Case report
Mechanical thrombectomy of an infected deep venous thrombosis: a novel technique of source control in sepsis

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Key points
- Mechanical thrombectomy should be considered where infected thrombus does not respond to conservative treatment.
- Mechanical thrombectomy may have advantages over thrombolysis in avoiding an associated acute deterioration.
- Large fragment embolization is a risk. Prophylactic steps should be considered.

Septic thrombophlebitis and septic pulmonary emboli are serious and life-threatening complications of deep vein thrombosis (DVT). Usually, patients can be successfully treated with broad-spectrum i.v. antibiotics, anticoagulation, and occasionally thrombolytic therapy. If conservative therapy fails, surgical venous thrombectomy is an option of last resort. We report successful endovascular management of extensive septic thrombophlebitis with septic pulmonary emboli arising from a lower-limb DVT, refractory to conventional treatment, using percutaneous mechanical thrombectomy to extract a reservoir of infected material and avoiding thrombolysis with the attendant risk of further dissemination of septic material.

A 24-yr-old man with a history of long-standing i.v. drug abuse and recurrent lower-limb DVTs presented to our institution with an acutely swollen leg, pleuritic chest pain, shortness of breath, and general malaise.

Examination revealed him to be tachypnoeic but fully conscious and alert. Old sinuses from i.v. drug injection were clearly visible over both groins, but there was no evidence of external active infection. His left leg was swollen and was painful to touch. He was febrile with an oral temperature of 38.3°C, heart rate was 135 beats min⁻¹ and regular, and arterial pressure was 135/83 mmHg. \( S_O_2 \) was 98% on air. Electrocardiogram showed sinus tachycardia with no markers of right ventricular strain. Chest radiograph was unremarkable. Initial blood tests showed Hb 14.0 g dl⁻¹, white cell count 2.7 × 10⁹ litre⁻¹, platelets 104 × 10⁹ litre⁻¹, sodium 129 mM, potassium 3.9 mM, urea 4.5 mM, and creatinine 109 μM. D-Dimers were raised at 8835 μg litre⁻¹. Prothrombin time was 14 s, international normalized ratio (INR) 1.4, and activated partial thromboplastin time (aPTT) was 26.7 s (aPTT ratio 1.0). Arterial blood gas analysis on air was \( P_ACO_2 \) 3.9 kPa, \( P_ACO_2 \) 11.6 kPa, and BE +2.4 mmol litre⁻¹. Urine toxicology testing was positive for cocaine, cannabinoids, and opiates.

An initial clinical diagnosis of DVT with presumed pulmonary embolus was made and treatment started with subcutaneous tinzaparin 175 units kg⁻¹ o.d. which continued until day 16. Antimicrobial therapy with flucloxicillin 1 g q.d.s and gentamicin 500 mg o.d. was commenced. On day 2, the patient became intermittently hypotensive but responded to further fluid resuscitation. A femoral central venous catheter was placed in the right groin by the admitting medical team. His white cell count had climbed to 13.8 × 10⁹ litre⁻¹, urea to 9.9 mM, and creatinine to 189 μM. \( S_P_O_2 \) remained 98% on air. Transthoracic echocardiography showed a mildly dilated right heart with trivial tricuspid regurgitation. All valves opened well with no evidence of vegetations and no pericardial effusion.

On day 3 followed further episodes of hypotension and persisting fever. Owing to lack of clinical improvement, antibiotic therapy was changed from flucloxicillin to vancomycin 1 g b.d. to broaden cover to include potential methicillin-resistant \( Staphylococcus aureus \). The patient was transferred to the high dependency unit where he was stabilized with further fluid resuscitation. Subsequently, blood cultures grew \( Streptococcus constellatus \) sensitive to...
penicillin, so antibiotic therapy was narrowed to high-dose benzyl-penicillin 2 g 4 hourly and gentamicin 500 mg o.d. *Streptococcus constellatus* is a member of the *Streptococcus milleri* group associated with a wide range of purulent infections. Ultrasound scans confirmed an extensive left iliofemoral DVT without abscess formation in the groin and an enlarged spleen at 17 cm (normal <12 cm). The patient remained pyrexial (38.4 °C). Screening for hepatitis B, hepatitis C, and HIV were negative. The platelet count had decreased further to 90×10⁹ litre⁻¹, the prothrombin time was 15.9 s, INR 1.6, and the aPTT was 30.4 s, aPTT ratio 1.2.

By day 6, the patient was increasingly drowsy with frequent rigors, persistent pyrexia up to 40 °C, and increasing oxygen requirements, despite ongoing appropriate antibiotic therapy. Further examination for possible sources of his sepsis revealed poor dentition and a dental abscess. Drainage of the abscess and dental extraction did not result in improvement in his condition. Further investigations including a skeletal survey for osteomyelitis failed to reveal a source of his sepsis.

On day 8, computed tomography (CT) scan of the abdomen showed no intra-abdominal collection and confirmed an extensive DVT extending into the external iliac vein but not into the common iliac vein. CT scan of the thorax showed multiple pulmonary emboli (Fig. 1) and subsequent trans-oesophageal echocardiogram on day 9 showed no evidence of intracardiac vegetations. It was felt that having excluded other sources of sepsis, the likely source was an extensive infected thrombus with septic pulmonary emboli despite anticoagulation, unresponsive to treatment due to inadequate antibiotic penetration.

By day 10, the patient was in established septic shock requiring vasopressors and 100% oxygen via a continuous positive airway mask. After consulting with the patient and his parents, we approached a vascular surgeon at our referral centre to discuss options for further treatment including thrombolysis or a hindquarter amputation plus laparotomy for surgical thrombectomy. After multidisciplinary deliberation, we decided against thrombolysis due to the risk of further dissemination of infected material. The vascular radiologist instead devised a plan to perform a minimally invasive extraction thrombectomy using an AngioJet Rheolytic Thrombectomy (ART) catheter (Medrad Interventional/Possis, Indianola, PA, USA) with a temporary inferior vena cava (IVC) filter to protect against large fragment embolization.

On day 11, the patient underwent elective tracheal intubation to facilitate transfer to our referral centre. He remained on mechanical ventilation there and on day 12 was transferred to the vascular radiology suite where a percutaneous thrombectomy was performed. Initially, a 6 Fr sheath was placed in his left popliteal vein and then a 10 Fr sheath in the left internal jugular vein through which a temporary infrarenal IVC filter was placed. Mechanical thrombectomy was performed via the popliteal vein of the popliteal, femoral, and iliac veins with extraction of 333 ml of effluent; samples sent for culture grew *Streptococcus viridans*. Angioplasty with a 9 mm balloon was carried out on the recanalized segment and flow observed to be present (Fig. 2). A large clot was noted in the IVC filter so the filter was left in situ.

On day 13, he remained ventilated but his oxygen requirements decreased to 40%, his pyrexia resolved, and his vasopressor requirement resolved. His trachea was extubated at the end of the day. The following day he was discharged to the ward on 28% oxygen. He was started on oral warfarin and his subcutaneous therapeutic tinzaparin stopped when his INR exceeded 2.0. He went home on oral anti-coagulants 1 week later having made a good recovery.

![Fig 1](https://academic.oup.com/bja/article-abstract/106/1/65/2919805/162190c19058bygueston13November2018)  
CT scan of the chest showing multiple septic pulmonary emboli (black arrows).

![Fig 2](https://academic.oup.com/bja/article-abstract/106/1/65/2919805/162190c19058bygueston13November2018)  
(A) Digital subtraction angiogram of near-occluded left popliteal and femoral vein (indicated by white arrows). (B) Digital subtraction angiogram of the same vein (indicated by black arrows) after mechanical thrombectomy and angioplasty. The ragged appearance indicates residual thrombus. The guide wire is visible within the vein.
Mechanical thrombectomy of an infected DVT

Discussion

The key to treating sepsis is effective source control without which organ support merely delays the downward spiral into multi-organ failure. The treatment of DVT by mechanical thrombectomy has been reported, here we report the first use of the ART system in treating established septic shock caused by septic thrombophlebitis.

Suggested clinical criteria for septic thrombophlebitis include the presence of (i) high-grade bloodstream infection, described as persistent bloodstream infection for 3 days after appropriate i.v. antimicrobial therapy with signs and symptoms of infection, or signs and symptoms of persistent or relapsing sepsis despite appropriate antimicrobial therapy for bloodstream infection; (ii) DVT diagnosed by duplex ultrasound scanning, CT, venography or surgery; and (iii) no other source of primary infection in a remote site, including endocarditis. Risk factors for septic thrombophlebitis are listed in Table 1.

Appropriate antibiotics and anti-coagulation are the main treatments of septic thrombophlebitis. Surgical thrombectomy for infected DVT where conservative management has failed has been reported with good survival rates but prolonged intensive care stays. Surgery for acute DVT is little used now due to the morbidity of the procedure and significant rethrombosis rates except where limb loss is imminent due to venous gangrene.

The successful use of thrombolysis in septic thrombophlebitis has been reported. However, there are reports of thrombolysis both alone or in conjunction with mechanical thrombectomy triggering significant deteriorations presumably from the release of infected emboli into the systemic circulation. We chose not to undertake thrombolysis to avoid precipitating clinical deterioration and elected to use mechanical thrombectomy instead as a means of both extracting infected material and allowing antibiotic penetration. Mechanical and pharmaco-mechanical thrombectomy are not new developments in the treatment of DVT and have been in use since the early 1990s, although their use in the treatment of sepsis has been limited. Mechanical thrombectomy could be of particular value where thrombolysis is contraindicated.

In the ART system, a thin flexible catheter is inserted into the thrombus via a distal vein. The ‘rheolytic’ component involves high-speed water jets alternating between suction and irrigation at about 60 Hz creating a low-pressure zone to pull the thrombus into the catheter where it is broken into small fragments and propelled back through the catheter to be evacuated. This might have advantages in limiting recirculation of septic material and micro-embolism. Our patient showed evidence of a large fragment of thrombus trapped in the prophylactically placed IVC filter, so even with the extraction mechanism intrinsic to the ART system proximal embolism is still a risk.

A common complication of rheolytic thrombectomy is haemoglobinuria. The high shearing forces of the vortices fracture red cell membranes releasing haemoglobin into plasma. Haemoglobin release seems to be related to the catheter used, duration of use, and exposure to free flowing circulating blood. If rheolytic thrombectomy is being used alongside thrombolysis, haemoglobinuria can be mistaken for haematuria leading to premature termination of thrombolytic therapy. Urine microscopy for red cells can be useful to distinguish haematuria from haemoglobinuria.

We believe that this case is the first that reported the use of the ART system to provide minimally invasive source control in established septic shock. This technique is a potential treatment of infected intravascular thrombus refractory to conventional therapy with less morbidity than other treatment options.

Conflict of interest

None declared.

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References


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<th>Table 1 Risk factors for septic thrombophlebitis</th>
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<tr>
<td>I.V. drug abuse</td>
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<td>Long-term venous catheters, e.g. home parenteral nutrition, chemotherapy</td>
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<td>Long-stay intensive care patients with multiple central venous catheters</td>
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<td>Primary hypercoagulable states, e.g. thrombophilias, anti-phospholipid syndrome</td>
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<td>Immunocompromised states</td>
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<td>Malignancy</td>
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<td>Puerperal sepsis (affecting pelvic veins)</td>
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<td>Oropharyngeal infections (affecting the internal jugular vein), Lemierre’s syndrome</td>
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