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A COMBINED REGIONAL ANESTHESIA-BASED OPIOID-SPARING APPROACH FOR THYMECTOMY IN A PATIENT WITH MYASTHENIA GRAVIS: A CASE REPORT

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Abstract

Introduction: Anesthesia for patients with Myasthenia Gravis requires carefully tailored anesthetic strategy, to minimize the risk of potentially fatal postoperative respiratory failure. A novel regional technique, the superficial parasternal intercostal plane block provides a safe and effective adjunct to combined general anesthesia, which can help reduce perioperative complications.

Case presentation: We report a case of successful anesthetic treatment of a 20-year-old female with Myasthenia Gravis that underwent thymectomy with mid-chest skin incision and sternotomy. The operation was performed under a combined general anesthesia protocol that anticipated strict avoidance of benzodiazepines and muscle relaxants with a decrease in the total dose of opioids. The patient was induced with propofol, fentanyl (50mcg), and remifentanil infusion. Sevoflurane and low-dose remifentanil infusion provided adequate hypnosis and sufficient relaxation during the operation. After the endotracheal intubation, we performed a modified bilateral superficial parasternal intercostal plane block, which, in combination with a low-dose remifentanil infusion, provided optimal analgesia that persisted throughout the postoperative period. The patient was extubated in the operating room and resumed spontaneous breathing without any respiratory complications. Postoperatively, according to the Visual Analog Scale at 4 time points (T_1 – after the operation, T_2 – 6 hours, T_3 – 12 hours, and T_4 – 24 hours), the patient reported minimal or no pain.

Conclusion: The implementation of a regional technique in this case facilitated multimodal analgesia, reduced the overall opioid requirement, and contributed to faster patient recovery. This case highlights the importance of meticulous, individualized planning tailored to the patient's needs in order to achieve favorable outcomes.

Keywords: *Myasthenia gravis; sternotomy; superficial parasternal block.*

Introduction

Myasthenia Gravis (MG) is an autoimmune disorder characterized by skeletal muscle weakness caused by destruction or inactivation of the postsynaptic acetylcholine receptors at the neuromuscular junction. Patients undergoing long-term pharmacological treatment are usually in a steady state and can experience relatively long symptom-free periods. However, in some clinical settings, relapses of MG can be resistant to pharmacological treatment, and patients can experience progression of symptoms despite regular therapy. In this clinical scenario, thymectomy is a recognized treatment option that can lead to long-term symptom improvement, reduced medication requirements, and potential remission, both in patients with thymoma and in those without thymic enlargement (1).

When a patient with MG presents for thymectomy or even for an unrelated surgical procedure, an individual anesthesia plan must be created. The anesthetic management of MG focuses on minimizing the risk of respiratory depression and avoiding exacerbation of the muscle weakness. Benzodiazepines are traditionally described as the biggest potential risk for this patient group. However, the detrimental potential of muscle relaxants and large doses of opioids mustn't be overlooked. Clinical experience, as well as available literature data, are the main guides, with key strategies focused on: regional anesthesia, minimizing the use of respiratory depressants, and avoiding neuromuscular blocking agents (2).

The preoperative evaluation and optimization of their pharmacologic treatment are very important first steps in the management of these patients. A neurology consultation is an essential component of the preoperative assessment and that provides a basis for the postoperative follow-up. The MGFA Clinical Classification is a clinical score accredited worldwide and is used to assess the severity of MG based on muscle weakness patterns and functional impact (3). Thymectomy that involves a midchest skin incision and sternotomy is a seriously invasive and painful operation that causes significant tissue destruction and subsequent inflammatory and neuroendocrine response. Thoracic epidural analgesia has historically been considered the gold standard in surgeries involving the thoracic wall. However, recently, regional anesthesia techniques that target the intercostal nerves have gained increasing attention among anesthesiologists worldwide.

The superficial parasternal intercostal plane block (SPIP), which was our technique of choice in this case, is an ultrasound-guided regional anesthesia technique that provides analgesia for thoracic and upper abdominal surgery. The local anesthetic is injected at multiple sites, to target each of the intercostal nerves innervating the dermatomes to be anesthetized. This technique deposits local anesthetic (LA) in a plane between the pectoralis major muscle and external intercostal membrane, targeting the anterior cutaneous branches of Th_2–Th_6. Compared with deep parasternal blocks, in which LA is injected in a fascial plane beneath the intercostal muscles, SPIP is considered a much safer technique because the risk of pneumothorax and vascular injury is significantly lower (4). In our case, we performed a modification of SPIP with additional injection of LA in a plane under the periosteum of the sternum until an ultrasound-visible spread of LA was achieved. This modification was done with the purpose of achieving complete surgical analgesia during sternotomy and thymectomy. Contraindications for SPIP include clinically significant coagulopathy, local infection, or patient refusal.

Case Presentation

We report a case of a 20-year-old female with Myasthenia Gravis (MG) who presented for a

thymectomy because of recent clinical deterioration.

The patient was diagnosed with MG 6 years ago, has since received pharmacological treatment, with regular follow-up by her neurologist. Since December of last year, she has experienced alternating periods of exacerbation and improvement, with symptoms that included difficulty in speaking, nasal speech, difficulty in swallowing, and, more recently, weakness in both arms and occasionally both legs. According to the MGFA clinical classification, our patient was classified as Class IIa (symptoms predominantly in limbs and axial muscles that may include mild oropharyngeal involvement). Patients at this stage of the disease are considered to be at moderate to severe risk of postoperative respiratory complications. (3) She reported a miscarriage at 9 weeks of pregnancy 1 year earlier and had no other relevant medical history.

Her clinical worsening 3 months prior to surgery was pharmacologically treated with prednisolone, azathioprine, and pyridostigmine (Mestinon®), but the treatment was unsuccessful, prompting the indication for thymectomy. Preoperative serologic tests detected autoimmune activity with both AChR (0.46 nmol/L) and MuSK (0.2 nmol/L) antibodies. At admission, the patient presented with ptosis of both eyelids, difficulty in speaking and swallowing, and weakness in both arms, mostly in her shoulders. She denied experiencing any respiratory symptoms such as difficulty breathing and coughing. The laboratory analysis and the hemostasis tests were within the reference range. The CT scan of her thorax showed a small mass (2-3cm) in the upper mediastinum with radiological characteristics of normal gland tissue or adipose tissue.

Our plan was to use a combined anesthesia approach focused on avoiding all agents that could contribute to the progression of the patient's disease, while providing adequate intra- and postoperative analgesia. Preoperative premedication with benzodiazepines was omitted. The patient was induced with propofol (1.5mg/kg) and 50mcg of fentanyl, which provided optimal intubation conditions, and she was intubated with a size 7 endotracheal tube. Throughout the entire procedure, hypnosis was provided with sevoflurane (1vol%) and continuous remifentanil infusion (0.15-0.25mcg/kg/min). Muscle relaxants were not used during the operation.

After induction and intubation, we performed an ultrasound-guided modified superficial parasternal intercostal plane block (SPIP), using a combination of lidocaine (30mg) and bupivacaine (75mg). According to her body weight (74 kg) and body mass index (28), the total administered doses of LA were in the safe therapeutic range for RA and significantly lower than the maximal recommended doses for lidocaine (30mg used versus maximal dose 3mg/kgBW) and bupivacaine (75mg used versus maximal dose 2mg/kgBW). Using a linear ultrasound probe (5-15 MHz) and a 100mm ultrasound needle, under strict aseptic technique, SPIP was performed with several injections in 4 adjacent intercostal sites on both sides of the sternum. LA was injected in a plane between the pectoralis major muscle and the external intercostal membrane. (picture 1) In order to achieve complete surgical analgesia of the sternum and the anterior chest wall, we decided to modify SPIP by adding a separate superficial injection of lidocaine and bupivacaine in the plane deep to the periosteum of the sternum. This ultrasound-guided injection was performed in the middle third of the sternum, with visible spread of the LA beneath the periosteum in both cranial and caudal directions.

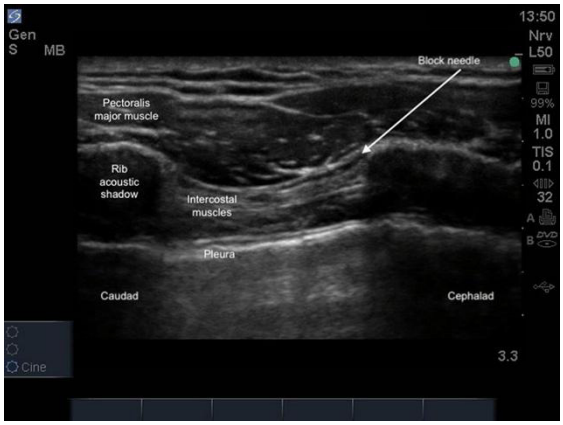

Image 1: Ultrasound view of the needle position during SPIS

The patient also received ceftriaxone, methylprednisolone (80mg), and famotidine (20mg) intraoperatively. Before emergence from general anesthesia, a 100ml Comboval® infusion was administered, containing 1.0 g of paracetamol and 300mg of ibuprofen. The procedure lasted a total of 2h45min and was uneventful. Continuous monitoring included ECG, SaO_2, non-invasive blood pressure, and end-tidal CO_2. The patient was completely hemodynamically and respiratory-wise stable, with variations in blood pressure and heart rate of less than 20% from baseline at all times during the procedure. The patient was successfully extubated in the operating room and resumed sufficient spontaneous breathing without any respiratory complications. After the surgery, the patient was transferred to the post-anesthesia care unit (PACU) and later to the surgery ward of the UC of Thoracic and Vascular Surgery until her discharge from hospital.

Her postoperative pain intensity was subjectively graded using the Visual Analog Scale (VAS 0/10 – with 0 being no pain and 10 being the worst pain possible) at 4 timepoints: (T_1) immediately after emergence from anesthesia, (T_2) after 6 hours, (T_3) after 12 hours and (T_4) after 24 hours. The results were: T_1 – 2-3; T_2 – 1-2; T_3 – 0-1; T_4 – 0. On the day of surgery and the 1st postoperative day, rescue analgesia with Paracetamol 1.0gr was required only for treatment of mild pain. The day after surgery, arterial blood gas analysis showed satisfactory respiratory function: pO_2 97.4mmHg, pCO_2 35.0 mmHg, SaO_2 96.8%, pH 7.45. The clinical examination, as well as the blood gas analysis, indicated solid respiratory function and excellent recovery progress with minimal to no pain.

Discussion

The treatment of postoperative pain is a serious challenge, especially following thoracic surgery and sternotomy, known to be extremely painful procedures. Inadequate postoperative analgesia is associated with insufficient mobility, atelectasis, impaired pulmonary function and prolonged hospital stays, ultimately compromising the overall quality of recovery. Modern literature highlights the impact of prolonged pain on inflammation and the activation of the neuroendocrine cascade, leading to a complex stress response that is detrimental to the immune system mechanisms (5). For these reasons, inadequate pain treatment is considered a silent propagator of complications in the postoperative period.

A nationwide matched cohort study by Yi-Wen Chang et al, showed that surgical patients with MG

are at a higher risks of postoperative pneumonia, septicemia and postoperative bleeding compared to surgical patients without MG (6). In their clinical study, Dost et al. reported that acute postoperative pain is a well-recognized risk factor for the development of chronic postsurgical pain, which can affect up to 20–60% of patients undergoing thoracic procedures (7). Administration of high-dose opioids is not ideal for any patient due to side effects, such as: nausea, vomiting, constipation, urinary difficulty, respiratory depression, sedation, possible persistent postsurgical pain, and drug dependency. All of these are even more concerning in patients with MG. Therefore, in recent years regional anesthesia techniques have become a valuable addition to balanced multimodal analgesia protocols. In this case, the regional anesthesia technique of choice was the superficial parasternal intercostal plane block (SPIP). This technique aims to anesthetize the anterior branches of the Th_2-Th_6 intercostal nerves, providing effective analgesia during general anesthesia for sternotomy. This block was originally described by de la Torre in 2014 as a regional anesthesia technique for patients undergoing breast surgery. Its wider use in patients primarily undergoing sternotomy in cardiac surgery has been recently proposed by Kumar et al., as well as in other sternotomy cases (8,9). Since the sternal periosteum is highly innervated and therefore highly sensitive to pain, the injection of the LA beneath the periosteum, in addition to the SPIP, provides a more effective and targeted intraoperative and postoperative analgesia. The intra-periosteal application of LA, originally described by Duncan et al. in 2002, is a recognized treatment for trauma patients with sternal fractures, but is not frequently used in elective surgery requiring a sternotomy. In our case, a single-shot injection provided sufficient surgical analgesia, rather than a continuous infusion via a periosteal-placed catheter, as described by Duncan et al. (10). The strategy behind multimodal analgesia is to combine different classes of medications and techniques that provide analgesia relying on different mechanisms, with the goal of optimizing pain control and minimizing the risk of potential side effects. The net result of the combined anesthesia protocol in our patient was a reduction in total opioid requirement, and minimal or no postoperative pain with only minimal use of rescue anesthesia consisting of paracetamol and ibuprofen.

While multimodal analgesia planning is important for every patient, surgical patients with MG are more vulnerable and require a carefully planned and individualized protocol. The rapid onset, short-term action, and swift awakening make remifentanil the preferred opioid for this group of patients. This modified regional anesthesia technique, together with the administered intravenous drugs, allowed for an optimal recovery of the patient.

Conclusion

Although each patient presents a unique challenge for an anesthesiologist, the successful management of patients with Myasthenia Gravis requires a multidisciplinary, multimodal approach, a profound understanding of the disease pathophysiology, and an individually tailored strategy. The contemporary practice of anesthesia offers numerous modalities and techniques that allow us to follow the key principles of anesthetic management for patients with MG: avoiding exacerbation of muscle weakness and preserving respiratory function. In our patient with symptomatic MG, a modified bilateral SPIP as an addition to the general anesthesia allowed for a painless and uneventful recovery.

Although the initial findings are promising, one major limitation of this report was that it assesses the clinical outcome of treatment in a single patient. Additional research and randomized clinical trials are necessary to establish the true significance of this technique in the treatment of different patient groups.

Declarations

Ethics approval and consent to participate: All data are available from the corresponding author upon reasonable request.

Informed consent: For the publication of this case report, a written informed consent was obtained from the patient, along with accompanying data and images.

Conflict of interest: The authors declare no conflict of interest.

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Author's contributions: Author A and Author B contributed in patient management and data collection; Author C contributed in the patient's postoperative follow-up and data collection; Author D did the literature review and supervision, while Author F contributed in data processing and writing; Author E was responsible for the surgical treatment of the patient and the follow-up in the postoperative treatment at the surgical ward.

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