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ANESTHETIC MANAGEMENT OF TWO ADOLESCENT GIRLS UNDERGOING POSTERIOR SPINAL FUSION FOR ADOLESCENT IDIOPATHIC SCOLIOSIS: TWO CASE REPORTS

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ABSTRACT

Objective: To describe the perioperative anesthetic management of two adolescent girls undergoing posterior instrumented spinal fusion for adolescent idiopathic scoliosis (AIS), with emphasis on neurophysiological monitoring, blood conservation, and postoperative recovery.

Methods: Two girls aged 16 and 14 years (ASA physical status I) with progressive idiopathic thoracic scoliosis underwent posterior spinal fusion under general anesthesia. Propofol-based total intravenous anesthesia (TIVA) with fentanyl was used, together with arterial pressure monitoring, bispectral index monitoring, motor evoked potentials (MEPs), and somatosensory evoked potentials (SSEPs). Tranexamic acid was administered as part of a blood-conservation strategy.

Results: Operative times were 5 hours and 4 hours 30 minutes, with estimated blood losses of 650 mL and 500 mL, respectively; neither patient required transfusion. MEP and SSEP recordings remained stable, and both patients were extubated early without neurological or anesthetic complications. The postoperative courses were uneventful.

Conclusion: A coordinated strategy combining propofol-based TIVA, multimodal neurophysiological monitoring, blood-conservation measures, and multimodal analgesia may facilitate safe perioperative management of AIS surgery. As a two-case report, these observations cannot establish the causal effectiveness of any single component.

Keywords: Idiopathic scoliosis; General anesthesia; Total intravenous anesthesia; Motor evoked potentials; Somatosensory evoked potentials; Spine surgery

1 INTRODUCTION

Adolescent idiopathic scoliosis (AIS) is a three-dimensional spinal deformity diagnosed in otherwise healthy children and adolescents after the age of 10 years. Treatment is individualized according to curve magnitude, skeletal maturity, progression risk, and response to nonoperative management. Surgical treatment is commonly considered for progressive curves in the approximately 40°–50° range or larger, depending on the clinical and radiographic context.

Anesthesia for this surgery is challenging for several reasons, including the long operative time, substantial potential for blood loss, the need to preserve the quality of neurophysiological monitoring, and the importance of early extubation to permit prompt postoperative neurological assessment.

This report describes the anesthetic management of two adolescent girls undergoing posterior spinal fusion for AIS and discusses the perioperative strategy in light of the available literature.

2 MATERIALS AND METHODS

2.1 Patients and ethical considerations

This report describes two adolescent girls with progressive idiopathic thoracic scoliosis who underwent posterior instrumented spinal fusion under general anesthesia and were managed by our department. Clinical, radiological, anesthetic, and postoperative data are presented. Written informed consent was obtained from the parents of both patients (see Ethical Statements).

2.2 Anesthetic protocol

The same anesthetic protocol was applied in both patients. Standard monitoring was established before induction (electrocardiography, noninvasive blood pressure, SpO₂, capnography, temperature, and bispectral index [BIS]). Anesthesia was induced with propofol (2 mg/kg), fentanyl (3 µg/kg), and rocuronium (0.6 mg/kg). After orotracheal intubation, a radial arterial catheter was inserted for continuous blood pressure monitoring and blood gas sampling.

Anesthesia was maintained with total intravenous anesthesia (TIVA) using a propofol infusion and intermittent fentanyl boluses. A loading dose of tranexamic acid (15 mg/kg), followed by a continuous infusion (2 mg/kg/h), was administered as part of the blood-conservation strategy. Neuromuscular recovery was assessed using train-of-four (TOF) monitoring. Neurophysiological monitoring included motor evoked potentials (MEPs) and somatosensory evoked potentials (SSEPs), and instrumentation was checked intraoperatively using fluoroscopy.

3 RESULTS

3.1 Case 1

A 16-year-old girl weighing 55 kg, with no relevant medical history (ASA physical status I), was followed for progressive right thoracic AIS. Radiography showed a Cobb angle of 32.9° without a brace and 26.2° with a brace (Figure 1). Surgery was performed following failure of nonoperative management, according to the treating surgical team's assessment. The preoperative work-up was normal, including a complete blood count, coagulation tests, electrocardiography, and pulmonary function tests.



Figure 1: Standing frontal radiographs of the spine of Patient 1 without a brace (left; Cobb angle, 32.9°) and with a brace (right; Cobb angle, 26.2°).

Neurophysiological monitoring included MEPs and SSEPs (Figures 2 and 3). No significant intraoperative neurophysiological change was reported.



Figure 2: Placement of stimulating and recording electrodes on the lower limbs, with impedance verification before the start of neurophysiological monitoring.



Figure 3: Intraoperative neurophysiological monitoring system (MEP module), showing bilateral recordings from the upper and lower limbs.

Adequate recovery from neuromuscular blockade was confirmed by TOF monitoring before extubation. Instrumentation was checked intraoperatively using fluoroscopy (Figure 4).



Figure 4: Intraoperative frontal fluoroscopic image after pedicle screw placement.

The procedure lasted 5 hours. Estimated blood loss was 650 mL, and no transfusion was required. The patient was extubated in the operating room after full recovery of spontaneous ventilation and neuromuscular function. She was then monitored in the intensive care unit for 24 hours before returning to the surgical ward. The postoperative course was uneventful.

3.2 Case 2

A 14-year-old girl weighing 48 kg (ASA physical status I) was admitted for surgical correction of progressive idiopathic thoracic scoliosis, with a Cobb angle of 45.8° (Figure 5). The anesthetic protocol was the same as that used for the first patient: induction with propofol, fentanyl, and rocuronium, followed by placement of an arterial catheter before prone positioning. Maintenance consisted of propofol-based TIVA with intermittent fentanyl boluses, and tranexamic acid was administered according to the same regimen as in the first patient.



Figure 5: Standing radiographs of the spine of Patient 2, showing frontal (left) and lateral (right) views of thoracic scoliosis with a Cobb angle of 45.8°.

MEPs and SSEPs remained stable throughout the procedure. The operation lasted 4 hours and 30 minutes, with an estimated blood loss of 500 mL and no transfusion. Multimodal analgesia consisted of paracetamol, ketoprofen, and titrated morphine. The patient was extubated immediately at the end of surgery. The postoperative course was uneventful, and she was discharged from the intensive care unit on postoperative day 1.

4 DISCUSSION

Posterior spinal fusion for AIS presents several anesthetic challenges. The principal goals are to maintain adequate spinal cord perfusion, minimize blood loss, facilitate reliable neurophysiological monitoring, and enable prompt postoperative neurological assessment [1,2].

In both patients, we used TIVA with propofol and fentanyl. TIVA is commonly used when MEP monitoring is required because intravenous anesthetic techniques can provide favorable conditions for reliable MEP recording, whereas volatile anesthetics can suppress evoked-potential amplitudes in a concentration-dependent manner [1,3]. Nevertheless, anesthetic effects on intraoperative neurophysiological monitoring (IONM) are multifactorial, and signal interpretation should also account for physiologic variables and technical factors. Neuromuscular blocking agents are generally limited after induction when MEP monitoring is required because residual blockade can attenuate or abolish MEP responses; quantitative TOF monitoring is therefore useful [4,5].

Fentanyl was the primary opioid used in our patients because remifentanyl was not available. Remifentanyl is often selected because of its short context-sensitive half-time and predictable offset. However, fentanyl can also be used when administered in appropriately titrated doses, with careful attention to hemodynamics, anesthetic depth, and recovery [3,5].

Neurophysiological monitoring is an important component of complex spine surgery. MEPs provide information about corticospinal motor pathway function, whereas SSEPs primarily assess sensory pathway function. Their combined use provides complementary information for detecting possible intraoperative neurological compromise [2,4,5]. In our patients, MEP and SSEP recordings remained stable throughout surgery, with no reported intraoperative neurophysiological evidence of spinal cord compromise. Interpretation of these signals, however, requires attention to anesthetic depth, arterial pressure, oxygenation, temperature, technical factors, and other physiologic variables that may affect signal quality [5].

Blood-loss control is another central objective. Blood loss varies according to curve characteristics, the number of fused levels, surgical technique, and operative duration. Blood-conservation strategies include tranexamic acid, maintenance of normothermia, appropriate hemodynamic management, cell salvage when available, and an individualized transfusion strategy [1,6]. In our patients, tranexamic acid was administered as part of this strategy. Meta-analyses support the efficacy of tranexamic acid in reducing blood loss and transfusion requirements in AIS surgery, although the optimal dose remains uncertain and the available evidence is heterogeneous [6–8]. Recent randomized evidence does not establish a clear superiority of high-dose over low-dose regimens, supporting an individualized approach to dosing.

Postoperative analgesia is an important component of recovery after posterior spinal fusion. Multimodal analgesia combining nonopioid analgesics with appropriately titrated opioids can reduce opioid exposure and facilitate recovery. Nonsteroidal anti-inflammatory drugs may be incorporated when clinically appropriate and when there are no contraindications. Multimodal analgesia is also a component of contemporary enhanced recovery pathways for AIS surgery [9].

Finally, successful management of these procedures relies on close collaboration among orthopedic surgeons, anesthesiologists, neurophysiology teams, nursing staff, and intensive care teams. Continuous communication is essential when hemodynamic or neurophysiological changes occur and facilitates prompt investigation and intervention. Such multidisciplinary coordination is a central component of safe perioperative care.

5 CONCLUSION

These two cases illustrate a perioperative strategy combining TIVA, multimodal neurophysiological monitoring, blood conservation, and multimodal analgesia. Both patients had stable intraoperative neurophysiological recordings, were extubated early, and did not require blood transfusion. Because this is a two-case report, these observations cannot establish the superiority or causal effectiveness of any individual component of the anesthetic strategy.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare that no competing interests exist.

Statement of informed consent

Written informed consent was obtained from the parents of both patients for the publication of these case reports.

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