Case Report

Opioid-Free Anesthesia Technique for Anterior Cervical Discectomy and Fusion (ACDF): Anesthesia Management

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Abstract

Anterior cervical discectomy and fusion (ACDF) is a safe and effective surgical procedure to treat cervical spine pathology. ACDF treats Cervical Spondylotic Myelopathy (CSM), where degeneration of the cervical vertebrae compresses the spinal cord, causing sensory, motor, reflex, and bowel function impairment. The use of opioids can have unpleasant effects, hence opioid-free anaesthesia techniques were developed as a strategy to reduce this risk. A man, 62 years old, complained of weakness in the upper limbs until it was difficult to move the hands. Supportive examination revealed cervical myeloradiculopathy due to multiple hernia nucleus pulposus (HNP). Management of opioid-free anaesthesia techniques using multimodal analgesics. During the operation, haemodynamics were relatively stable. Extubation was performed in the operating room and then the patient was transferred to the intensive care unit. The choice of opioid-free anaesthesia technique in the case was to provide multimodal using specific agents that have anaesthetic or analgesic properties. Opioid-free anaesthesia methods that support the Enhanced Recovery after Surgery (ERAS) concept are considered highly beneficial in accelerating recovery time, reducing length and cost of treatment and minimizing opioid-related unpleasant risks. The opioid-free anaesthetic technique in this case report demonstrates the feasibility and benefits of opioid-free anaesthesia in effective pain management and minimizing opioid-related risks, especially in ACDF surgical procedures. This technique is in line with the ERAS protocol.

Keywords: Opioid-free anaesthesia, anterior cervical discectomy and fusion, enhanced recovery after surgery

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Introduction

Anterior cervical discectomy and fusion (ACDF) is a widely used surgical technique that has been proven safe and effective for the treatment of cervical spine pathology. ACDF is one of the most common surgical procedures on the cervical spine, with approximately 132,000 cases performed annually in the United States alone.[1] Degenerative structures in the cervical spine compress the spinal cord or the blood vessels that supply it, resulting in a variety of symptoms, including impaired sensory, motor, reflexes, and even impaired defecation and urination. This condition is known as cervical spondylotic myelopathy (CSM).[2] CSM is caused by chronic mechanical compression of the ventral and dorsal sides of the spinal cord, leading to spinal cord ischaemia and parenchymal pathological changes in the spinal cord, which then cause spinal cord dysfunction. Surgical intervention is often necessary in cases where non-surgical treatment is ineffective or spinal cord dysfunction worsens.[3,4] Cervical anterior discectomy and fusion (ACDF) is the 'gold standard' for the treatment of CSM, as it can directly relieve spinal cord and nerve compression and alleviate patients' symptoms.[5]

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Due to the overuse of opioids and their side effects, a new strategy was developed in order to achieve balanced general anaesthesia, namely opioid-free anaesthesia. Over the years, opioids have become an integral part of general anaesthesia for effective treatment of chronic pain including pain management in cervical spondylotic myelopathy (CSM). However, evidence suggests that the use of opioids during surgery can cause hyperalgesia, leading to chronic postsurgical pain (CPSP) and long-term opioid use.[6] However, perioperative opioid administration is not risk-free. In fact, opioid dependence has become a worldwide problem, with an estimated 40.5 million people dependent on opioids in 2017 worldwide.[7] Opioids are also associated with life-threatening side effects such as respiratory depression, postoperative nausea and vomiting, opioid-induced hyperalgesia, constipation, urinary retention, immunomodulation and neurotoxicity.[8] Moreover, the prescription of opioids after surgery seems to trigger the development of opioid addiction, thus contributing to the widespread opioid abuse observed worldwide.[9] Therefore, opioid-free anaesthesia may be a relevant strategy.

Enhanced Recovery after Surgery (ERAS) in neurosurgery aims to reduce the duration of hospitalization by minimizing surgical stress and accelerating postoperative recovery. Traditional pain management often involves opioids, which have risks of dependence, tolerance and side effects. In response, opioid-free anaesthesia has emerged as a viable alternative, using non-opioid agents such as dexmedetomidine, lidocaine and paracetamol. This technique has been developed and is widely used in neurosurgical operations. This case report explores the application of opioid-free anaesthesia in neurosurgery in ACDF procedures, highlighting its role in supporting Enhanced Recovery after Surgery (ERAS) protocols.

Case

History

A male, 62 years old with a body weight of 60 kg. In the last 4 years before entering the hospital, he complained of weakness in the upper limbs which was getting worse so that the patient had difficulty in moving his hands. Complaints were accompanied with pain and tingling that radiates from the shoulders to the fingertips. Complaints of defecation and urination disorders (-). history of trauma (-), history of fever (-), long cough (-), weight loss (-). history of anticoagulant drug consumption (-). Hypertension (+) since last 5 years, taking medicine irregularly. During the illness, the patient took gabapentin 100mg - 0 - 300mg PO, amlodipine 1x10mg PO. During the illness, activity was limited and lying down mostly.

Physical examination

General state: composmentis, Neurological status: GCS 15, stiff neck (-), Sensory: Hypesthesia C5 and below, Numeric Rating Scale: 6/10, Head: pupillary reflex +/+, round pupils isocor 3 mm/3 mm, Respiration: breathing frequency 20–22x/min, vesicular breath sounds in both lungs, no rhonki and wheezing, SpO_2 97–98% with room air. Cardiovascular: blood pressure 170/90 mmHg, pulse 67 beats/min, heart sounds 1 and 2 single, regular, no murmur.

Abdomen: supple, normal bowel sounds, no palpable hepatic and splenic, lesions (-).

Uro-genital: normal urination without urinary catheter.

Musculosceletal: limited neck deflection due to pain, mallampati II, teeth intact, dentures and loose teeth absent.

Supporting examination

Laboratory examination revealed haemoglobin 12.7, haematocrit 38.5, leucocytes 6,030, platelets 240,000, Ur 23.8, Cr 0.54. Thorax X-ray examination was within normal limits. Cervical X-Ray examination obtained Malalignment (-), Cobb Angle 4.7 (20-35), C2-C7 SVA 19.9 mm (N<40 mm), Osteophytes (+) at C3-C5 endplate. Cervical MRI examination using contrast was obtained: Canal Stenosis (+), Protrusion disc at C3-C4, C4-C5, C5-C6, Bulging disc at C6-C7, C7-C8, Modic changes type 2, Pfirmann grade 5, Banana shape (+), Cord hyperintensity (+), Schmorl node (-). Cervical Spondylotic Myelopathy caused by Multiple HNP at Cervical C3-C4, C4-C5, and C5-C6, grade II hypertension

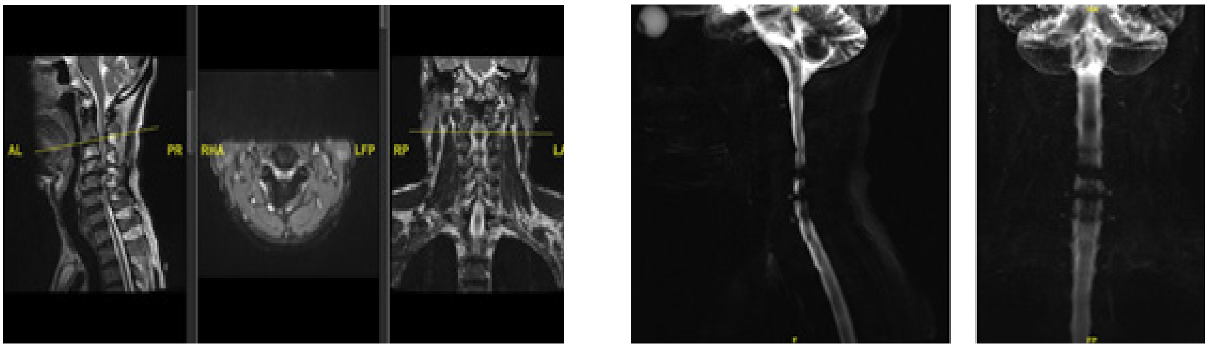

Figure 1: Overview of MRI Examination Results

and neuropathic pain which will be performed Anterior Cervical Discectomy and Fusion (ACDF) C3-4 and C5-6 with ASA physical status 3. The anesthesia technique plan uses general anesthesia with an endotracheal tube (ETT).

Anaesthesia Management

Pre-anesthesia preparation started from informed consent at the preoperative visit in the ward, the patient was prepared and fasting, the preparation of ready-to-use blood components (PRC), an infusion line with crystalloid fluid has been installed in the ward, preparing the intensive care room but the room was still full so that it was prepared after the operation and the patient returned to the regular care room. Preparation in the operating room started from the preparation of anaesthetic machines, scope, tube, airway device, tape, inducer, connection (STATICS), airway management tools, endotracheal tubes (ETT), anaesthetic and emergency drugs, and syringe pumps. Monitoring using non invasive blood pressure (NIBP), ECG, Capnograph, Train-of-Four (TOF), Connox and SpO_2.

On the operating table, blood pressure was found to be: 140/90 mmHg, pulse: 88 x/min, oxygen saturation 99%, then dexmedetomidine 0.5 mcg/kgBB was given as analgesic using a syringe pump which ran out in 10 minutes, followed by propofol induction 100 mcg IV. Before intubation, translaryngeal nerve block and superior laryngeal nerve block was performed using lidocaine 1% to reduce pain caused during laryngoscopic intubation. This was followed by rocuronium 50 mg and lidocaine 80 mg. Intubation using ETT no 7.5 fixation at the lip border 21 cm. Ventilator: VCV mode FiO_2 50%, flow 3 L/m, Vt: 425 ml, rate: 12 times/minute, PEEP: 5 cmH_2O, maintenance: O_2 : N_2O: 1,5 : 1,5. Next, a cervicalis superficial block was performed with lidocaine 1%, 10 cc using ultrasound guidance to reduce pain at the incision in the anterior cervical region. During surgery sevoflurane 2–3 vol%, intermittent rocuronium, dexmedetomidine 0.2–0.7 mcg/kgBB/hour (syringe pump), and nicardipine (syringe pump). Fluid maintenance with ringerfundin 100 cc/hour. During surgery, systolic blood pressure was 120–141 mmHg,

Figure 2: Superficialis Cervicalis Block

Figure 3: Monitoring and Maintenance during Operation

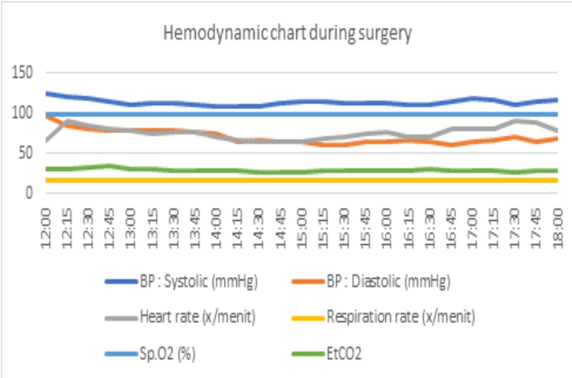

Figure 4: Haemodynamic Graph during Surgery

diastolic blood pressure was 70-85 mmHg, pulse was 49-60 beats per minute, oxygen saturation was 98%–99%, BIS was 42–59, TOF was 0/4-3/4. The operation lasted for 6 hours, with a total fluid intake of 2500 cc, with a total urine output of 1000 cc. Total bleeding was 250 cc. After the operation was completed, cough reflex (+), swallowing reflex (+), spotty breathing, the patient was extubated in the operating room and transferred to the semi-intensive care unit for postoperative care. Postoperative analgesics were given, dexmedetomidine 0.2 mcg/kgbw/hour, paracetamol 4x1 gram. 24 hours after surgery, the patient was found calm, GCS 15, blood pressure 134/75 mmHg, pulse 60 beats per minute, respiration 20 beats per minute, oxygen saturation

Figure 5: Haemodynamics after Surgery

99%, nasal cannul 3 lpm and urine production 0.5-1 cc/kgbw/hour. On the second postoperative day, the patient was moved to the regular ward.

Discussion

Pain management during surgery is very important. The most patented drugs often used to control severe pain are opiods. They have long been used to supplement general anaesthesia, but are associated with well-recognized side effects such as nausea and vomiting, sedation, ileus, confusion and delirium, respiratory depression, increased postoperative pain and morphine consumption, immunodepression, hyperalgesia and chronic postoperative pain, addiction, and even abuse.[10]

The opioid crisis especially in the United States has further questioned the use of perioperative opioids.[11] Ongoing pain during surgery and postoperative is one of the main causes of agitation and discomfort after surgery, as well as in craniotomy surgery. Effective analgesia after ACDF remains one of the biggest challenges for an anaesthesiologist in order to support the success of the Enhanced Recovery After Surgery (ERAS) concept.[12,13] Lidocaine, ketamine, and alpha-2 agonists such as clonidine or dexmedetomidine have been proposed to replace single opioids or combined forms.[14] In this case report, we present a patient who underwent ACDF surgery for the indication of Cervical Myeloradiculopathy at C5 due to Cervical Spondylotic Myelopathy caused by multiple HNPs at Cervical C3-C4, C4-C5, and C5-C6, where in the perioperative and periprocedural period, opioid-free anaesthesia techniques were used with successful results, adequate pain management, by avoiding opioid drugs and replaced with a combination of several other agents and modalities even for acute postoperative pain management.

The anaesthetic technique we performed in this patient's case was opioid-free anaesthesia by applying a multimodal approach using specific agents that have anaesthetic or analgesic properties, administered in subanesthetic doses to achieve the desired effect. Non-opioid agents such as dexmedetomidine, lidocaine and paracetamol offer effective analgesia with less risk. Dexmedetomidine provides sedation and analgesia without respiratory depression. Lidocaine, as a local anaesthetic, reduces pain and inflammation. Paracetamol offers antipyretic and analgesic effects.

On the operating table, translaryngeal nerve block and superior laryngeal nerve block were performed using lidocaine 1% just before intubation. The role of opioids which are often used as intubation analgesics was replaced by intravenous lidocaine at a dose of 1 mg/kgbw, both of which were given to dull the pain during intubation. Intravenous administration of dexmedetomidine combined with propofol and inhaled anaesthetic sevoflurane were used to maintain anaesthesia during surgery in this patient. One gram of paracetamol was administered during skin closure. After surgery, the patient was given paracetamol 1 gram which was given routinely every 8 hours. Lidocaine has effects as an analgesic agent, anti-inflammatory, and anti-hyperalgesic properties. Due to the common use of lidocaine infusion in treating cardiac arrhythmias, it is certain that its plasma levels for therapeutic effects and specific organ toxicity can be estimated.[15] Lidocaine has 2 active metabolites: monoethylglycinexylidide (MEGX) which is further metabolized to xylidine. MEGX is 80% as active as lidocaine, and xylidine is 10% as active as lidocaine. Lidocaine is metabolised in the liver and excreted by the kidneys. Lidocaine is said to have an opioid sparing effect as it works by blocking ectopic nerve release but not conduction.[15,16] The combination of propofol with dexmedetomidine in this patient was shown to provide adequate maintenance of anaesthesia and replace the role of opioids as analgesics during surgery.[15]

Dexmedetomidine is an alternative to opioid-free anaesthetic techniques in these patients. Dexmedetomidine is an alpha-2 agonist that has hypnotic, sedative and analgesic effects and is estimated to be 7–10 times more potent than clonidine. Dexmedetomidine provides hypnotic and sedation effects and has analgesic properties. Sedation with dexmedetomidine has been shown to be beneficial in suppressing the adrenergic response to tracheal intubation as well as reducing the plasma concentration of catecholamines during anaesthesia that would otherwise result from the surgical response. Continuous administration of the agent dexmedetomidine results in decreased minimum alveolar concentration (MAC) for inhaled anaesthetic agents and has an opioid-sparing effect. The analgesia effect is dose-dependent with little or no ventilatory depression. However, caution in the administration of this agent relates to the hypotensive effects that can occur when administered in non-titrated doses. Dexmedetomidine may attenuate the cardiostimulating effects and complications of post-anesthetic delirium.[17] ERAS is considered very beneficial in speeding up recovery time, reducing the length and cost of treatment. However, perioperative pain management in neurosurgical surgery is a challenge for anaesthetists especially with the evolving concept of ERAS including ACDF surgical procedures. An opioid-free anaesthesia technique approach supports ERAS protocols, minimizing opioid-related risks and improving recovery time.

Conclusion

The opioid-free anaesthesia technique presented in this case report demonstrates its feasibility and benefits in neurosurgical care, especially in ACDF surgical procedures. This technique aligns with the ERAS protocol, promotes effective pain management and minimises opioid-related risks. Further research and larger studies are needed to establish a standardised protocol and evaluate long-term outcomes. This case underscores the potential use of opioid-free anaesthesia in neurosurgery, advocating further exploration of multimodal analgesia approaches. Standardizing opioid-free protocols and conducting large-scale studies will be essential to validate the effectiveness and safety of this technique in diverse surgical populations.

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