

“Subarachnoid block in active burn injury”: A case report of anesthetic challenges and considerations

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ABSTRACT

Anesthetists pose different challenges in burn cases associated with polytrauma. Here, we present a case of a 35-year-old male electrician with an electric burn and a fall from height who sustained major chest trauma (hemothorax, pneumothorax, emphysema, and multiple rib fracture, and bilateral femur fracture). The collocated burn over the spinal region posed the challenge to administering a subarachnoid block, which was overcome with a paramedian approach anesthesia. The surgical outcome was good, and the patient was stable post-surgery. The paramedian approach provides an excellent alternative to the midline approach for spinal anesthesia. It should be considered in burn patients where it is impossible for the patient to flex, where the intervertebral space is very low, or when there is a burn present over the spinal region. Ultimately, early therapy and mobility goals, two essential components of burn care and rehabilitation, can be achieved with the use of paramedian regional anesthesia.

Keywords: Burn, femur and fracture, poly trauma, regional anesthesiology, subarachnoid block

Introduction

The World Health Organisation (WHO) estimated that 180,000 deaths occurred every year due to burn cases.^[1] Burn cases may sometimes be complicated by the incidence of multiple traumata. A retrospective review identified fractures, complex soft-tissue injury, head injury, abdominal, and chest trauma in cases with burns. However, polytrauma in burns is uncommon.^[2] Bones are the most resistant tissue to electrocution injury and thereby generate a great amount of heat. Destruction of the bone matrix and periosteal burn make the bone prone to breakage. Therefore, high-voltage Direct Current (DC) often throws the victim away in a single muscle spasm, resulting in a secondary mechanical injury.^[3,4] In burns complicated by trauma, it is often difficult

to prioritize management. The timing of orthopedic injury requiring stabilization is still debated. Burns complicated by chest injury often present difficulties in management due to chest tube placement, pain, hypercoagulability, impaired endothelial integrity, and immobilization.^[4,5] Fixation of fractures in cases of burn injury are dependent on the stability of the patient. It is advisable to undergo major surgery where the patient is “stable” or “borderline”.^[6] However, factors such as inhalation trauma and total body surface burn area must be considered.^[7] On the contrary, in situations of polytrauma, it is recommended to conduct stabilization of all long bone fractures sooner to minimize ischemia-perfusion injury, lessen pulmonary problems, and encourage mobilization.^[8] The regional-first strategy is always considered for burn cases with burns involving less than 15% total body surface area. Regional anesthesia is inadvisable in cases of eschar or burned skin overlaying the spinal area. However, single-shot blocks can be delivered sterilely prepared burned skin.^[9] Here, we report a difficult and high-risk burn case with bilateral fracture femur, which was managed using spinal anesthesia.

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Case Presentation

A 35-year-old male patient, an electrician, was referred to our hospital with the complaint of a fall from height 3 days ago due to an electric burn. There was chest trauma and fractured lower limbs. On examination, second-degree partial-thickness burns with a total body surface area of 9% were observed. Bilateral skeletal traction with pins was present, indicating a femoral fracture. There was no history of loss of consciousness, seizures, vomiting, bleeding from the ears or nose, or any other comorbidities. On examination, the pulse was 96/min, BP 104/62 mm of Hg, and right-sided air entry in the lungs was reduced. Intercostal drainage tube no. 28 was *in situ* with 200 ml of blood on the left and 200 ml of fluid on the right. He had an ankle joint fracture 2 years ago, for which the implant was *in situ*. X-ray of the lower limbs revealed bilateral femur shaft fracture (left proximal femoral shaft and right femoral mid shaft). High-resolution computed tomography (HRCT) of the thorax showed right pneumothorax, bilateral hemothorax, bilateral pleural effusion (right > left), subcutaneous emphysema, and multiple rib fractures extending from the 2nd to 5th ribs on the right and 2nd to 6th ribs on the left. Due to the presence of unstable laboratory parameters during admission, surgery was scheduled after a week. Table 1 shows the investigation parameters on admission and in the preoperative evaluation.

The patient was treated with antibiotics, anti-inflammatories, inotropic, analgesics, and adequate fluid resuscitation. Low Molecular Weight Heparin (LMWH) was initiated subcutaneously as prophylaxis for deep vein thrombosis. A chest X-ray on day 6 revealed no pleuro-parenchymal abnormality. External fixator surgery was advised for the misaligned right leg mid-shaft femur fracture. Given the polytrauma with electric burns over the back lumbar region and deranged parameters, it was a high-risk case with chances of intraoperative complications. Therefore, regional anesthesia was preferred over general anesthesia in this case.

However, as there was an overlaying, collocated burn over the spinal region [Figure 1a and b], the usual lumbar spinal approach was difficult, with a high chance of failure of the subarachnoid block. Due to this, spinal anesthesia was administered using a paramedian approach at the L3-L4 space by the barbotage technique. It was a single-shot procedure, where a dense level of adequate anesthesia was achieved up to T6. Intraoperatively, the patient remained persistently under tachycardia, and the blood pressure ranged between 100/58 mm of Hg to 110/66 mm of Hg. Blood transfusion was performed post-surgery due to intraoperative blood loss. The patient was stable post-surgery.

Discussion

We present a complicated case of polytrauma with an active burn, challenging the surgical management of fractures. It was a very high-risk case with bilateral hemothorax, right-sided hydropneumothorax, and subcutaneous emphysema. The

Table 1: Investigations on admission and preoperative time periods

Parameters	On admission	Pre-operative
Hemogram		
Hemoglobin (gm/dl)	9.1	9.6
Red blood cells (cells/L)	3.2×10^{12}	3.49×10^{12}
Total leucocyte count (cells/L)	9.20×10^9	9.90×10^9
Platelets	1.49×10^9	2.14×10^9
Coagulation parameters		
Prothrombin time (sec)	12.8	-
D-dimer	6929	-
Creatine Kinase-MB	154	-
Renal function parameters		
Blood Urea Nitrogen (mg/dl)	25.0	30.0
Serum creatinine (mg/dl)	1.0	0.7
Sodium (mmol/L)	139.0	126.0
Serum potassium (mmol/L)	5.2	4.5
Serum chloride (mmol/L)	106.0	101.0
Serum magnesium (mg/dl)	1.8	2.1
Phosphorus (mg/dl)	2.8	2.2
Calcium (mg/dl)	7.7	7.6
Liver function tests		
Total Bilirubin (mg/dl)	0.8	1.9
Conjugated bilirubin (mg/dl)	0.4	1.0
Unconjugated bilirubin (mg/dl)	0.4	0.9
SGPT (IU/L)	105	76
SGOT (IU/L)	160	57
Alkaline phosphatase (IU/L)	36	170
Total protein (g/dl)	4.6	5.3
Other		
Troponin I	1226	-
HbsAg	Positive	-

SGOT=Serum Glutamic Oxaloacetic Transaminase, SGPT=Serum Glutamic Pyruvic Transaminase, HbsAg=Hepatitis B surface antigen

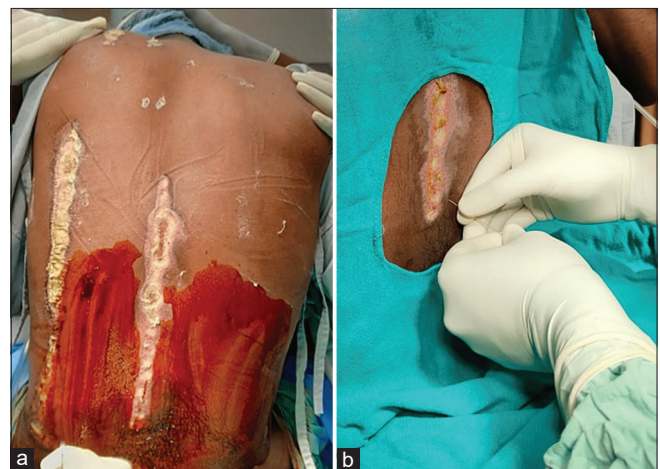


Figure 1: Patient position, cleaning and draping (a), and paramedian approach (b) for subarachnoid block

patient had significantly higher levels of CKMB and troponin I. It is important to understand that burn cases are a substantial anesthetic challenge, especially in the presence of polytrauma. Regional anesthesia techniques are desirable in burn cases, as they can facilitate a better experience for patients and early

recovery and mobility.^[9] Our case showed increased Troponin I levels. The increased levels of major cardiac biomarkers, such as Troponin I, after the high-voltage electric burn suggest a potential myocardial injury.^[10] This can pose a challenge during the surgical management of patients. In addition, higher D-dimer levels have clinical significance. D-Dimer has been shown to be associated with an increased risk of venous thrombosis and pulmonary embolism in patients with orthopedic trauma.^[11] The patient was at high risk of bleeding due to coagulopathy caused of low levels of calcium in the blood. Thus, to begin with, our patient was classified as high-risk for successfully provide anesthesia for the surgery.

The uniqueness of the case was the challenge of delivering the subarachnoid block (SAB). Regional anesthesia is preferred in burn cases with an extent of less than 15% of the total body surface area. The advantage of using regional anesthesia is that it reduces the demand for opioids intraoperatively and postoperatively and prevents chronic pain. However, administering SAB over the eschar or burn is contraindicated. It poses the risk of “seeding” the cutaneous infection into the deeper tissue through the burn wound. Additionally, given the chest trauma, our patient could not be placed in the general lateral incline position, and we had to administer the spinal block in a seated position. Preference was given to the regional block in our case. This approach is helpful in difficult median SAB and is usually adopted in high-risk cases such as the elderly.^[9] On the contrary, the use of general anesthesia might have resulted in ventilator support for a longer duration. Neuromuscular blocking agents used in general anesthesia can cause an exaggerated response in burn patients, resulting in hyperkalemia leading to cardiac arrhythmia.^[12] Owing to the collocated burn over the spinal area and the risk of superimposed hyperkalemia due to general anesthesia, a paramedian approach was taken while administering spinal anesthesia, tailoring the approach according to the demands of the case. Compared to midline spinal anesthesia, the paramedian approach has a higher success rate. The success rate on the first attempt is higher with the paramedian approach than with the median approach (85% vs. 45%, respectively).^[13] The paramedian approach does not require flexion of the spine, as in a midline approach. The midline approach was not possible in our cases due to overlapping burns. Paramedian anesthesia has lesser technical difficulties, fewer complications and a higher success rate. This has been reported in the elderly population as well.^[14] Recent advances in anesthesiology recommend the use of paramedian spinal anesthesia as a better technique for enhanced safety, efficacy, and patient satisfaction.^[15] It reduces post-dural puncture headache (PDPH) and postoperative backache significantly.^[16] The paramedian approach does not require full lumbar lordosis reduction and thus is helpful in elderly and pregnant women.^[17] For these reasons, we preferred this approach, as the lateral decubitus position was not feasible in our case. This case highlights that, in cases where routine approaches are challenging, the anesthetist must resort to modified approaches to fulfil the obligations required for surgical management.

Conclusions

An uncommon case of active burn with multiple traumas and deranged parameters, deemed very high risk, was handled efficiently pre- and perioperatively. Regional anesthesia provides many benefits, but it is recommended that the approach to the administration of regional anesthesia be tailored according to the demands of the case. Ultimately, early therapy and mobility goals, two essential components of burn care and rehabilitation can be achieved with the use of regional anesthesia, making the overall patient experience better.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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