



Beyond Diagnosing DVT with POCUS: A Case of Phlegmasia Cerulea Dolens

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A 69-year-old lady, with a history of diabetes mellitus on diet control and hyperlipidemia, presented with acute swelling of her left lower limb 2 hours prior to attendance. The swelling was noticed suddenly when she was sitting on the sofa at home. It rapidly progressed from the toes to the buttock. She described a heavily congested feeling in the affected limb with mild pain and numbness. She was able to move the limb but mobility was largely impaired due to swelling. There was no injury or insect bite to the limb. She had been well without any systemic illnesses or febrile conditions in the past few days. There was no dyspnea or chest pain. She reported normal oral intake. She did not take any hormonal replacement therapy. There was a distant history of right knee operation for injury, but she had no recent immobilization. She had no family history or personal history of venous thromboembolism.

Clinical examination in the A&E

On examination, she was conscious but distressed by pain in her left leg. She had a blood pressure of 154/70, pulse 92, temperature 37.0°C, oxygen saturation of 98% in room air and respiratory rate of 20. Her entire left lower limb appeared swollen and had a diffuse dusky non-blanching erythema (Fig. 1). The left calf was tense but non-tender. The skin was non-tender, had a normal temperature,

and did not reveal any blister or wound. There were no dilated superficial veins. Dorsalis pedis and posterior tibial pulses were palpable and equal on both sides. Toe movement and sensation were intact. Passive dorsiflexion of toes did not yield significant pain. Abdominal examination revealed no masses. Wells score for deep vein thrombosis (DVT) was 2 (Entire leg swollen and circumference difference > 3 cm), corresponding to moderate risk. A bedside point of care ultrasound (POCUS) was performed.



Figure 1. Note the gross swelling up to upper thigh level, and the dusky appearance of her left lower limb

Investigation and bedside diagnostic tests

Point-of-care ultrasound (POCUS) was performed, focusing on the left lower limb deep venous system. Common femoral vein, femoral vein and popliteal vein were traced along, which showed extensive luminal filling with echogenic materials along all positions. The common femoral vein, femoral vein and popliteal vein were non-compressible with pressure. No flow signal was obtained with colour Doppler examination (Fig. 2). A screening echocardiography showed a normal-sized right ventricle without any volume or pressure overload.

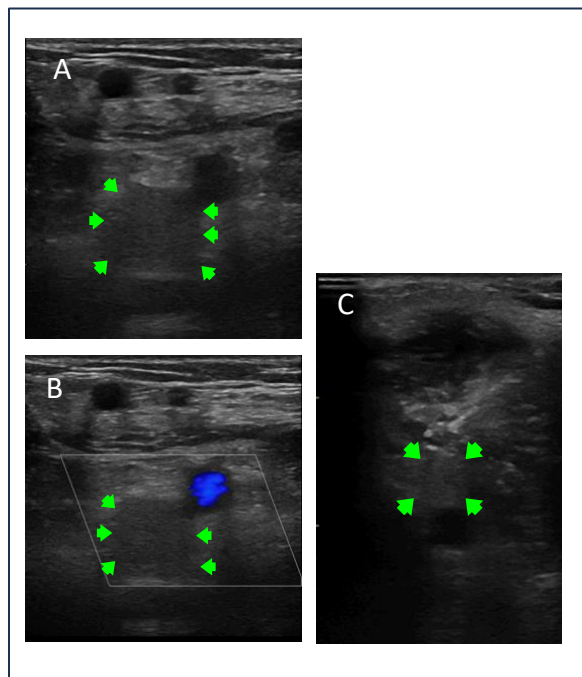


Figure 2. A: Left common femoral vein, increased diameter and filled with echogenic thrombus (marked by green arrow heads); B: Lack of Doppler signal in the vein compared with the adjacent artery (blue colour); C: Left popliteal vein also filled with echogenic thrombus. (Green arrows outline the positions of veins)

Management and progress

A therapeutic dose of enoxaparin (60 mg subcutaneously) was given, and her leg was elevated to 60 degrees. Normal saline fluid replacement was given intravenously. Provisional diagnosis was severe deep vein thrombosis (DVT) with phlegmasia cerulea dolens (PCD), and she was admitted to the department of surgery.

An urgent computed tomography (CT) venography of her left lower limb was performed 2 hours after admission, showing extensive left iliofemoral DVT with a short segment of thrombus extending into the inferior vena cava (IVC). An endovascular thrombectomy was subsequently performed. A large amount of acute and subacute thrombus was removed. A stent was then placed at the common iliac vein. (Figs. 3 and 4)

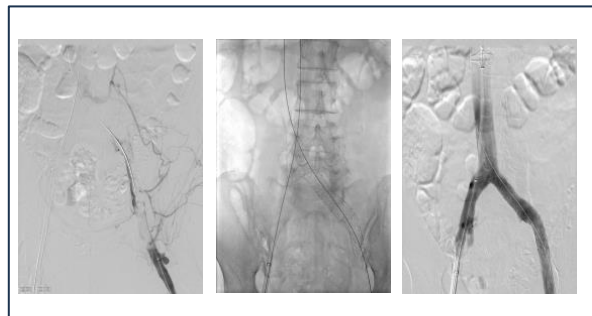


Figure 3. Image captured from intraoperative venography. Left: Pre-thrombectomy, contrast filling defect starting from common femoral vein to common iliac vein. Some collateral formations were seen. Middle: After thrombectomy, a metallic stent was deployed to the common iliac vein. Right: Post thrombectomy, patent contrast flow along the deep venous system.



Figure 4. Clinical photo of the extensive clot load retrieved during thrombectomy

She had a good recovery post operation. The leg swelling and discomfort resolved with the return of normal skin colour and capillary refill. Post-operative bedside venous Doppler revealed no residual clots with patent deep veins. She was discharged, ambulatory, on day 7 of admission. PET-CT scan was arranged for malignancy screening. A referral was made to internal medicine for prothrombotic and malignancy screening. She was put on apixaban upon discharge for continuing anticoagulation.

Evaluation for DVT in the ED

How is DVT diagnosed in the ED?

Diagnosis in the ED typically combines clinical pre-test probability scoring, such as the Wells score, with D-dimer testing in patients stratified as low risk. In patients with moderate-to-high pre-test probability, or when D-dimer is positive, compression Doppler ultrasonography is the confirmatory investigation of choice. Point-of-care ultrasound performed by emergency physicians has good sensitivity and

specificity for proximal DVT and allows rapid bedside triage, though its accuracy is limited for iliac vein and IVC segments, which require further imaging when clinical suspicion for extensive or unusual thrombosis remains, as illustrated in this case. However, normal ultrasound findings of the thigh veins may occur in the calf DVT.

Key elements of POCUS assessment for DVT

A systematic bedside DVT scan should incorporate the following components, each adding complementary information. The transducer is placed in transverse plane to trace along the common femoral vein, femoral vein, and popliteal vein:

- **Two-dimensional (grey-scale) appearance** – thrombosed veins often appear distended compared to the accompanying artery, and may contain visible echogenic material, though acute thrombus can occasionally be anechoic and easily missed on grey-scale alone.
- **Compression technique** – the primary diagnostic manoeuvre. Firm, even pressure is applied until the adjacent artery just begins to deform. A normal vein collapses completely; failure of full luminal apposition (non-compressibility) is the most reliable sign of DVT. In case of highly suspicious appearance of intraluminal clots in 2D mode, vigorous pressure should be avoided to prevent a clot dislodgement.
- **Colour Doppler** – applied along the length of the vein to assess for the presence, completeness, and symmetry of flow. Absent or partial filling of the colour signal within the lumen suggests thrombus, and comparison with the adjacent patent artery helps confirm the vein has genuinely lost flow rather than being technically under-insonated.

- **Spectral (pulsed-wave) Doppler** – records the venous waveform, which normally shows gentle phasic variation with respiration. Loss of phasicity or a flat, continuous waveform suggests proximal obstruction between the probe and the heart, providing an indirect clue to more centrally located clot (e.g. iliac or caval) even when it cannot be directly visualised.

Phlegmasia alba dolens (PAD) and phlegmasia cerulea dolens (PCD)

PAD and PCD describe the clinical appearance of the limb affected by a rare, massive and hyperacute form of deep vein thrombosis, existing along a continuous pathophysiological spectrum that can progress to venous gangrene if untreated. The thrombotic location involves the iliofemoral venous segment, which is different from the more typical form that involves the femoral to popliteal region. Entities of the spectrum, the respective presentations and treatment plans are summarized in Fig. 5.

- **Phlegmasia alba dolens (PAD)** represents the earlier stage. Thrombosis is confined to the major deep venous channels, sparing the venous collaterals, which
- **Phlegmasia cerulea dolens (PCD)** represents progression to a more advanced stage, in which thrombosis extends into the venous collaterals themselves. With both the main venous channel and its collaterals occluded, outflow is nearly abolished, causing severe venous congestion and massive fluid sequestration into the limb. The exponential increase in hydrostatic capillary pressure causes rapid fluid shift to the third space in the involved limb, which can cause systemic hypovolemia and underperfusion. This drives the cyanotic, tensely swollen appearance and can precipitate systemic hypovolemic shock in up to a third of patients.
- **Venous gangrene** is the end stage of this spectrum. As venous and capillary hydrostatic pressure progressively exceeds oncotic pressure, arterial inflow is further

Condition	 Etymology / Latin Meaning	Clinical Presentation	Disposition & Treatment
Uncomplicated DVT	N/A	Localised calf/thigh swelling, mild pain, normal skin colour, collateral veins patent	Urgent: Often managed with systemic anticoagulation and medical follow-up
Phlegmasia Alba Dolens (PAD)	Phlegmasia (inflammation/burning), Alba (white), Dolens (painful)	Massive swelling, severe pain, pale/white skin, main deep vein occluded but collaterals spared	Emergency: Requires prompt admission, anticoagulation, and vascular surgery consultation for potential intervention
Phlegmasia Cerulea Dolens (PCD)	Cerulea (dark blue/cyanotic)	Massive non-pitting edema, agonizing pain, cyanosis/dusky skin, both main veins and collaterals occluded	Life/Limb-Threatening Emergency: Requires immediate anticoagulation, rapid cross-sectioning (CT Venogram), and timely endovascular/surgical intervention for limb salvage

Figure 5. Clinical presentation and management of DVT, PAD and PCD

compromised through a combination of shock, increased outflow resistance, and arteriolar collapse from raised interstitial pressure. This produces anoxic injury to skin, subcutaneous tissue, and eventually muscle. Roughly 40-60% of PCD cases progress to capillary involvement and irreversible gangrene if not promptly treated.

Understanding this spectrum clarifies why PCD is a time-critical emergency: PAD and early PCD remain reversible with prompt decompression of venous pressure, whereas established gangrene is not. Case series have reported amputation (12-50%) and mortality (22-60%) from this condition.¹ As such, a prompt recognition in emergency practice is vital to the outcome.

Are there any special etiologies leading to this condition?

The traditional predisposing factors of venous thromboembolism (VTE) apply to PCD, as outlined by the Virchow's triad. Malignancy is involved in 20-40% of cases.² Prothrombotic blood disorders, use of contraceptives and hormonal therapies, recent surgery and prolonged immobilisation should be enquired in history taking.

Pregnancy should be checked in women of childbearing age. A special anatomical consideration is called May-Thurner syndrome, which describes an anatomical variation causing extrinsic venous compression, obstructed flow and thrombosis. The most common occurrence is the compression of left common iliac vein by the pulsating right common iliac artery against the L5 vertebra.³ Left sided lower limb DVT is therefore more common than the right.

How can PCD be recognised at the bedside?

While the presentation can be drastic and fulminant as in this case report, literature has also reported gradual progression over a few

days.² Specific appearance should differentiate PCD from the usual DVTs and other pathologies, such as cellulitis and arterial limb ischaemia.

An early presentation can be phlegmasia alba dolens, characterised by white blanching skin and increased swelling. Progression to PCD classically gives the appearance of cyanosis especially at the distal limb, as in this case, together with massive non-pitting oedema and sudden intense pain. The skin should be examined for any blistering or gangrenous changes. Arterial pulses should be palpated and documented. In cases where palpation is difficult due to significant oedema, Doppler ultrasound can help to ascertain the presence of arterial flow. A motor and sensory examination should also be performed.

Systemically, there may be signs of hypovolemia, such as hypotension. Symptoms and signs of pulmonary embolism (PE), such as dyspnea, chest pain and tachycardia should be actively explored, as PE is a concurrent finding in about 30% of patients with phlegmasia.⁴

What investigations are useful in ED and subsequently?

A bedside point-of-care ultrasound of the involved limb with Doppler examination can be performed. The classic findings of DVT include non-compressibility, increased luminal echogenicity and increased venous diameter. Electrocardiography (ECG) can be performed to look for features of pulmonary embolism. Standard laboratory biomarkers can reflect organ perfusion status and baseline coagulation profile prior to anticoagulation.

A CT, or magnetic resonance (MR), venography is usually indicated in the context of PCD. This is because ultrasound has limited access to visualising thrombosis in iliac veins and IVC. It also helps to map the proximal extent of blood clots, see any IVC involvement and look for any extrinsic mechanical compression.⁵

Catheter-based venography is the gold standard and provides real-time dynamic flow visualisation, but this is usually performed at the time of intraoperative treatment with endovascular thrombectomy and stenting. Intravascular ultrasound (IVUS) is the gold standard for definitively diagnosing May-Thurner syndrome.⁶

What immediate management should be started?

The goal of management in emergency care is to minimise propagation of thrombus, reduce venous hypertension, treat hypovolemia and shock state, with subsequent disposal plan to restore venous flow rapidly. Strict bed rest is advised. Elevation of limb to 60 degree can promote venous drainage, reduce hydrostatic capillary pressure and improve tissue perfusion.⁵ Crystalloid fluid should be given upon evidence of hypovolemia, as massive fluid sequestration is not uncommon.

Systemic anticoagulation should be immediately commenced to prevent further clot propagation. While this case used low molecular weight heparin, literature prefers the use of unfractionated heparin (UFH) due to its shorter half-life and rapid reversibility in emergent surgical or endovascular intervention,⁵ with gradual titration to achieve therapeutic activated partial thromboplastin time (aPTT).

Is endovascular or surgical treatment necessary?

The short answer is yes, unless it is an early phase with good arterial Doppler signals, in which anticoagulation with intensive monitoring may be appropriate.

In the setting of severe PCD with impending tissue loss, conservative approach with anticoagulation alone is universally associated with poor outcome and high rate of amputation.⁷ Early clot removal is achieved by

one of the following, or in combination: endovenous mechanical thrombectomy, endovenous thrombolysis and surgical thrombectomy.

In general, a percutaneous pharmacomechanical approach is recommended if expertise and resources allow. Mechanical thrombectomy excels in a rapid reduction in clot load, which compounds the effect of the pharmacological phase by thrombolytics and allows a lower dose to be used. Open surgical approach is reserved for selected patients who are candidates for anticoagulation but contraindicated for thrombolytic therapy.⁷

A self-expanding metallic stent can be inserted to maintain patent venous flow in the long term, but the practice is not universally agreed upon. However, chronic ilio caval compressive or obstructive lesions that are uncovered after thrombolysis are widely agreed indications for stenting.⁷

In patients with late presentation of phlegmasia, the treating surgeon should be aware of possible reperfusion injury, including hyperkalemia and myoglobinuria. A prophylactic fasciotomy may be necessary.⁸ Amputation is required in patients with non-viable limbs.

Learning points

1. Phlegmasia cerulea dolens (PCD) represents a severe entity on the spectrum of venous thromboembolism which can be limb and life threatening. Obstructions in the iliofemoral region make the pathophysiology different from usual DVT, and should be treated as a vascular emergency.
2. Recognise the typical presentation and appearance of PCD. Differentiate from other diseases like cellulitis, arterial limb ischaemia and lymphoedema.
3. Understand the PAD–PCD–venous gangrene continuum: collateral vein sparing versus involvement determines whether the limb remains white (PAD) or becomes cyanotic (PCD), and untreated PCD can progress to irreversible venous gangrene.
4. Complications should be actively looked for and managed. Systemic hypovolemia, compartment syndrome and PE are well documented associated conditions.
5. A thorough POCUS DVT assessment is a valuable bedside tool for emergency physicians in the right clinical context. Techniques include compression, grey-scale appearance, colour Doppler and spectral Doppler waveform.
6. Prompt initiation of anticoagulation upon recognition helps prevent further clot propagation.
7. PCD requires prompt multidisciplinary management involving emergency medicine, radiology, vascular surgery, and haematology, as a conservative approach alone leads to poor outcome.

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