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Continuous intrathecal morphine infusion for pain management in a polytrauma patient: A Case Report

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Abstract

Polytrauma patients are at high risk for neurologic complications as a result of the primary mechanism of their trauma and/or delirium caused by subsequent pain, sedatives and analgesic exposure, sleep disturbances, infections, metabolic derangements, organ dysfunctions, withdrawal syndromes, or other factors. The high prevalence of delirium within trauma intensive care units increases risks for both patients and providers and is associated with worsened patient outcomes. This case report explains rationale and utilization of continuous intrathecal morphine administration to improve pain control while reducing and eliminating IV analgesics and sedatives to enable wakefulness in a polytrauma patient with refractory agitated delirium.

Introduction

Delirium occurs in up to 70% of critically ill trauma patients.¹ Risk factors include hypoxia, intracranial injury, immobility, physical restraints, increased sedative exposure, and pain.^{1,2} Delirium prevention and treatment is critical as increased duration is associated with significantly worse in-hospital and long-term outcomes.^{3–6} Pain and resulting delirium is often difficult to treat in polytrauma patients, resulting in escalating doses of intravenous (IV) analgesics and sedatives to maintain patient and provider safety. Current practice guidelines recommend using analgesia-based sedation and regional (or neuraxial) analgesia when appropriate.⁷ Neuraxial analgesia is often deferred in trauma patients due to coagulopathy, hemodynamic instability, need for additional procedures, and potential neurologic or infectious complications. We present a case of refractory pain and agitated

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delirium in a polytrauma patient following venovenous extracorporeal membrane oxygenation (VV-ECMO). We aim to highlight the use of intrathecal continuous analgesia for pain management, enabling de-escalation of IV analgesic and sedative medications ultimately facilitating mobility and delirium resolution.

The patient provided Health Insurance Portability and Accountability Act authorization and written consent to publish this report. This manuscript adheres to Case Report (CARE; Enhancing the Quality-Transparency of Health Research [EQUATOR]) guidelines for case reports.

Case Description

A 33-year-old, 71 kg male presented following high-speed motor vehicle crash. He suffered multiple injuries including splenic laceration, liver laceration, mesenteric hematoma, subdural hematoma, traumatic brain injury, right rib fractures, pneumomediastinum, right intertrochanteric fracture, right femur shaft fracture, left distal femur fracture, right sternoclavicular dislocation, right brachial plexus injury, transverse process fractures and hemodynamic instability requiring massive transfusion. He underwent multiple operations and procedures, outlined in Figure 1, including three exploratory laparotomies (Hospital Day [HOD] 1 [x2] and 2), splenectomy (HOD 1), hepatic embolization (HOD 1), left femoral intramedullary nailing (HOD 2), tracheostomy (HOD 9), right femoral open reduction internal fixation (HOD 21), and VV-ECMO cannulation (HOD 5–22) for hypoxic respiratory failure and associated severe acute respiratory distress syndrome (ARDS). His course was further complicated by persistent refractory agitated delirium associated with weaning of sedation and analgesia.

Appropriate analgesia was unable to be achieved despite a multimodal approach to pain management including methadone and continuous IV fentanyl, hydromorphone, ketamine, and dexmedetomidine infusions.

Decision was made to pursue neuraxial analgesia on hospital day 24. Medication and laboratory data were reviewed, specifically patient's coagulation status in setting of recent splenic and hepatic lacerations, hepatic embolization, and acute hemorrhage. Hepatic function and coagulation studies were within normal limits (INR 1.2, platelets $494 \times 10^3/\text{mCL}$) and patient was not receiving systemic anticoagulation. He remained on subcutaneous heparin (5000U twice daily) for venous thromboembolism prophylaxis with morning dose held on day of procedure to ensure > 12 hours since previous dose. Patient was placed in left lateral decubitus position and L4/5 intrathecal catheter was placed using sterile technique in a single pass. Following placement, 2 mg of preservative free intrathecal morphine was bolused followed by a continuous infusion of preservative free morphine at 0.2 mg/hour. Catheter was secured, covered with a chlorhexidine tegaderm, and monitored daily for integrity and signs of infection.

Patient had dramatically improved pain scores after catheter placement allowing for rapid wean of IV midazolam, hydromorphone, and ketamine infusions. Refractory agitation subsequently improved allowing for transition from supportive ventilation to trach collar the

following day and eventual discontinuation of dexmedetomidine infusion by the fourth day (HOD 28) of catheter placement. Catheter remained in place for 6 days (removed HOD 30), over which time he received twice daily subcutaneous heparin (5000U), was weaned from all continuous sedatives, and transitioned to an oral pain regimen (Figure 2). Regimen included 20 mg methadone/day, 300 mg gabapentin three times/day, and duloxetine 30 mg/day. Twice daily subcutaneous heparin (5000U) was switched to daily enoxaparin (50mg) following removal of catheter on HOD 30. Patient required essentially no other IV narcotics for the remainder of his hospitalization. With refractory agitated delirium resolved, patient was transferred out of the ICU neurologically intact and participating in physical rehabilitation.

Patient remained hospitalized for an additional 10 days. Prior to discharge to inpatient rehabilitation on HOD 43, oral methadone was reduced and eventually discontinued. He was discharged with no narcotic prescriptions, actively participating in extensive rehabilitation.

The choice of methadone for pain management allowed for gradual wean without withdrawal symptoms despite extensive and prolonged exposure throughout early hospitalization. Patient did not experience complications of intrathecal catheters placement. He completed inpatient rehabilitation without evidence of neurologic weakness or injury.

Discussion

Pain is a major driver of delirium and agitation, particularly within the trauma population¹. Analgesia-based sedation, or “analgo-sedation”, is recommended to optimize pain control and decrease exposure to additional sedatives,⁷ with benefits including decreased duration of mechanical ventilation and shorter ICU lengths of stay.^{7–9} Alternatively, mismanaged pain is associated with significant downstream physiologic effects including increased stress hormone production, hemodynamic instability, vasoconstriction, increased catabolism, impaired tissue perfusion and wound healing, immunosuppression, chronic pain and post-traumatic stress disorder (PTSD) that can all contribute to worsened functional outcomes.⁸ Appropriate analgo-sedation can be difficult following polytrauma, and was difficult to achieve in this patient despite multimodal IV and PO pain regimens.

Acute pain services utilize nerve blocks and epidurals to treat localized pain throughout the body; however, when the injury extends across more than 8–10 dermatomes, these modalities often fail to provide adequate coverage. Epidurals, especially thoracic, can produce profound sympathectomy, contributing to hypotension. Local anesthetics produce motor blockade which inhibit participation in mobilization and physical rehabilitation. Intrathecal opioids can be preferred as they do not cause sympathectomy or create motor blockade.

Successful intrathecal catheter placement in this polytrauma patient allowed rapid wean of IV sedatives/analgesics and improved adherence to the ABCDEF bundle.¹⁰ The ABCDEF Bundle incorporates evidence-based strategies shown to improve ICU patient outcomes and recovery using the following principles: **A**ssessing and treating pain, **B**oth awakening and breathing trials, **C**hoice of appropriate sedation, **D**elirium monitoring and management,

Early mobility, and Family engagement.¹⁰ Adequate pain management, a cornerstone of the bundle, was achieved allowing for rapid de-escalation of systemic sedatives/analgesics allowing for orientation, clearance of previous refractory delirium, and accelerated ventilator wean. Removal of pharmacologic immobilization due to over-sedation and the lack of motor blockade afforded by intrathecal opioids allowed for early mobility and participation within physical rehabilitation—vital to improving in-hospital outcomes.^{10,11}

There is limited data describing this technique across patient populations. Prior case report by Zuehl et al. described a similar dramatic effect for a patient with 45% total body surface area burns.¹² Burn patients share many characteristics with polytrauma patients including notoriously difficult pain management, airway injury requiring prolonged ventilation, and need for multiple procedures. Utilization of this technique within these high-risk populations to optimize pain management warrant investigation to identify patients that may benefit most and strategies to decrease potential risks and adverse effects.

Intrathecal catheter placement and opioid administration are not without potential risks. Intrathecal opioid administration, similar to systemic opioids, can contribute to reduced bowel mobility, nausea, pruritus, and respiratory depression. Intrathecal doses, however, were significantly less than systemic dose equivalents required to achieve appropriate pain management and thus no significant adverse effects were observed. Our patient was on mechanical ventilation at time of catheter placement which could have inhibited our ability to detect mild respiratory depression from initial morphine bolus; however, his subsequent rapid improvement in respiratory status, as evidenced by transition to trach collar for the first time during hospitalization, corresponds with de-escalation of systemic opioids and sedatives. The most dreaded complications of intrathecal catheters are hematoma and infection. Despite initial transfusion requirements, our patient demonstrated complete recovery in coagulopathy, placing him at no increased risk for bleeding or hematoma. Signs of infection were monitored daily. There is little population data from which to quantify these risks due to limited application of this technique within trauma patients. Cancer pain patients with life expectancy of less than one year do not qualify for internalized intrathecal pain pumps and frequently receive externalized intrathecal catheters, similar to the technique described in this case report. In a systematic review of 821 terminal cancer patients with externalized intrathecal catheters, there was a 0.9% risk of bleeding after 3,330 catheter days and 2.2% incidence of catheter site infections after an average 54 days.¹³ A similar study population demonstrated a 2.8% infection rate for catheters over an average 74 days.¹⁴ Neurosurgery literature shows infection rate for endoventricular drains increases with duration in place and number of times accessed.¹⁵ Careful selection for patient candidacy should follow institutional guidelines for neuraxial anesthesia which generally excludes patients with unstable spine fractures, coagulopathy, therapeutic anticoagulants, terminal injury, significant brain injury, ongoing significant infections, or otherwise unable to be turned. Limiting access and duration of catheters along with careful patient selection will allow for successful catheter placement in appropriate patients to safely balance risks and benefits.

Pain management in polytrauma patients is frequently difficult to achieve. Suboptimal pain management contributes to poor in-hospital and long-term patient outcomes. Continuous

intrathecal opioid catheter placement should be considered as part of multimodal analgesia-based pain management strategies to reduce analgesia and sedative exposure, improve mobility, and aid in treatment of refractory agitated delirium.

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Glossary of Terms:

IV	Intravenous
VV-ECMO	Venovenous Extracorporeal Membrane Oxygenation
ARDS	Acute Respiratory Distress Syndrome
HOD	Hospital Day
ICU	Intensive Care Unit
PTSD	Post-Traumatic Stress Disorder

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Figure 1: Patient's Procedural Timeline

Timeline of patient's clinical course highlighting procedures performed throughout hospitalization. Patient was admitted directly to the ICU on hospital day 1 following operative procedures and transferred to the general care floor on hospital day 33. Discharge to inpatient rehabilitation occurred on hospital day 43.

Definition of abbreviations: ECMO = Extracorporeal membrane oxygenation; ICU = intensive care unit

Figure 2: Daily Sedation and Analgesia Received

Daily sedation totals received over the 13 days immediately surrounding intrathecal catheter placement. Intrathecal catheter was placed on hospital day (HOD) 24 and discontinued on HOD 30. Medication totals reflect total medication received, or average amount received per hour, on each hospital day as depicted.

Definition of abbreviations: HOD = Hospital day