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Precision Anesthesia Techniques in Brachial Plexus Injury Repair: A Case Study with Neuromuscular Monitoring and Dexmedetomidine Infusion"

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ABSTRACT

Introduction: Precision anesthesia techniques play a pivotal role in optimizing outcomes for patients undergoing surgical repair of brachial plexus injuries. Utilizing tailored approaches, such as neuromuscular monitoring and selective drug infusions, enhances surgical conditions and postoperative recovery.
Case Presentation: In this case, a 35-year-old male with a left global brachial plexus injury underwent surgical repair. Anesthesia induction included fentanyl, thiopentone, and succinylcholine, followed by intubation. Neuromuscular monitoring obviated the need for further muscle relaxants. Anesthesia maintenance utilized a combination of oxygen, nitrous oxide, isoflurane, dexmedetomidine (0.5 mcg/kg/hr), and propofol via a Target-Controlled Infusion (TCI) pump. The surgery lasted 5.5 hours with stable vital signs post-extubation.
Discussion: The combination of dexmedetomidine and propofol allowed for precise control over anesthesia depth, ensuring hemodynamic stability and optimal surgical conditions. This tailored approach minimized adverse effects and provided effective analgesia without respiratory depression.
Conclusion: Precision anesthesia techniques, including neuromuscular monitoring and dexmedetomidine-propofol infusions, optimize perioperative management in brachial plexus repair. These strategies enhance patient safety, surgical outcomes, and postoperative recovery, highlighting the importance of individualized anesthesia care in complex procedures.

INTRODUCTION:

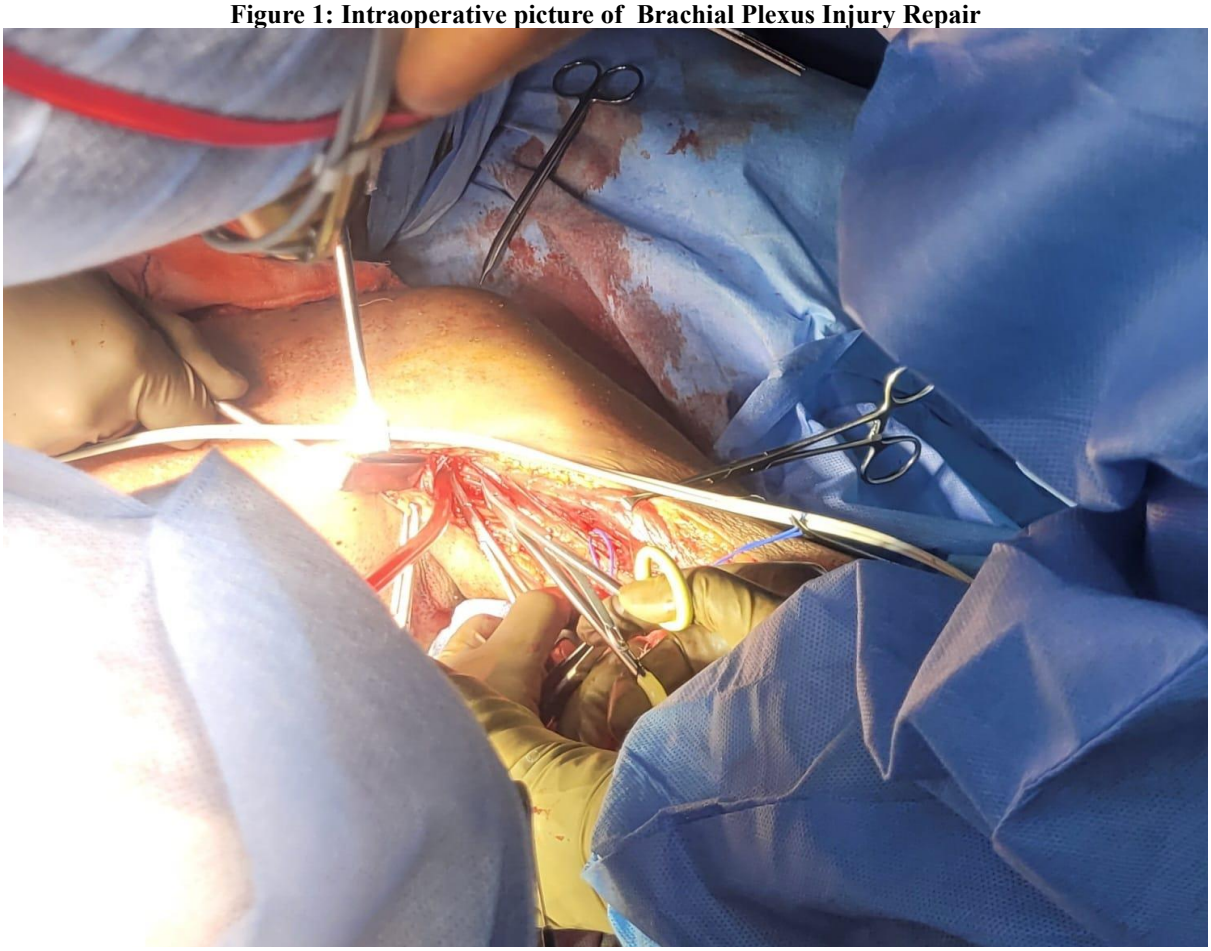
Brachial plexus injuries constitute a significant portion of peripheral nerve injuries, with brachial plexopathy affecting approximately 2% of patients in trauma clinics and increasing to 5% when root involvements are considered [1-2]. These injuries predominantly affect young adults, with a median age of 34, and are more common in men than women, often resulting from high-energy forces such as traffic collisions. Closed traction, the primary mechanism of injury in adults, leads to section, contusion, and stretch injuries to neural tissues, including avulsions or injuries to cervical nerve roots near the spinal cord [3].
Intraoperative neurophysiologic monitoring, particularly direct nerve stimulation, has become crucial in preventing postoperative neurological impairments in brachial plexus surgery. Surgeons prioritize pain management, with root exploration and grafting assisting in reducing or eliminating postoperative pain complaints.
While regional anesthesia offers advantages such as lower morbidity and mortality rates, better postoperative analgesia, and increased cost-effectiveness general anesthesia remains the preferred method for brachial plexus lesion repair in many settings, potentially due to medicolegal concerns [4-7].
Dexmedetomidine, an α2-adrenergic receptor agonist, is used as an adjuvant during general anesthesia to enhance hemodynamic stability and reduce anesthetic and analgesic requirements [8-10]. Its role in brachial plexus injury repair warrants further investigation.

CASE PRESENTATION:

A 35-year-old male with a history of a road traffic accident (RTA) three months ago presented for surgery. He had undergone open reduction internal fixation (ORIF) with plating for fractures of the left clavicle, left humerus, and left radius, with additional plating done for a fracture of the right forearm. The patient also had a known seizure disorder and was on T. Eptoin BD. Clinical examination revealed a left global brachial plexus injury, resulting in complete motor paralysis (0/5) of the left upper limb and absent sensation below the elbow, while the motor and sensory functions of the right upper limb were normal. His general examination indicated a height of 168cm, weight of 60kg, and stable vital signs: pulse rate (PR) of 72/min, blood pressure (BP) of 130/70mmHg, and oxygen saturation (SPO2) of 100% on room air. Airway examination showed adequate mouth opening with a Mallampati score of 2, normal neck movements, and

clear lung auscultation. Routine blood investigations and ECG were within normal limits. In the operating room, routine ASA monitors were applied, and prophylactic antibiotics were administered. Intravenous access was established with two wide-bore IV cannulas, followed by premedication with intravenous glycopyrrolate 0.2mg. The patient was preoxygenated and then induced with intravenous fentanyl 100mcg, thiopentone 200mg, and suxamethonium 75mg for intubation. Intubation was performed with a size 8.5 endotracheal tube (ET tube), which was then confirmed for proper placement and secured. During the maintenance phase of anesthesia, a balanced technique was employed using a combination of oxygen and nitrous oxide along with isoflurane. Additionally, a continuous infusion of dexmedetomidine at 0.5mcg/kg/hr and propofol via a target-controlled infusion (TCI) pump was utilized. No further muscle relaxants were administered during the surgery due to the use of neuromuscular monitoring. The surgical procedure lasted approximately 5 and a half hours, during which there was an estimated blood loss of 400ml. Adequate fluid resuscitation was provided, and hourly urine output was monitored to ensure proper hydration and renal function. The intraoperative period proceeded without any significant events. Following the completion of the surgery, the patient was extubated and transferred to the post-anesthesia care unit (PACU). Post-extubation vitals remained stable, indicating successful anesthesia management and a favorable recovery.

Figure 1: Intraoperative picture of Brachial Plexus Injury Repair



DISCUSSION:

The case study presented demonstrates the successful application of precision anesthesia techniques, including neuromuscular monitoring and dexmedetomidine-propofol infusions, in optimizing perioperative management for brachial plexus injury repair.

Recent investigations have demonstrated a considerable reduction in pain scores with dexmedetomidine when compared to propofol and sevoflurane [12]. When other types of sedation and muscle relaxants were avoided during brachial plexus procedures, it was the best option for providing strong analgesia. Additionally, dexmedetomidine has a high sedation rating. Consequently, it was adequate as a sedative in situations when inhalational anaesthetics were not used. One possible side effect of dexmedetomidine is increased postoperative sedation [13]. Because of this, it was wise to keep an eye on the patients in a post-anesthesia care unit for the first two hours following surgery. Although postoperative

drowsiness is a problem, dexmedetomidine is known to lessen agitation and delirium in post-operative patients. Additionally, it lowers the patients' breathing rate and raises their CO2 levels. At the conclusion of the surgical process, hypercapnia-driven ventilatory drive aids in the awakening of respiratory functions [14]. Dexmedetomidine produces excellent hemodynamic stability. Propofol functions as a positive allosteric modulator and agonist for γ-Aminobutyric-Acid A (GABAA) receptors, lengthening the channel's closure time and triggering it to provide a sedative-hypnotic effect. Propofol is the perfect medication for easily titratable IV sedation because of its quick start of action, short context-sensitive half-time, and short effect-site equilibration time. In one patient whose initial rate of dexmedetomidine infusion was insufficient, it was chosen for induction and as a bolus dosage to deepen the plane of anaesthesia due to its quick recovery, antiemetic activity, and lack of residual sedation [16]. The study highlights successful utilization of precision anesthesia techniques, including neuromuscular monitoring and dexmedetomidine-propofol infusions, ensuring stable intraoperative conditions and effective pain control in brachial plexus injury repair. However, limitations such as its retrospective nature and single-patient focus warrant cautious interpretation and emphasize the need for further research to validate findings and optimize anesthesia protocols.

Conclusion:

In conclusion, precision anesthesia techniques, including neuromuscular monitoring and dexmedetomidine-propofol infusions, effectively optimized perioperative management for brachial plexus injury repair. this tailored approach ensured stable intraoperative conditions, minimized adverse effects, and facilitated smooth postoperative recovery, highlighting their crucial role in enhancing patient safety and surgical outcomes.

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