic event. Normal legs with minimal or no edema were reported in 81% of survivors<sup>(6,7)</sup>. However, higher rates of rethrombosis have been reported in thrombectomy for PCD<sup>(10)</sup>, addition of temporary arteriovenous fistula can reduce the rates of rethrombosis<sup>(11)</sup>. Thrombectomy offers a treatment that can provide rapid relief of venous and compartmental hypertension<sup>(3-6)</sup>. Pulmonary embolism occurs in 12 to 40% of PCD patients and the incidence is greater when tissue necrosis is present<sup>(1,2)</sup>. Caval interruption is indicated in the concomitant pulmonary embolism and the incomplete thrombus removal, which may reduce fatal pulmonary embolism<sup>(9)</sup>.

Plate and colleagues<sup>(6)</sup> randomized 62 patients with iliofemoral DVT to either conventional anticoagulation or open surgical thrombectomy with temporary arteriovenous fistula (AVF). At six months, patients treated with thrombectomy had significantly higher proportions with normal phlebography of the iliofemoral segment, no valvular insufficiency, and freedom from post-thrombotic symptoms. Of note, there was no difference in the patency of the femoropopliteal segments between the two groups. Juhan and colleagues followed 77 patients who underwent open surgical thrombectomy for acute lower extremity DVT and reported results after a mean follow-up of eight years<sup>(5)</sup>. The 5-year secondary patency was 84% of the iliofemoral segment, and 80% of patients had no valvular insufficiency at five years. Over 90% of patients had no post-thrombotic symptoms at five years. Meissner and Huszcza reported on the results of 30 patients who underwent open surgical thrombectomy for DVT with temporary AVF with a 1-year follow-up<sup>(12)</sup>. There were three deaths owing to complications from phlegmasia cerulea dolens, but none was directly related to the operation. In follow-up, no patients developed recurrent DVT, with a majority of patients reporting no post-thrombotic symptoms at one year.

Treatment of reversible phase of venous ischemia in PCD, whether by anticoagulation, thrombectomy, or thrombolysis, has a good chance for success. Whenever venous gangrene develops, treatment results are universally dismal and the amputation rate and mortality rate are high. Nevertheless, amputation may be the only chance for survival with venous gangrene. Amputation of PCD and venous gangrene is encountered in 20 to 50% of patients with this condition<sup>(13-17)</sup>. Many of venous

gangrene lesions are superficial and 60% of survivors required only minor amputations (toes, fingers, or transmetatarsal) or debridement and skin grafting<sup>(14-17)</sup>.

Postoperatively, patients are at risk for wound complications and will need a separate procedure to ligate the AVF in several months' time. In addition, an open approach does not necessarily address the underlying etiology for the acute DVT, such as left common iliac vein compression by the right common iliac artery, which would require a significantly more complex procedure<sup>(18-21)</sup>.

Thrombolysis offers an attractive method of treatment for both PCD and venous gangrene<sup>(20,21)</sup>. Thrombolytic agents can be delivered into the occluding thrombus, allowing lysis in both major veins and smaller venous channels inaccessible to surgery, while preserving patency of venous collaterals. These potential advantages may be outweighed by contraindications to thrombolysis. More than one-third of patients with venous gangrene had an underlying malignancy<sup>(23)</sup>. Thrombolysis may prove to be the best first-line management.

Currently, thrombolysis and thrombectomy are usually reserved for the treatment of PCD after anticoagulation fails or impending venous gangrene<sup>(20-22)</sup>.

## Conclusion

Surgical Venous thrombectomy with distal AVF are safe method and should be reserved to treat PCD and venous gangrene patients with contraindications to thrombolysis or in condition that thrombolytic therapy is not available. There is no pulmonary embolism (PE) or perioperative mortality after the operations. All survived patients have no postphlebotic syndrome on the long-term follow-up (>120 months).

Vascular surgeons should include contemporary venous thrombectomy as part of their routine operative armamentarium, offering this procedure to patients with extensive deep vein thrombosis involving the iliofemoral venous system, especially if other options are not available or have failed.

## What is already known on this topic?

Surgical Venous thrombectomy with distal AVF are safe method and should be reserved to treat PCD and venous gangrene patients with contraindications to thrombolysis or in condition that thrombolytic therapy is not available.

### What is this study adds?

There is no pulmonary embolism (PE) or immediate mortality after the operations. All survived patients have no postphlebotic syndrome on the long-term follow-up (>120 months).

### Potential conflicts of interest

None.

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## การผ่าตัดเอาลิ้มเลือดออกจากอุดตันหลอดเลือดดำในภาวะหลอดเลือดดำชั้นลึกของขาหนีบอุดตันอย่างรุนแรง จนมีภาวะขาดเลือดชั้นวิกฤติ

กำพล เลาหพิชญ์แสง, สยาม หาญพิพัฒน์, สุภพงษ์ อารณ, สารนาถ ออรพินท์

**วัตถุประสงค์:** ภาวะหลอดเลือดดำชั้นลึกที่อุ้งเชิงกรานและขาหนีบอุดตันอย่างเฉียบพลันจากลิ้มเลือด ทำให้ขาบวมอย่างรุนแรงจนเกิดการขาดเลือดมาเลี้ยง ต้องการรักษาที่รีบด่วน ภายหลังที่การรักษาแบบประคับประคองไม่ประสบผลสำเร็จ การผ่าตัดจำเป็นต้องเอาลิ้มเลือดที่อุดตันผ่านทางหลอดเลือดดำบริเวณขาหนีบออกให้มากที่สุด ร่วมกับการผ่าตัดเชื่อมหลอดเลือดดำและหลอดเลือดแดงบริเวณนี้เข้าด้วยกันเพื่อป้องกันการเกิดลิ้มเลือดอุดตันซ้ำ การผ่าตัดนี้ยังไม่ได้นำมาใช้เป็นที่แพร่หลายทั่วโลก ทำให้ข้อมูลแสดงถึงอัตราการประสพผลสำเร็จ และอัตราความปลอดภัยจากการรักษาด้วยวิธีการผ่าตัดนี้ยังมีไม่มาก การศึกษาผลการผ่าตัดด้วยวิธีนี้ในผู้ป่วยที่มีภาวะขาดเลือดจากการอุดตันของหลอดเลือดดำชั้นลึกที่อุ้งเชิงกรานและขาหนีบ จึงมีประโยชน์ในการเปรียบเทียบผลการรักษาภาวะเร่งด่วนนี้ด้วยวิธีการอื่น

**วัสดุและวิธีการ:** คณะผู้ประพันธ์ได้ทำการศึกษาข้อมูลย้อนหลังในผู้ป่วยที่มีภาวะขาดเลือดจากหลอดเลือดดำลึกไอลิโอพีมอรัลอุดตันเฉียบพลัน จำนวน 15 ราย ที่ได้ดูแลรักษาในช่วง 140 เดือน ตั้งแต่เดือนมกราคม พ.ศ. 2534 ถึง เดือนสิงหาคม พ.ศ. 2545 **ผลการศึกษา:** ในผู้ป่วยจำนวน 15 ราย ที่ได้รับการผ่าตัดรักษาด้วยวิธีนี้ ขาบวมอย่างรวดเร็ว สามารถเก็บขาได้ 6 ราย อีก 9 รายลดระดับการตัดขาลงเป็นตัดนิ้วและข้อเท้าแทน ไม่เกิดภาวะแทรกซ้อนรุนแรงจากการผ่าตัดจนผู้ป่วยถึงแก่กรรม เย็บปิดท่อเชื่อมหลอดเลือดดำและหลอดเลือดแดงปลายต่อบริเวณที่ผ่าตัดเอาลิ้มเลือดที่อุดตันออกอีก 6 สัปดาห์ หลังผ่าตัดครั้งแรก และให้ยาต้านลิ้มเลือดต่ออีก 6 เดือน จากการติดตามดูแลผู้ป่วยมาตลอด 10 ปีหลังผ่าตัด ไม่พบลิ้นปิดเปิดหลอดเลือดดำลึกที่ขาถูกทำลายอย่างถาวรจนเกิดภาวะหลอดเลือดดำลึกบวมพร่อง

**สรุป:** การผ่าตัดวิธีนี้เป็นวิธีการที่ปลอดภัย ภาวะแทรกซ้อนน้อยจึงควรนำมาใช้ในการรักษาภาวะหลอดเลือดดำลึกที่ขาหนีบอุดตันเฉียบพลัน ในกรณีที่มีข้อห้ามในการใช้เฮปาริน หรือ สารละลายลิ้มเลือด

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