

Ultrasound-guided costoclavicular block as a neuroprotective strategy in a 29-week pregnant patient with mild traumatic brain injury and forearm fracture: case report and literature review

Abstract

Anesthetic management of pregnant patients with traumatic brain injury (TBI) requiring non-obstetric surgery represents a clinical challenge due to the need to simultaneously maintain maternal hemodynamic stability, cerebral perfusion pressure, and adequate uteroplacental perfusion. Furthermore, factors that can precipitate secondary brain injury, such as hypotension, hypoxemia, or hypercapnia, must be avoided. The case of a 29-week pregnant patient with TBI mild injury and right radius and ulna fracture, who underwent osteosynthesis under ultrasound-guided brachial plexus costoclavicular block with intravenous sedation. The anesthetic procedure allowed avoiding airway manipulation and hemodynamic variations associated with general anesthesia. Hemodynamic parameters remained stable during the intraoperative period, with mean arterial pressure variation less than $\pm 10\%$ of the baseline value. Fetal heart rate remained within normal ranges throughout the procedure. Postoperative analgesia was adequate, with a visual analog scale (VAS) score of 1/10 during the first 24 hours. This case suggests that ultrasound-guided costoclavicular block may represent a safe and physiologically favorable anesthetic alternative in selected pregnant patients with mild traumatic brain injury undergoing upper extremity surgery. The technique allows maintaining hemodynamic stability, preserving cerebral perfusion, uteroplacental perfusion, and avoids airway manipulation. Additional studies are required to evaluate its potential impact on maternal-fetal neuroprotection. The available literature on regional anesthesia in pregnant patients with traumatic brain injury is limited and mainly restricted to isolated reports of interscalene or supraclavicular blocks. However, these approaches may be associated with respiratory complications or a higher risk of pneumothorax. The brachial plexus costoclavicular block, recently described with the development of ultrasound-guided regional anesthesia, offers anatomical and physiological advantages that could make it particularly useful in this clinical scenario. To our knowledge, there are few reports documenting its use in pregnant patients with traumatic brain injury undergoing upper extremity surgery. The present case illustrates the feasibility and potential hemodynamic benefits of this technique, highlighting its possible role as a neuroprotective anesthetic strategy in complex clinical situations.

Keywords: costoclavicular block, pregnancy, mild traumatic brain injury, regional anesthesia, non-obstetric surgery

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Case presentation

A 37-year-old female patient, 29 weeks pregnant, admitted after a car accident with a diagnosis of polytrauma, right radius and ulna fracture, and mild traumatic brain injury.¹⁻⁴

History

Family history: none of relevance. Personal non-pathological history: denies allergies, previous hospitalizations, or chronic-degenerative diseases. Reports a complete COVID-19 vaccination schedule (three doses). Obstetric history: two previous cesarean sections, in 2013 for premature rupture of membranes and in 2017 for preeclampsia with HELLP syndrome, both under neuraxial anesthesia without complications.

Current condition

Five days prior to admission, she was involved in a car accident secondary to mechanical failure of the vehicle's brakes, impacting against a fixed object. The event was accompanied by transient loss

of consciousness and trauma to the right upper extremity, with a diagnosis of radius and ulna fracture. She was initially treated at a primary care hospital and subsequently referred to this hospital unit for definitive management. Vital signs on admission: BP: 130/80 mmHg, HR: 88 bpm, SpO₂: 96 %, Height: 1.60 m, Weight: 95 kg. Neurological examination: patient awake, conscious, and oriented to time, place, and person. Glasgow Scale 15 points. Airway: Mallampati II, Patil-Aldrete II, Bellhouse-Doré II, cervical circumference 38 cm. Tchest with adequate bilateral ventilation and rhythmic heart sounds without added sounds. Abdomen globose due to a single live intrauterine product with a fetal heart rate of 130 bpm. Right upper extremity with a braquiopalmar splint; rest of extremities anatomically and functionally intact. Laboratory: Hemoglobin: 11 g/dL, Hematocrit: 32 %, Platelets: 236,000 /mm³, PT: 16 s, PTT: 22 s, INR: 1.0 Cranial computed tomography: mild cerebral edema without evidence of hemorrhage or ischemic lesions. Chest X-ray: no cardiomegaly or pulmonary alterations. ASA Classification: II.

Anesthetic plan: brachial plexus block via costoclavicular approach guided by ultrasound with intravenous sedation.

Informed consent was obtained and the following was indicated:

- a) peripheral venous access
- b) 8-hour fast
- c) transfer to operating room upon availability.

Anesthetic management

Patient entered the operating room for placement of a DCP plate on the radius and an intramedullary nail in the ulna. Non-invasive monitoring was performed: BP: 125/82 mmHg, HR: 80 bpm, SpO₂: 96 %, FHR: 125 bpm. Premedication: Midazolam 1 mg IV y Fentanyl 100 µg IV. Anesthetic technique: With the patient in the supine position, head rotated contralaterally to the block site and the arm right in 90° abduction, under sterile technique, ultrasound exploration was performed with a 5 MHz convex transducer.

The axillary artery and the three fascicles of the brachial plexus were identified subsequently with a hyperechoic needleof blunt tip, caliber 21G X 100mm, an in-plane approach was performed, depositing local anesthetic around the fascicles, observing adequate mass effect and distribution of the medication, type bupivacaine isobaric 35 mg at 0.35% plus lidocaine at 2% (100 mg) making a total volume of 10ml, achieving adequate diffusion, with a latency of 10 min and corroborating adequate anesthesia and analgesia at this incision site, asepsis and antisepsis of the surgical, iarea was performed. The surgical procedure began without incident.

The surgical procedure was carried out without complications, not requiring increased sedation.

Complementary medication: Acetaminophen 1 g IV y Dexamethasone 4 mg IV

Intraoperative: Average BP: 116/78 mmHg, HR: 79 bpm, RR: 13 rpm, SpO₂: 97 %

Supplemental oxygen was administered at 2 L/min via nasal prongs.

Fetal heart rate remained stable around 130 bpm throughout the procedure.

Hartmann's solution: 300 ml, Estimated blood loss: 100 ml, Surgery duration: 80 min, Anesthesia duration: 90 min

At the end of the procedure BP: 125/78 mmHg, HR: 86 bpm, SpO₂: 96 %

She was transferred to the Post-Anesthesia Care Unit. In postoperative follow-up at 6, 12, and 24 hours, she presented with VAS 1/10. Obstetric monitoring was performed with an average fetal heart rate of 145 bpm, without alterations. The patient evolved satisfactorily until her hospital discharge.⁴⁻¹²

Discussion

Close monitoring and conservative management are fundamental in patients with mild traumatic brain injury, especially in resource-limited settings, as established by the Brain Trauma Foundation guidelines. On the other hand, the American College of Obstetricians and Gynecologists (ACOG) states that non-obstetric surgery during pregnancy should not be delayed when there is a clear indication, regardless of the gestational trimester.

The choice of anesthetic technique in this type of patient presents a pathophysiological challenge. General anesthesia is associated with episodes of transient hypotension even when administered carefully.

Furthermore, laryngoscopy and endotracheal intubation can induce sympathetic responses with elevated intracranial pressure.

Although patients with mild TBI usually preserve cerebral autoregulation, even brief episodes of hemodynamic instability can contribute to secondary brain injury mechanisms. Avoiding airway manipulation in this patient allowed for a reduced risk of: sympathetic surges associated with laryngoscopy, vasodilation secondary to anesthetic induction, variations in PaCO₂, desaturation during apnea y gastric aspiration. Cerebral perfusion pressure depends directly on mean arterial pressure, especially when cerebral autoregulation is altered after trauma. Simultaneously, uteroplacental circulation lacks autoregulatory mechanisms and depends linearly on maternal perfusion pressure. Therefore, maternal hypotension constitutes a shared vulnerability that compromises both maternal and fetal cerebral oxygenation. In the present case, mean arterial pressure remained within a variation range of less than ±10% of the baseline value, suggesting preservation of cerebral and uteroplacental perfusion. From the perspective of regional anesthesia, the costoclavicular block offers relevant advantages over other brachial plexus approaches, such as a lower risk of pneumothorax and a lower incidence of hemidiaphragmatic paralysis compared to the supraclavicular block.

Limitations

This report presents limitations inherent to its design as a single clinical case, which prevents establishing causal relationships or generalizing the results to broader populations. Furthermore, advanced monitoring of cerebral perfusion or direct measurement of intracranial pressure was not performed, so the conclusions regarding the potential neuroprotective effect of costoclavicular block are mainly based on the observed hemodynamic stability. Likewise, follow-up was limited to the immediate hospital period, without long-term maternal or fetal neurological evaluation. Despite these limitations, the case provides clinical evidence that may contribute to generating hypotheses for future research on the use of peripheral regional anesthesia in pregnant patients with traumatic brain injury.

Conclusion

This case illustrates the potential role of ultrasound-guided peripheral regional anesthesia as a physiologically favorable anesthetic strategy to minimize systemic damage in selected pregnant patients with mild traumatic brain injury undergoing non-obstetric surgery. Ultrasound-guided costoclavicular block can represent a safe alternative that allows maintaining maternal hemodynamic stability, preserving cerebral and uteroplacental perfusion, and avoiding airway manipulation. Additional studies are required to systematically evaluate its impact on maternal and fetal neuroprotection.

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