Case Report

Anesthetic Management in a Patient with Acute Cervical Spinal Cord Injury in Neurogenic Shock for Humerus Plating - Ideal Timing and Anesthetic Technique

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ABSTRACT

Traumatic acute cervical spinal cord injury (ACSCI) often presents with non-emergent coexisting injuries, which might need surgical intervention. The ACSCI affects multiple systems including respiratory, cardiovascular, and neurological systems, which pose a great challenge to the treating anesthesiologist. The ideal time and anesthetic technique for non-emergent surgeries following ACSCI is not clear. Maintenance of mean arterial blood pressure between 85 and 90 mmHg for 7 days following spinal cord injury would improve the outcome. The secondary injury peaks at 4–6 days following the primary cord injury. Considering the above-mentioned factors, the non-emergent procedures could be performed after the seventh day following an injury of the spinal cord. Regional anesthesia (RA) (diaphragm sparing supraclavicular block (SCB)) edges over general anesthesia (GA), as the manipulation of the cervical spine could be avoided and it also provides stable cardiac and respiratory dynamics. In this case report, we are discussing about a case of conservatively managed ACSCI posted for left humerus plating. We conclude that ultrasound-guided diaphragm sparing SCB is a safe alternative to GA for ACSCI patients posted for upper limb surgeries in neurogenic shock.

KEYWORDS: *Anesthesia, cervical spine injury, spinal cord injury, trauma*

Submission: 06-11-2021,
Decision: 08-02-2022,
Acceptance: 14-02-2022,
Web Publication: 12-04-2022

INTRODUCTION

Traumatic acute cervical spinal cord injury (ACSCI) often occurs following road traffic accidents, falls from height, and acts of violence.[1] It is often accompanied by coexisting injuries like traumatic brain injury (TBI), chest/abdominal injuries, and long bone fractures.[2] These patients have to undergo emergency surgeries for cervical spine fixation and other coexisting life-threatening injuries. The incidence of long bone fractures following ACSCI is less (7%), as compared to head (42%) and torso injuries (26%).[2] The ideal anesthetic technique and timing of non-emergent surgeries following ACSCI is not clear. The most important anesthetic principles in the management of spinal cord injury patients are 1) early detection and 2) prevention of secondary injury to the spinal cord.[1] Here, we report a case of conservatively managed ACSCI, in neurogenic shock posted for humerus plating. Humerus plating can be done either under general anesthesia (GA) or regional anesthesia (RA). ACSCI is associated with alterations in the respiratory, cardiovascular, and neurologic systems, which makes the patient more susceptible to complications following GA.[3] Brachial plexus block (supraclavicular approach) resulting in ipsilateral phrenic nerve palsy may worsen the respiratory reserve in patients with ACSCI.[4,5] Depending upon the site, volume, and concentration of local anesthetics, the incidence of phrenic nerve palsy can be minimized. The incidence of secondary injury of the spinal cord can be averted by maintaining good

Access this article online

Quick Response Code:

Website: www.mjdrdypv.org

DOI: 10.4103/mjdrdypu.mjdrdypu_870_21

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How to cite this article: Krishnagopal V, Murugan R, Krishnakumar S, Thilak M. Anesthetic management in a patient with acute cervical spinal cord injury in neurogenic shock for humerus plating - Ideal timing and anesthetic technique. Med J DY Patil Vidyapeeth 2023;16:268-71.

oxygenation, perfusion, and immobilization while these patients are posted for surgery during the stage of neurogenic shock.

Case Description

Informed written consent for publication was obtained from the patient.

A 59-year-old male was admitted to our hospital with an alleged history of fall from height with cervical spine fracture and ACSCI. On examination, the patient had quadriplegia, with a Glasgow Coma Scale (GCS) score of E4V5M6. The patient was on spontaneous respiration and his oxygen saturation was 100% with 2 l/min of nasal oxygen. Sensation and motor activity were preserved up to the C6 level. The patient's cervical spine was immobilized with a cervical collar. The patient was in neurogenic shock and his circulation was maintained with volume replacement and inotropes to maintain a mean blood pressure of more than 90 mmHg.

On investigation, the magnetic resonance imaging (MRI) spine revealed a fracture of the C4 endplate, C6 lamina, and disc bulge at C5-6 [Figure 1]. Invasive blood pressure (IBP) and central venous pressure (CVP) lines were secured and monitored. Neurosurgeon advised conservative management for ACSCI. The patient had a painful fracture of the left humeral shaft, which had to be fixed for preventing complications and initiating physiotherapy.

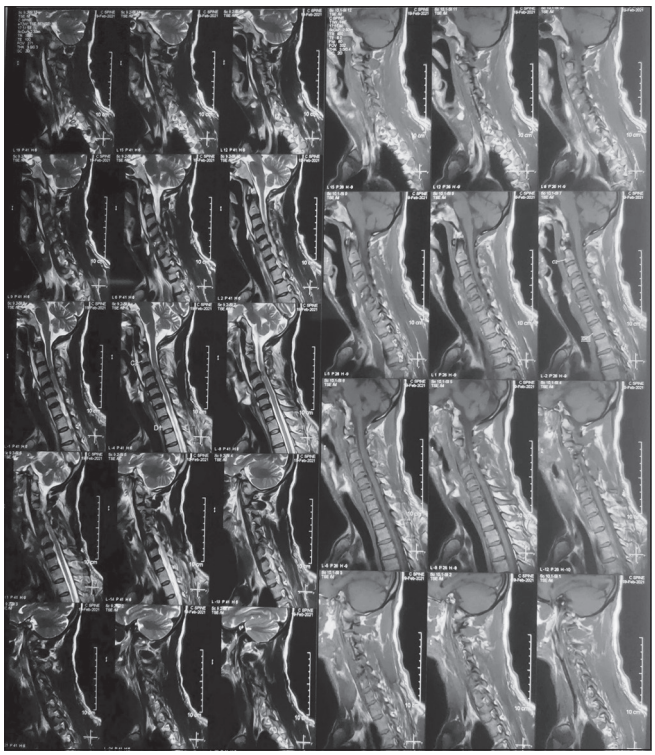

Figure 1: MRI showing cervical spinal cord injury

Surgical correction of humeral fracture was planned on day 8 following injury. The patient was placed in a supine position and the neck was immobilized with a cervical collar. The patient was under supportive measures for spinal shock. The patient was assessed under the American Society of Anesthesiologists physical status III (ASA PSIII) for surgery. In addition to minimal mandatory monitors, IBP and CVP levels were monitored. Supplemental oxygen was administered using nasal prongs throughout the procedure.

Injectable glycopyrrolate 0.2 mg IV was given to counteract unopposed vagal activity. The patient was sedated with 1 mg of injectable midazolam IV. Under aseptic precautions, the neck was positioned neutrally and the left hand was adducted by the side of the body. The high-frequency linear probe (10 Mhz) was placed in the left supraclavicular fossa, in the coronal oblique plane. The brachial plexus was identified as a cluster of hypoechoic structures located laterally, posterior, and superior to the subclavian artery in-between the scalene anterior and middle muscles. Under ultrasound guidance, the needle was advanced slowly towards the angle formed by the first rib and the subclavian artery, using an in-plane approach from lateral to medial. After negative aspiration, ultrasound-guided supraclavicular brachial plexus block (SCBPB) with 10 ml of 0.5% bupivacaine + 10 ml of 2% lignocaine was administered (15 ml in the corner pocket and 5 ml in the neural cluster). The intra-operative period was uneventful. After the procedure, the patient was shifted back to intensive care unit (ICU) in a hemodynamically stable condition for further management. Radiographic evaluation in the post-operative period revealed a normal diaphragmatic position [Figure 2]. The patient's sensation recovered at C5-C6 level after 6 h following the procedure.

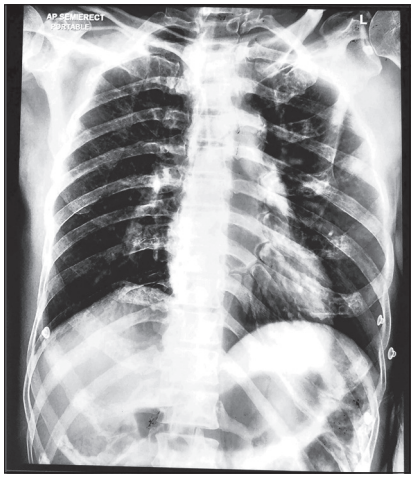

Figure 2: Chest X-ray showing normal left hemidiaphragm

Discussion

The most important principle that one should follow while performing a non-emergent surgery in an ACSCI patient is the prevention of secondary injury. This is achieved by maintaining cervical immobilization, good oxygenation, and perfusion to the spinal cord. The above-mentioned factors can be maintained more appropriately with RA than GA [Table 1].

Supraclavicular block (SCB) was used in our patient as the patient had a fracture in the mid-shaft of the humerus and the incision extended up to the upper one-third of the arm. Respiratory depression due to hemidiaphragmatic palsy (HDP) following SCB could worsen the respiratory dynamics of the patient.

In order to avoid this, we used ultrasound-guided SCB with a lower volume of local anesthetic (20 ml) and injected the majority of the drug in the corner pocket rather than in the neural cluster.[6] A study suggested that lowering the volume of local anesthetic from 30 to 20 ml would decrease the incidence of HDP significantly.[7] Injecting the majority of the drug in the corner pocket reduces the incidence of HDP considerably.[4]

An ideal time for non-emergent surgeries may be affected by the cardiovascular, neurological, and respiratory derangement due to ACSCI. Avoidance of hypotension and maintenance of mean arterial blood pressure at 85 to 90 mmHg for 7 days following ACSCI, helps to improve the spinal cord perfusion.[8] Secondary injury begins within minutes following trauma and peaks at 4–6 days following an injury.[9] Hence we posted the case after 7 days following the injury. By day 8, the perfusion of the spinal cord would have improved and the peak effect of secondary injury would have passed.

Conclusion

This is a successful case of ultrasound-guided hemidiaphragm sparing SCB for humerus plating, in a patient with ACSCI in neurogenic shock with no further adverse effects. Hence, to sum up, ultrasound-guided hemidiaphragm sparing SCB can be safely used at the end of 7 days following injury in preference to GA in patients with ACSCI in neurogenic shock without the fear of worsening the secondary injury.

Contribution of authors

Dr. K.Vinod - Concept, Design, Definition Of Intellectual Content, Literature Search, Data Acquisition, Manuscript Preparation.

Table 1: Illustrating advantages of regional anesthesia over general anesthesia

Factor	General anesthesia	Regional block
Airway management	a) Jaw thrust and chin lift would be difficult with underlying ACSCI b) Extension of the cervical spine for direct laryngoscopy would render more disruption to the cervical spinal cord c) Awake intubation/supraglottic device may still produce critical movements of the cervical spine d) Immobilization with collar may limit mouth-opening and interfere with airway management	The movement of the cervical spine would not be necessitated
Intubation response	e) May lead to bradycardia, hypotension, and cardiac arrest	These effects could be avoided
Blood pressure management	f) Routine IV induction agents and volatile anesthetics would result in significant systemic hypotension and thence lead to reduced spinal cord perfusion pressure	The effects on systemic hypotension by regional block is not much pronounced
Hypothermia	g) Anesthetic-induced vasodilation and depression of hypothalamic thermoregulatory centers may lead to hypothermia, which may result in complications like coagulopathy, cardiovascular instability, and infection	Hypothermia could be reduced
Use of muscle relaxants	h) From 3 days to 9 months, following ACSCI, usage of succinylcholine can trigger fatal hyperkalemia.	No need of muscle relaxant usage
Cardiovascular system	i) In ACSCI, there would be reduced vascular tone and unbalanced vagal hyperactivity, due to disruption in sympathetic nerve fibers in the superior ganglion Abnormalities like bradycardia, hypotension, supraventricular arrhythmias, and cardiac arrest are caused by autonomic nervous system imbalance	The effects of a block on the normal functioning of the cardiovascular system is not much pronounced
Respiratory system	j) ACSCI disrupts the function of the diaphragm, accessory respiratory muscles, reduces lung/chest wall compliance, leading to loss of vital capacity and expiratory force, predisposing patients to atelectasis and retention of secretion, thence resulting in a higher incidence of pneumonia k) Intubation and ventilation would render more risk of inflicting infection to the patient	Hemidiaphragm palsy may occur following SCB but the incidence can be reduced by using ultrasound, lower volume of local anesthetic, and varying the site of injection.

SCB=Supraclavicular block

Raj Murugan, K.Sharanya, Thilak.M - Literature Search, Data Analysis, Manuscript Preparation, Manuscript Editing And Manuscript Review.

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.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Dooney N, Dagal A. Anesthetic considerations in acute spinal cord trauma. Int J Crit Illn Inj Sci 2011;1:36-43.
2. Drew J, Chou VB, Miller C, Borg B, Ingalls N, Shackelford S. Clearing the cervical spine in a war zone: What other injuries matter? Mil Med 2015;180:792-7.
3. Kim BG, Yang C, Lee K, Choi WJ. Bilateral brachial plexus block in a patient with cervical spinal cord injury: A case report. Medicine (Baltimore) 2020;99:e21126.
4. Kang RA, Chung YH, Ko JS, Yang MK, Choi DH. Reduced hemidiaphragmatic paresis with a "corner pocket" technique for supraclavicular brachial plexus block: Single-center, observer-blinded, randomized controlled trial. Reg Anesth Pain Med 2018;43:720-4.
5. Urmey WF, McDonald M. Hemidiaphragmatic paresis during interscalene brachial plexus block: Effects on pulmonary function and chest wall mechanics. Anesth Analg 1992;74:352-7.
6. Renes SH, Spoormans HH, Gielen MJ, Rettig HC, van Geffen GJ. Hemidiaphragmatic paresis can be avoided in ultrasound-guided supraclavicular brachial plexus block. Reg Anesth Pain Med 2009;34:595-9.
7. Bao X, Huang J, Feng H, Qian Y, Wang Y, Zhang Q, *et al*. Effect of local anesthetic volume (20 mL vs 30 mL ropivacaine) on electromyography of the diaphragm and pulmonary function after ultrasound-guided supraclavicular brachial plexus block: A randomized controlled trial. Reg Anesth Pain Med 2019;44:69-75.
8. Hadley MN, Walters BC, Grabb PA, Oyesiku NM, Przybylski GJ, Resnick DK, *et al*. Blood pressure management after acute spinal cord injury. Neurosurgery 2002;50 (3 Suppl):S58-62.
9. Young W. Secondary CNS injury. J Neurotrauma 1988;5:219-21.