Case Report

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Thrombolysis for Trauma-Associated Inferior Vena Caval Thrombosis can be Safe in Selected Patients: A Case Report and Review of the Literature

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Traumatic injury results in significant physiological changes that place patients at elevated risk for venous thromboembolism (VTE). Percutaneous catheter-directed thrombolysis has been recommended as first-line therapy for the treatment of VTE but is relatively contraindicated in trauma cases due to increased risk of bleeding. The authors present a case to support the opinion that thrombolysis for trauma-associated inferior vena caval thrombosis can be safe in selected patients, with a discussion of existing literature.

Keywords: *Vascular; Trauma; Thrombolysis; Thrombosis; Vena Cava*

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Case Report

A 55-year-old male presented to the regional major trauma centre following a fall from height whilst flying a Microlight aircraft. He was haemodynamically stable on admission and found to have soft tissue injuries and an unstable L2 vertebral body fracture. Admission was arranged under neurosurgeons for surgical management of the fracture. He was unable to have his surgery in the subsequent 9 days due to development of an ileus which splinted his diaphragm and limited his ability to be ventilated in a prone position. On day 9 post-injury, he was noted to have developed swollen legs and an ultrasound duplex confirmed acute bilateral femoral deep venous thrombosis. His surgery was postponed as venous phase computed tomography (CT) demonstrated a thrombosed inferior vena cava (IVC) with bilateral iliac, femoral and popliteal vein occlusions (Figure 1). The IVC had an anomalous appearance suggesting a congenital narrowing of the renal and immediate suprarenal segment but not involving the hepatic segment.

Despite the recent significant trauma, the risk of bleeding was considered to be low and a decision was made to perform catheter-directed chemical and mechanical thrombolysis. Suprarenal IVC filter was placed via the right internal jugular vein approach. Under local anaesthetic, 6 Fr sheaths were placed into each popliteal vein. Initial venography confirmed the CT findings and thrombolysis was commenced through bilateral popliteal venous catheters (100 cm length, 40 cm infusion length; Cragg Mcnamara EV3) using a total dose of 1 mg/hour Alteplase split between the two catheters. Intravenous heparin was also given via a peripheral intravenous line. Good thrombus clearance was demonstrated after 36 hours of thrombolysis. Further Angiojet (Boston Scientific) thromboaspiration was performed achieving good clearance of the residual thrombus in the iliac veins and the IVC (Figure 2).

Despite this, there was significant residual narrowing and poor flow within the IVC. The IVC was treated with high-pressure balloon angioplasty to 18 mm (Atlas, Bard) and stented with two overlapping 20 mm × 100 mm venous stents (Sinus-XL, Optimed) (Figures 3 and 4). This produced a good final result with excellent contrast

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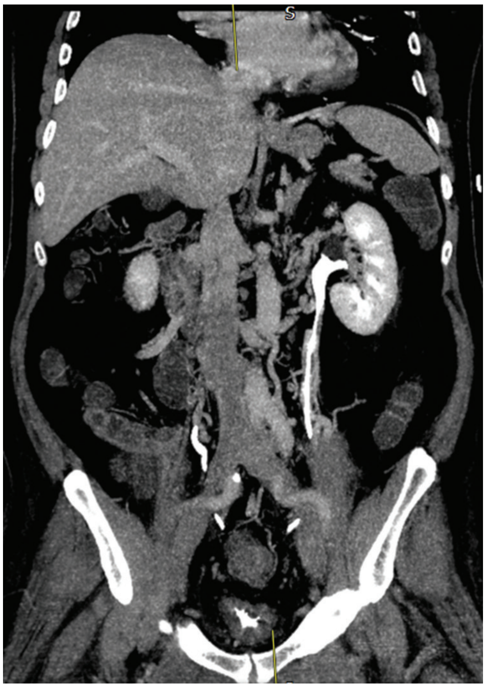

Figure 1 Coronal CT image demonstrating IVC thrombosis.

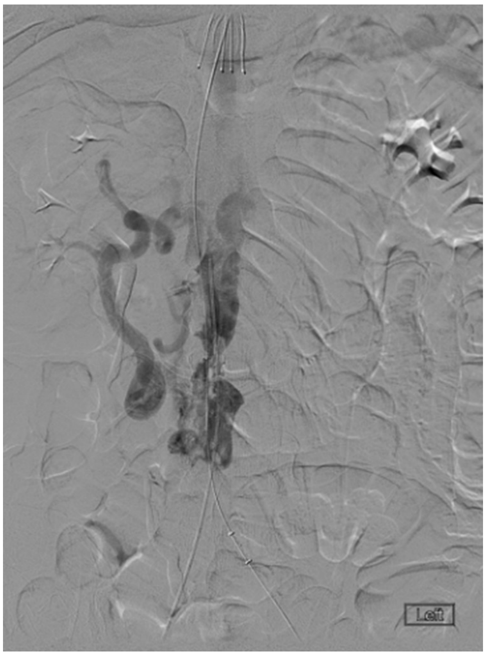

Figure 2 Fluoroscopic image of IVC following thrombolysis.

flow across the stent; the suprarenal IVC filter was removed prior to discharge from hospital.

It was felt that the risk of re-thrombosis would be high if anticoagulation was paused to operate on the patient's spine in the first 3 months. He was therefore discharged on therapeutic subcutaneous enoxaparin and advice of initial bedrest. CT venography at 6 weeks (Figure 5) showed good

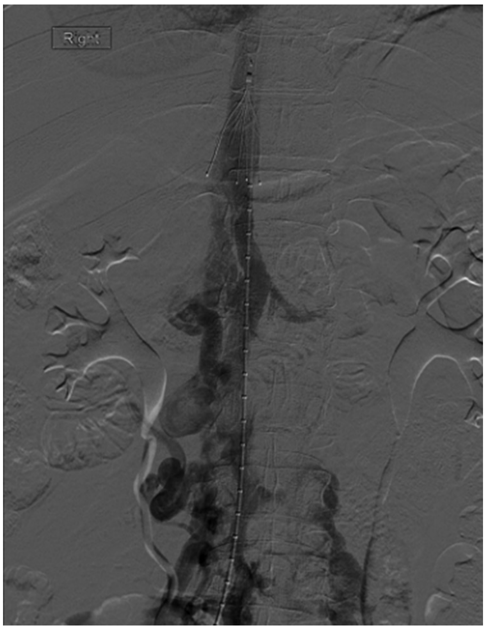

Figure 3 Fluoroscopic image of IVC following thrombolysis and balloon dilatation.

Figure 4 Fluoroscopic image of the IVC with stents in situ.

stent placement and patent vessels. At 3 months, repeat imaging of his spine showed fracture healing and he started to mobilise, with guidance from physiotherapists. He was converted to a direct oral anticoagulant (DOAC) medication at this point for ongoing anticoagulation. Follow up is now clinical, with interval duplex scans. At the clinic, approximately 3 months later, he was complaining of dependant leg swelling but no evidence of chronic venous

Figure 5 Coronal venous phase CT image demonstrating the IVC appearance on follow up imaging (45 days post-stent insertion).

changes or ongoing pain. He continues to wear compression hosiery and has a plan for lifelong anticoagulation.

DISCUSSION

Traumatic injury results in significant physiological changes that place patients at elevated risk for venous thromboembolism (VTE), a term that encompasses both deep venous thrombosis (DVT) and pulmonary embolism (PE). Patients exhibit elevated serum levels of inflammatory cytokines (including interleukin (IL)-6, IL-8, and tumour necrosis factor-alpha) and thrombin. This systemic inflammatory response results in a hypercoagulable state that increases the likelihood of developing VTE [1]. The incidence of deep vein thrombosis in trauma patients has been reported to be 7–58% depending on the diagnostic methods used [2]. The pathophysiology associated with polytrauma and hypercoagulability is most widespread and potentially destructive in the first 72–96 hours following injury [3]. However, another study reported that the highest risk occurs in the first 3 months after injury, with incidence at 10.3% in patients with traumatic pelvic fractures, vertebral fractures and spinal cord injuries [4]. Trauma patients may require prolonged anaesthesia for procedures, followed by periods of bed rest, and those with orthopaedic injuries require post-operative immobilisation or protected weight bearing, which may contribute to venous stasis [1,3]. This, along with hypercoagulability and endothelial injury, comprise Virchow's Triad, the trio of conditions that contribute to venous thrombosis [1].

Percutaneous catheter-based therapies (either pharmacological or pharmacomechanical) have been recommended as first-line therapy for early thrombus removal in patients with VTE, whether isolated to calf veins, the femoropopliteal veins or involving the iliofemoral veins, with or without extension into the IVC [5]. In the UK, NICE guidelines reserve thrombolysis for patients with symptomatic iliofemoral DVTs who can be treated within 14 days of symptom development [6]. Thrombolysis has been demonstrated to effectively dissolve the clot to result in complete thrombus breakdown more often than with standard anticoagulant therapy and venous patency is better maintained. The use of an endovascular technique to lyse the clot also allows for the opportunity to correct any anatomical anomalies. In the case presented, the patient was found to have an IVC anomaly which undoubtedly contributed to his risk of developing an IVC thrombosis. The prevalence of congenital venous malformations in the population has been estimated at 1%, with anomalies of the IVC present in half of these cases. Theoretically, these anomalies may contribute to VTE due to the increased risk of venous stasis [7]. In a small study of 56 patients with VTE, 45 were found to have anatomical abnormalities of thrombosed deep veins; the most common lesion was common iliac vein compression by the iliac artery [8].

Benefits of Thrombolysis Over Anticoagulation in Trauma

Numerous risk factors for DVT have been reported in the trauma literature, including age, injury severity, polytrauma, fracture of the pelvis, femur, or tibia, spinal cord injury, central vein cannulation, number of procedures, and medical comorbidities including diabetes and obesity [1]. Despite polytrauma being a stated risk factor for VTE, preventative methods, particularly heparin medications, are not used due to increased risk of bleeding. Regardless, VTE continues to occur despite the use of preventative measures such as vena caval filters, heparin medications, elastic stockings, and sequential compression devices [3], and no one method is proven to prevent VTE in 100% of cases. The nature of polytrauma can often confound the diagnostic process and lead to delayed recognition and treatment.

The incidence of symptomatic PE is much less common than DVT [2], although post-traumatic PE is associated with a high mortality rate, especially in those with associated heart failure [2,3,9]. Guidelines state that in the management of high-risk PE, thrombolysis is the first line treatment unless an absolute contraindication exists [3].

Post-Thrombotic Syndrome

Patients who suffer VTE despite reversible provoking factors such as trauma have a long-term risk of recurrence greater than 20% [9]. They are prone to the development of short and long-term complications such as post-thrombotic syndrome (PTS) which can affect functional capacity and quality of life. Alongside recurrence, the anatomic extent of the DVT is a significant factor [9], with one study stating that proximal (acute iliofemoral) DVT was the strongest independent risk factor for developing PTS, with a twofold increase in likelihood [10]. Male sex and elevated BMI are also factors which increase risk [10].

PTS is a complex syndrome involving pain, swelling, oedema and skin induration, which has been reported to significantly impact physical and mental health. It is estimated that the economic burden in the United States is US$200 million annually [11]. Evidence from a 2016 Cochrane review of thrombolysis for DVTs suggests that fewer patients develop PTS when treated with thrombolysis. Seventeen randomised controlled trials (RCTs) with 1,103 participants were included in the analysis, and 9 of these specifically included patients who had proximal DVT, with or without concomitant calf thrombosis. The majority excluded patients who had undergone surgery in a defined time period (i.e. 3–14 days) or were considered post-traumatic. The conclusion is that thrombolysis increases the patency of veins and reduces the incidence of PTS following proximal DVT by one-third. Evidence suggests that systemic administration and catheter-directed thrombolysis have a similar efficacy [12].

Risks of Thrombolysis in Trauma

The use of thrombolysis is associated with bleeding complications, stroke or intracerebral haemorrhage. The Cochrane review states that strict eligibility criteria appear to improve safety and may be necessary to reduce the risk of bleeding complications, which may limit the applicability of this treatment [12]. NICE guidelines state that catheter-directed thrombolytic therapy should be considered only in patients who have a low risk of bleeding and a life expectancy of more than a year [6]. Most trauma patients are likely to be at increased risk for bleeding depending on their mechanism of injury. It is generally recognised that major abdominal surgery within the preceding 48 hours or gastrointestinal (GI) or genitourinary (GU) bleeding within 14 days are relative contraindications to thrombolysis so any trauma requiring an operative intervention may not be appropriate in the early phase of treatment; the presence of a recent intracranial haemorrhage is an absolute contraindication [2]. However, the risk of bleeding in patients with non-haemorrhagic trauma who are being managed conservatively is more difficult to quantify. The therapeutic window of safety is narrow when using thrombolytic agents, as such careful patient selection is of utmost importance. Risk versus benefit should be considered on an individual case basis. Complications are not uncommon, with one study reporting an incidence of 21% [2].

CONCLUSION

Multiple dynamics in trauma patients make treatment decisions complex. VTE in trauma remains a significant risk and some of the longer term morbidity might be reduced with timely thrombolysis in symptomatic patients with a low risk of bleeding. It is the opinion of the authors that the technique should be reserved for specific cases after thorough investigation and consideration of the risk/benefit ratio and performed in line with a departmental protocol to reduce any undue risk to the patient.

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