

# *Phlegmasia Caerulea Dolens and Venous Gangrene*

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## **Abstract**

**Objectives:** Phlegmasia caerulea dolens (PCD) and venous gangrene are rare conditions of severe form of lower extremity acute deep vein thrombosis (DVT) that tend to occur in association with malignancy and hypercoagulable state. Our aim is to evaluate the results of surgical management in 15 patients with PCD and venous gangrene in 125 DVT patients.

**Methods:** This is a 12 year (140 months) retrospective study in management of 6 PCD and 9 venous gangrene patients from total 125 patients with acute DVT of lower extremities seen at Chiang Mai University Hospital and nearby private hospitals from January 1991 to August 2002.

**Results:** Six patient with impending gangrene and failure from initial management of bed rest, extremity elevation, fluid resuscitation and systemic anticoagulation for 6-12 hours underwent iliofemoral venous thrombectomy and distal arteriovenous fistula. All of these patients achieved limb salvage. In other nine patients with venous gangrene underwent iliofemoral thrombectomy, 2 caval interruption, inevitable below knee and transmetatarsal amputation was performed after improved leg oedema. There was no pulmonary embolism (PE) or immediate mortality.

**Conclusion:** Venous thrombectomy with temporary distal arteriovenous fistula are indicated for treatment of PCD after failure of anticoagulation or impending venous gangrene. In patients with venous gangrene, thrombectomy can decrease oedema, limited extension of gangrene with preservation the length of leg amputation and reduced the rate of pulmonary embolism.

Venous thrombectomy should be reserved for patients with contraindications to thrombolysis or in condition that thrombolytic therapy is not available.

Phlegmasia caerulea dolens (PCD) is an acute severe and extensive iliofemoral deep vein thrombosis (DVT) that causes massive thrombotic occlusion of the venous drainage of the extremity. It also involves microvascular collaterals with extension of thrombosis to venular and capillary levels. PCD is characterized by cyanosis in an acutely swollen limb with an extreme constant bursting pain, a potentially reversible phase of ischaemic venous occlusion that may progress to venous gangrene in 40-60 percent of cases.<sup>1</sup> Venous gangrene is always preceded by phlegmasia caerulea dolens starting distally in the toes and foot which progresses proximally and may involve skin and

subcutaneous tissue, or muscle or both. At the tissue level, venous thrombosis produces a massive increase in capillary hydrostatic pressure causing outpouring of fluid and massive interstitial oedema. Such pressure in the tissues may increase up to five folds.<sup>2-4</sup> A significant percentage of PCD may require extremity amputation and the mortality rate has been reported in the range of 25-41 per cent.<sup>5</sup> Pulmonary embolism (PE) is common in venous gangrene with an incidence of 12-40 per cent.<sup>6</sup>

Therapeutic options for PCD include anticoagulation, fasciotomy, venous thrombectomy and thrombolysis.<sup>1,6-8</sup> Treatment in an early uncomplicated

cases consists of intravenous fluid resuscitation to correct hypovolemic shock, bed rest, extremity elevation and heparin therapy.<sup>1,6</sup> Failure of clinical response within 6-12 hours should be followed by iliofemoral venous thrombectomy or thrombolysis.<sup>1,6,9</sup> For patients presenting with severe ischaemia or impending venous gangrene, venous thrombectomy has been recommended as the primary intervention.<sup>8,10-12</sup>

In this report we described our experience using this treatment algorithm and thrombectomy in 15 advanced cases of PCD and venous gangrene out of the total of 125 patients of acute deep vein thrombosis seen in consultation at University and private hospitals during a period of 140 months from January 1991 through August 2002.

## PATIENTS AND METHODS

From January 1991 through August 2002, fifteen patients (19 extremities) with PCD and venous

gangrene were evaluated. Eleven patients were women and 4 men. Their mean age was 56 years with a range of 38-81 years. (Tables 1, 2) (Figure 1).

Associated conditions known to predispose to thrombotic events were present in all 15 patients. Malignancy was the most common condition. There were nine cases with history of malignancy. Documented primary sites included lung (3), ovary (2), cervix (2), and pancreas (2). A prior history of lower extremity deep vein thrombosis was elicited in six patients. Nine patients had prolonged bed rest (over one month) from the illness prior to the development of PCD. Diabetes mellitus was present in three patients. Other associated conditions were COPD, renal failure, pneumonitis, gastroenteritis, atrial fibrillation and coronary heart disease. More than one associated conditions was presented in all 15 patients. All of the patients were in hypercoagulable state (Table 3).

All patients had pain, massive oedema, and cyanosis of the affected extremity at the time of initial evaluation (Figure 1). Disease was present bilaterally

**Table 1** Number of the patients with DVT venous gangrene and PCD seen during 1991-2002 (140 months period).

	1991-1995	1996-1999	2000-2002	Total
DVT	30	38	42	112
Venous gangrene	2	3	4	9
PCD	1	1	4	6
	<b>33</b>	<b>42</b>	<b>50</b>	<b>125</b>

**Table 2** Sex, Side involved and associated condition in 15 patients with PCD and venous gangrene

Patient Data	1991-1995	2000-2002	Total
<b>Sex</b>			
Men	2	2	4
Women	5	6	11
<b>Side involved</b>			
Right side	2	1	3
Left side	4	4	8
Both sides	1	3	4
<b>Associated conditions</b>			
Hyper coagulable state	7	8	15
The regimen of malignancies	6	3	9
Prolonged bed rest	5	4	9
Previous DVT	3	3	6
Diabetes	2	1	3

Average age 56 (38-81) years



**Fig. 1** PCD with mottling cyanosis and severe pain on the left foot in a 38 year-old women patient.



**Fig. 2** Venous gangrene with cutaneous blebs on the left foot



Fig. 3 Bilateral venous gangrene of feet with cutaneous blebs



Fig. 4 Ultrasound examination on right groin demonstrating uncompresable intraluminal thrombus of the femoral vein.



Fig. 6 Venous thrombectomy and distal arteriovenous fistular.  
 (A) Longitudinal incision on common femoral vein for iliofemoral venous thrombectomy.  
 (B) Creation of distal arteriovenous fistula with end side branch of greater saphenous vein to side superficial femoral artery after closure of common femoral venotomy.

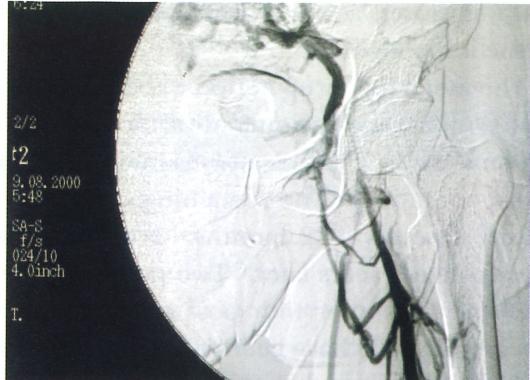


Fig. 5 Venous collaterals around an extensive iliofemoral thrombosis

in four patients. Venous gangrene was present at the initial evaluation in nine patients (12 extremities). (Figures 2, 3). Pedal pulse deficit was found in 12 patients. There were 12 left sided and 7 right-sided thrombosis. The mean duration of symptoms was 6 days (range 1-12 days).

A presumptive diagnosis of PCD and venous gangrene was made on clinical presentation and confirmed by Doppler venous examination in 19, ultrasonography in 7, venous color-flow duplex scan in 8, and phlebography in 2 extremities. Abdominal CT scan revealed extensive involvement of iliac vein thrombosis in 2 patients (Figures 4, 5).

Two patients with severe pain and cyanosis who were diagnosed at bedside with Doppler examination and ultrasonography underwent immediate iliofemoral venous thrombectomy after an initial intravenous bolus of 5,000 units of heparin.

All others 13 patients were initially managed with bed rest, extremity elevation, fluid resuscitation and systemic anticoagulation. The regimen of anticoagulation included an initial intravenous bolus of 5,000 units of heparin, followed by a continuous infusion to maintain the activated partial thrombo-

plastin time (a PTT) at least to the twice the control value. Four patients, with impending venous gangrene who failed to respond to initial anticoagulation in 6-12 hours, underwent emergency iliofemoral venous thrombectomy. Nine patients presenting with venous gangrene underwent venous thrombectomy after initial therapeutic maneuver. Ilio-femoral venous thrombectomy was done in all patients (19 extremities) of whom eleven with distal arterio-venous fistula (Figures 6, 7). Caval interruption was performed in 2 patients due to extensive IVC and iliac veins thrombosis detected by abdominal CT scan. Vascular scope or

pediatric bronchoscope was used intraoperatively to evaluate the residual thrombus. Calf and thigh fasciotomy was done in 12 extremities (7 patients) due to massive oedema and elevated compartment pressure (Table 3). In 9 patients with venous gangrene, amputation was done in 12 extremities with 7 transmetatarsally and 5 below knee. Heparin therapy was continued for 10 days thereafter a long term oral anticoagulation therapy was continued for 3-6 months. All 6 patients with impending gangrene and failure to initial therapeutic maneuver who underwent venous thrombectomy survived with limb salvage.



**Fig. 7** (A) Fresh thrombus from the patient in Figure 1 who underwent immediate venous thrombectomy  
 (B) Organized thrombus from venous gangrene patient who came on 12th day after DVT.

**Table 3** Surgical treatment of PCD and venous gangrene

	1991-1999	2000-2002	Total
Venous thrombectomy	8	11	19
Distal arteriovenous fistula (4 patients had bilateral iliofemoral venous thrombosis)	4	7	11
Fasciotomies	5	7	12
Amputations	6	6	12
- transmetatarsals	4	3	7
- below - knee	2	3	5
Caval interruption	2	-	2

## RESULTS

The rate of PCD in DVT of our patients during 1991-2002 was 12 percent (15 of 125) and progression to venous gangrene was 60 percent (9 of 15).

After iliofemoral venous thrombectomy the patients experienced less pain and decreased leg oedema. For the 9 venous gangrene patients, 5 underwent (7 extremities) transmetatarsal amputation, 4 patients (5 extremities) underwent inevitable below-knee amputation because the extent of venous gangrene had involved skin, subcutaneous tissue down to muscle compartments or following inadequate previous transmetatarsal amputations (Table 3). There was no immediate mortality. The distal arteriovenous fistula was closed as secondary operation 3 months after the initial operation.

The mean follow up period was 42 months (3-80 months). Seven patients died from advanced carcinoma at 3, 7, 9, 12 and 14 months after the vascular operation. The remaining 6 patients were followed up every 1-12 months. Four patients lost follow up 1 to 5 years later. Two patients (one with COPD and the other with post operative coronary artery bypass graft) have been followed up beyond 60 months without sign and symptom of post phlebitic syndrome (PPS).

## DISCUSSIONS

Treatment of PCD is aimed at preventing propagation of thrombus and reducing venous hypertension to preserve tissue viability.<sup>1,7,8</sup> Initial management are the correction of hypotension by intravenous fluid resuscitation, bed rest and leg elevation.<sup>1,6</sup>

Definitive management thereafter involves three forms of treatment: anticoagulation, thrombectomy or thrombolysis in any combination.<sup>1,6-8</sup>

The purposes of thrombectomy is to prevent thrombus propagation and gangrene, prevent pulmonary embolism and to avoid post phlebitic syndrome.<sup>13</sup> Thrombectomy for iliofemoral DVT had a patency rates of 85 percent if performed within 10 days of the onset with normal legs or minimal oedema in 81 percent of survivors.<sup>11</sup> For PCD and venous gangrene, higher rates of rethrombosis have been reported after thrombectomy.<sup>14</sup> A 5-year follow-up in patients with good early results revealed 94 percent of oedema and stasis requiring compression stocking.<sup>15</sup> Two-thirds of postoperative deaths resulted from pulmonary embolism.<sup>15</sup> Thrombectomy fails to clear thrombus distally from small venules and capillary, with poor results in patients with venous gangrene.<sup>16,17</sup> An adjunctive temporary distal arteriovenous fistula improved outcome of venous thrombectomy.<sup>18,19</sup> The objectives of temporary distal arteriovenous fistula, which is closed 3 months later, are to increase blood flow in the thrombectomized segment to prevent immediate rethrombosis, to allow time for healing of the endothelium and to promote the development of venous collateral in case of incomplete clearance or immediate rethrombosis.<sup>18-20</sup> Fasciotomy offers advantages in reducing compartment pressures.<sup>21</sup> Amputation for PCD and venous gangrene is necessary in 20-50 percent of patients.<sup>17,22</sup> Amputation in venous gangrene should be delayed as long as possible while aggressive treatment is pursued to allow venous channels to open, limb swelling to subside and the extent of tissue loss to be established.<sup>17</sup>

Our experiences in 15 patients with PCD and venous gangrene of 125 DVT patients revealed. six patients underwent immediate venous thrombectomy for the reason of impending gangrene (2) and failure of initial management (4) with anticoagulation, fluid resuscitation, bed rest with leg elevation for 6-12 hours. Limbs salvage was achieved after intraoperatively clearance of iliac vein thrombosis was performed by using vascular scope or pediatric bronchoscope as well as temporary arteriovenous fistula (AVF) to prevent re-thrombosis in all 6 patients. After operation, patency of iliofemoral vein can be evaluated with ultrasonography or duplex scan.

Nine patients with venous gangrene under went

venous thrombectomy. Temporary distal arteriovenous fistula performed in patients with moderate oedema and vascular structures were could be clearly identified. For the patient with massive oedema, fasciotomy was done to relieve compartment pressure (12 extremities). After venous thrombectomy and/or fasciotomy, limb swelling subsided rapidly and extent of the tissue loss was established with line of demarcation for easier consideration of the level of amputation. Seven transmetatarsal and 5 below-knee amputation were done. Two retroperitoneal caval interruptions were done because of extension of thrombosis from iliofemoral vein to IVC detected by CT scan. There was no immediate mortality and no pulmonary embolism was encountered. Closure of temporary distal arteriovenous fistula was performed 3 months postoperatively. Seven of nine patients with malignancy died in one year after the operation. Five patients were lost to follow-up at 6 months to 2 years. Only 2 patients have a regular follow up up to 5 years without post phlebitic syndrome.

Thrombolysis offers an attractive method of treatment for both PCD and venous gangrene.<sup>23-25</sup> Thrombolytic agents can be delivered into the occluding thrombus or intraarterially,<sup>25</sup> allowing lysis in both major veins and smaller venous channels that are inaccessible to surgery, while preserving of venous collaterals and normal venous valve function. These advantages should be considered and weighted against any conditions contraindicated to thrombolysis.<sup>23,24</sup> We have no experience in thrombolytic therapy.

## CONCLUSIONS

Iliofemoral DVT, particularly with PCD or venous gangrene, is a limb and life-threatening condition. Our experience suggested that aggressive treatments with venous thrombectomy and temporary distal arteriovenous fistula yielded good results with less immediate rethrombosis particularly when the treatment was started as early as possible. Thrombectomy combined with a temporary distal arteriovenous fistula appeared to give superior results compared with conservative anticoagulant treatment. Because of improved preoperative management and surgical technique with special precautions in patients with extension of the thrombus into the inferior vena cava, the results of surgery have improved. The use of

perioperative vascularscopy to demonstrate clearance of the iliac vein, as well as the adjunctive temporary distal arteriovenous fistula, will decrease the risk of rethrombosis.

There is an absolute indication for surgery in patients with PCD and venous gangrene to save life and limb. Thrombectomy with a temporary distal arteriovenous fistula is a better operation and can achieve specific goals of restored venous patency, limb viability and reduced mortality in comparison to the standard conservative treatment alone.<sup>13</sup>

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