Compartment syndrome of the leg in the coagulopathic, end-stage liver disease patient: Fasciotomy is not the best answer

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Available online 1 November 2006

Abstract

Background: Compartment syndrome of the leg secondary to spontaneous bleeding has been described in coagulopathic patients. Correction of the coagulopathy and emergency fasciotomy is the recommended treatment. We present a cirrhotic patient with a short life expectancy who developed compartment syndrome of the leg secondary to spontaneous bleeding. This patient underwent fasciotomy of the leg and subsequently developed persistent postoperative bleeding and required repeated transfusions of blood and blood products. The patient eventually expired in the hospital 1 month after surgery.

Results: Compartment syndrome of the leg occurring in patients with coagulopathy secondary to cirrhosis is very difficult to manage. Coagulopathy in these patients is hard to correct and constant bleeding from fasciotomy site is a major complication mandating frequent transfusions of blood and blood products. The complications of fasciotomy in these patients may outweigh the complications of untreated fasciotomy, particularly in patients with a short life expectancy.

Conclusions: Fasciotomy is not always the best treatment for compartment syndrome of the leg. In certain patients, particularly in the coagulopathic, end-stage cirrhotic patient with a short life expectancy who is not a candidate for liver transplantation, fasciotomy is not indicated. Fasciotomy should be used selectively, if at all, in patient population with end-stage and terminal diseases.

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Introduction

Compartment syndrome (CS) is an increase in the pressure of a closed compartment with subsequent compromise of blood circulation. The pressure gradient first impairs venous outflow and, ultimately, compromises the arterial circulation leading to irreversible injury to peripheral nerves and muscles. Compartment syndrome is seen more commonly in the legs. Causes of compartment syndrome of the extremities are numerous (Table 1).

In the involved extremity, ischemia of the nerves and muscles causes irreversible injury and leads to pain followed by hypesthesia and paralysis and, in long term,
contracture of the extremity. All of these lead to permanent disability of the extremity and the patient. Treatment of CS of the leg is emergency fasciotomy, preferably within 6 hours of the onset of symptoms, otherwise the injury may be irreversible.2

CS has been described in coagulopathic patients. The majority of these cases are patients with hemophilia3 or other hereditary coagulation disorders, who develop bleeding in the compartment (usually leg), whether spontaneous or after a minor trauma.4 This has also been seen in patients undergoing anticoagulation therapy.5 The treatment of compartment syndrome in these patients includes correction of the coagulopathy and emergency fasciotomy. Repeated transfusion of coagulation factors and blood products is needed in an attempt to correct the coagulopathy.6 Replacement of coagulation factors may be needed as long as the fasciotomy incision is open, unhealed and in risk of bleeding.

Compartment syndrome of the extremities is reported in cirrhotic patients, who are frequently coagulopathic. Coagulopathy in cirrhotic patients is hard to correct and these patients often need massive and repeated transfusions of fresh frozen plasma and other blood products.

**Case report**

A 45-year-old woman with alcohol-induced end-stage liver disease with severe secondary anemia and coagulopathy requiring multiple hospital admissions for blood transfusions was admitted for progressive weakness, confusion, anorexia and bleeding from the gums. Examination revealed severe jaundice and encephalopathy. Her INR was 3.7, total bilirubin 38.3 mg/dL, hematocrit 14.2% and platelet count was 35,000. Her Child-Pugh Score was 13 (grade C) and her MELD scorea was 40 (The maximum value for the MELD score). Patients having a MELD score of 40 have a 3-month mortality rate of 71.3%.7 She was not a candidate for liver transplantation because of her continuous alcohol consumption. She was not ambulatory before this admission due to severe encephalopathy and generalized weakness. Over the course of the following days, she was noted to have increasing swelling of the right leg and then developed intense pain on passive dorsiflexion of the right foot. The calf was tense and tender to palpation. On hospital day 5, she developed dropfoot and numbness of the first interdigital space of the right foot. An MRI of the right leg revealed an $8.6 \times 4.4 \times 3.1$ cm hematoma within the posterior compartment of the leg (Fig. 1). The compartment pressure was not measured because of coagulopathy and the risk of bleeding. The patient was taken to the operation room and underwent a four-compartment right leg fasciotomy with evacuation of the intramuscular hematoma. She received fresh frozen plasma and packed red blood cells before and after surgery.

Postoperatively the patient experienced persistent bleeding from the fasciotomy wounds and required repeated transfusions of blood and blood products. Multiple hemostatic techniques were used including compression dressing of the fasciotomy site, local hemostatic agents (fibrin, cellulose, collagen, etc.) andelectrocautery of the fasciotomy incisions and subcutaneous tissues; none of these successfully controlled the bleeding. The bleeding was from the subcutaneous tissue, skin and raw muscular surfaces. Bleeding continued, warranting local exploration of the fasciotomy site with ligation of several small, muscular vascular branches. Repeated transfusions of FFP and cryoprecipitate only partially and transiently corrected the coagulopathy and the bleeding continued.

Patient later developed respiratory distress and continued deteriorating and died 30 days post-fasciotomy. Autopsy revealed that the mechanism of death was multi-organ failure due to alcohol-induced end-stage liver disease and secondary coagulopathy, hypertrophic bilateral cardiomyopathy, early pneumonia and pulmonary edema. Throughout the course of her hospital stay, she remained severely confused with altered mental status secondary to hepatic encephalopathy. She was never ambulatory due to encephalopathy, weakness and open fasciotomy wound of her leg.

During her postoperative course (30 days), she received a total of 124 units of fresh frozen plasma, 61 units of packed red blood cells, 100 units of cryoprecipitate and 230 units of platelets.

![MRI of right leg showing hematoma in posterior compartment.](image)

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**Table 1** Etiologies of the compartment syndrome of the leg

<table>
<thead>
<tr>
<th>External restriction of the compartment</th>
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<tbody>
<tr>
<td>Splints, casts and dressings</td>
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<tr>
<td>Burns</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Internal increase in compartment volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemorrhage (trauma, coagulopathy, hemophilia, anticoagulation)</td>
</tr>
<tr>
<td>Fractures</td>
</tr>
<tr>
<td>Gun shot wound</td>
</tr>
<tr>
<td>Crush injuries (Rhabdomyolysis)</td>
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<tr>
<td>Snake envenomation</td>
</tr>
</tbody>
</table>

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*a* MELD stands for Model for End Stage Liver Disease, a disease severity scoring system applied to adult patients with liver disease.
Discussion

Coagulopathy is a dilemma in cirrhotic patients. Any procedure or operation in the cirrhotic patient carries a significant risk of bleeding. These patients often have a combination of coagulation defects, such as thrombocytopenia from hypersplenism, decreased synthesis of coagulation factors and abnormal fibrinogen due to impaired hepatic synthesis; therefore bleeding in these patients is severe and difficult to control. Vitamin K, fresh frozen plasma, cryoprecipitate, platelets and, most recently, recombinant factor VIIIa have all been used in cirrhotic patients to achieve hemostasis, none with complete success. Uncontrollable bleeding after fasciotomy and any major surgery is a predictable outcome in cirrhotic patients.

Proper management of this case and similar cases can be a dilemma. Surgeons are always taught that compartment syndrome of the extremity is an absolute indication for emergency fasciotomy, therefore it is hard to accept other modalities of treatment instead of fasciotomy.

The complications of not performing fasciotomy for compartment syndrome of the extremities include paralysis, hypesthesia, contracture and deformity of the affected limb, all of which causes permanent disability of the limb. Loss of the limb due to gangrene is rarely reported in cases of untreated compartment syndrome, usually following crush injuries or comminuted fractures of the extremities.

To the best of our knowledge, there is no other surgical alternative to fasciotomy in these patients. Amputation of the extremity, although theoretically may be considered an option, is not mentioned in the medical literature and we do not consider it an option.

In the cirrhotic patient with compartment syndrome of the extremity, the severity and prognosis of the underlying disease, pre-morbid functional status and life expectancy should all be carefully considered before making the decision to perform fasciotomy. A MELD score of 40 carries a 3-month mortality rate of 71.3% and liver transplantation is the only hope of a cirrhotic patient with a high MELD score to survive. Coagulopathy secondary to cirrhosis can be hardly corrected adequately and usually bleeding in these patients cannot be controlled despite repeated transfusions of blood products. The complications of repeated transfusions of blood and blood products can be serious. In addition, the shortage of blood and blood products should be considered in any treatment plan that will necessitate ongoing, massive transfusions. Therefore the expected outcomes must be weighed not only against the specific risks and benefits to the individual but also in terms of the institutional resources. In the non-ambulatory patient with a debilitating, end-stage disease and short life expectancy, the complications of an untreated compartment syndrome of the leg does not significantly worsen the already poor quality of life. In this case, the only alternative approach instead of fasciotomy is to try to correct the coagulopathy and observe the affected limb.

In patients who survive, physical therapy should be considered to prevent further disability of the patient and to prevent contracture of the extremity.

Conclusion

Fasciotomy for compartment syndrome of the lower extremity should be withheld in the cirrhotic, coagulopathic patient with poor pre-morbid function and short life expectancy who is not a candidate for liver transplantation. Correcting the coagulopathy as much as possible and observing the affected limb should be considered an alternative in these patients, as well as accepting some degree of inevitable disability of the limb.

References