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Dexmedetomidine as an Adjunct in Anesthesia for Adolescent Idiopathic Scoliosis (AIS) Surgery: A Case Series

[*)]Eko Nofiyanto, [**)]Radian Ahmad Halimi, [**)]Iwan Fuadi, [**)]Iwan Abdul Rachman
[*)]Department Anesthesiology and Intensive Care, Medical Faculty, Universitas Brawijaya, General of Horpital Dr. Saiful Anwar, Malang, [**)]Department Anesthesiology and Intensive Care, Medical Faculty, Universitas Padjadjaran, General of Horpital Dr. Hasan Sadikin, Bandung
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correspondence: anestesiekonof@gmail.com

Abstract

Scoliosis is a spinal curvature deformity >10°, with Adolescent Idiopathic Scoliosis (AIS) affecting those aged 10-18 years. The global prevalence of AIS is between 1%-2%, while in Indonesia, it stands at 2,93%, with a female-to-male ratio of 4.7:1. Perioperative challenges include nerve damage, bleeding, and postoperative pain. Neuromonitoring (MEP and SSEP) helps prevent injury, while careful drug selection supports spinal protection. Three female patients scoliosis reconstructions were performed under general anesthesia. All received target- controlled infusion (TCI) propofol, dexmedetomidine, and fentanyl, with stable hemodynamics and no neurological changes post-surgery. Epidemiological data showed that AIS predominantly affects females. The study included patients with curve progression impacting activity, with no motor or sensory abnormalities observed. Anesthesia was induced with propofol TCI (4 µg/mL) and dexmedetomidine (0.3-0.7 mcg/kg/hr), reducing propofol and opioid use. Dexmedetomidine targets α2-adrenergic receptors, reducing sympathetic outflow, stabilizing hemodynamics, blocking pain transmission, and improving recovery by reducing blood loss and inflammation. Dexmedetomidine provides sedation, analgesia, and stable hemodynamics in scoliosis surgery, minimizing blood loss and transfusion needs. It supports neurophysiological monitoring, reduces postoperative pain, and enhances recovery.

Keywords: Adolescent idiopathic scoliosis, dexmedetomidine, hemodynamic, neurophysiological monitoring, spinal protection

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Introduction

Scoliosis is defined as a deformity of the curvature of the spine > 10° seen from the frontal position.[1] Adolescent idiopathic scoliosis (AIS) is a type of scoliosis in patients aged 10–18 years. The exact cause is still uncertain, but some theories suggest it may be due to genetic factors, connective tissue abnormalities, musculoskeletal abnormalities, and other biomechanical factors.[2] The prevalence of AIS in the world ranges from 1–2% of the population. Women experience AIS more than men with a ratio of 1.5:1.1 In a study in Surabaya, Indonesia, the prevalence of AIS was 2.93%, with female and male patients at 4.7:1.3. Clinical manifestations vary from asymptomatic, cardiopulmonary symptoms and neurological disorders, chronic back pain, musculoskeletal pain, physical activity limitation, decreased respiratory function. These physical appearance abnormalities have an impact on psychosocial disorders in the school environment, difficulty in activities, decreased self-confidence, depression to psychological stress.[2,3] Interventions are carried out by wearing a scoliosis brace to improve physical posture, and periodic radiological evaluation. However, 15% of AIS cases experience progressive progression so that surgical procedures are needed for

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correction and reconstruction.[4] Significant increases in curves can be resulted in ventilation/perfusion (V/Q) mismatching, respiratory failure and cor pulmonale, which will be a challenge for perioperative management of anesthesia.[4,5] Surgery can cause mechanical injuries due to excessive distraction. Nerve damage will directly become a primary spinal injury, while blood vessels damaged due to over distraction will cause ischemic in the spine.[5] The impact of this damage will be resulted in acute spinal injury, but it is found that 0.35% – 4% of cases of complications in the form of delayed postoperative neurological deficits (DPND) appear.[4,6]

Spinal protection is a series of measures to minimize the occurrence of secondary spinal injuries.[5] Spinal protection is carried out perioperatively, including preoperative preparation, paying attention to the patient's physical condition, during surgery, attention to the airway, optimal patient position, hemodynamics, fluid management, using neurophysiological monitoring, and postoperative attention to the timing for extubation and multimodal analgesia.[5] The use of neuromonitoring in the form of motor evoked potential (MEP) and somatosensory evoked potential (SSEP) monitoring functions to mitigate the occurrence of injuries during surgical procedures so that corrections can be made immediately.[7] The use of wake up tests as neurological evaluations has begun to be abandoned because of its limitations in not being able to identify neurological deficits quickly and potentially delaying response, as well as the risk of causing extubation.[8] Spinal protection also pays attention to the choice of drugs that have an impact on the prevention of secondary spinal injuries and anesthetic drugs that support neuromonitoring measures.[9] In this case report, the role of dexmedetomidine as an adjunct anesthesia that supports spinal protection of scoliosis reconstruction surgery in 3 AIS patients in achieving good recovery outcomes.

Case 1

Anamnesis

A 20-year-old female, weighing 44 kg, 159 cm tall, BMI 17.4 kg/m2 with a diagnosis of Adolescent Idiophatic Scoliosis Lenke 6C (N) Cobb angle 75° and Risser V underwent a scoliosis reconstruction procedure. A history of asthma with cold air and dust triggers was obtained, complaints were reduced with salbutamol. The patient complained that the back looked crooked which was felt since 4 years ago, the complaint was also accompanied by mild back pain since 1 year ago disappeared, the pain complaint was felt aggravated only during activities.

Physical examination

It was obtained that the airway was patented, spontaneous breathing, breath frequency 18x/minute, SpO_2 98% of the air space, vesicular breath sound +/+, no ronkhi or wheezing was obtained, evaluation of mallampati 2, mouth opening 3 fingers, thyromental distance of 6 cm, neck flexi movement and free extension. Red dry warm akral, CRT < 2 seconds, blood pressure 91/63 mmHg, pulse frequency 80x/min, regular pulse strong lift, single S1/S2. GCS 456, sensory and motor normal without deficits, without pathological reflexes.

Table 1. Laboratory result 1st case

Hemoglobin	15.2 g/dL
Leucocytes	8,900/µL
Hematocrit	46.8%
Platelets	233,000/µL
Sodium	134 mmol/L
Potassium	4.00 mmol/L
Chloride	102 mmol/L
Hemostatic	In the normal range PPT 10.8/11.0 INR 1.04 APTT 32.4/24.0
Albumin	5.12 g/dL
SGOT	27 U/L
SGPT	14 U/L
Ureum	16.6 mg/dL
Creatinine	0.52 mg/dL

Supporting examination

Radiological results of scoliosis view and AP

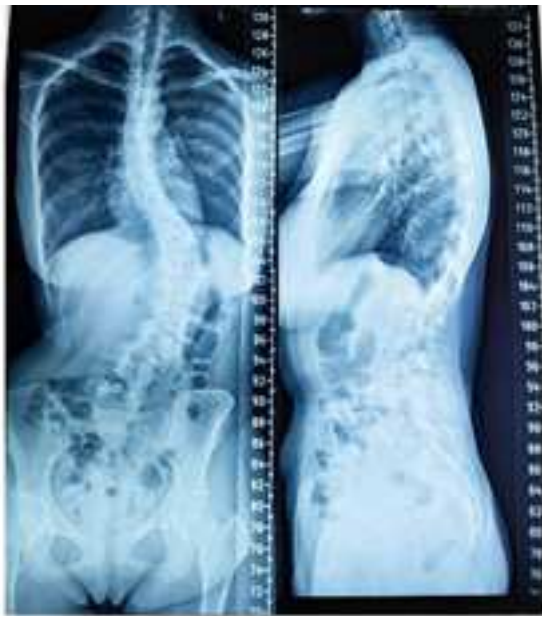

Figure 1. Preoperative Radiology 1st Case

pelvis were obtained dextroscoliosis thoracal, levoscoliosis thoracolumbal, structural, thoracal modifier (N), lumbar modifier C, coronal balance (-), Sagital Balance (+), Ossification Risser type V. Spirometry examination results obtained a mixed diagnosis, FEV1/FVC 33.8%, FEV1 16.3%, COPD classification with very severe COPD Stage IV, TV 220 ml. The patient was assessed as ASA 3, moderately mild persistent asthma controlled, dextroscoliosis main thoracal angle Cobb 75°, COPD severe stage IV.

Anesthesia Management

In the preoperative phase, IV preremedication of Ranitidin 50 mg, Metoclopramide 10 mg, methylprednisolone 62.5 mg was given, salbutamol nebulization was carried out at night before surgery. Preemptive analgesics were administered IV metamizole 1 g. a hemodynamic monitor and a bispectral index (BIS) monitor were installed prior to induction. Anesthesia induction was performed with TCI propofol schneider mode 4 µg/mL, sedation with loading dexmedetomidine 1 mcg/kgbb in 10 minutes followed by maintenance of 0.3 mcg/kgbb/hour. Analgesic with fentanyl 100 mcg, intubation facilitation was used muscle relaxant rocuronium 50 mg. After intubation, ventilation control was carried out through an anesthesia machine with a pressure control target tidal volume of 220 ml (5–8 ml/kgbb). CVC in the subclavia dextra, arterial line in the radial artery dextra. Intraoperative Monitoring for SSEP and MEP evaluation is installed by the neurologist. The patient was positioned in a prone position with attention to the emphasis on the soft organs of the eye, positioning the neck without hyperreflexion-extension, evaluating the achievement of ventilation targets, and installing pads on areas that are potentially injured due to pressure. The evaluation of SSEP and MEP was carried out at the beginning to determine the baseline. TCI Propofol 4-5 µg/mL, intravenous Dexmedetomidine 0.3-0.7 mcg/kgbb/hour, and continuous fentanyl 50 mcg/hour as anesthesia maintenance with BIS-guided anesthesia depth with a target of 25–40 during surgery. Scoliosis reconstruction was carried out with an operation duration of 6 hours, bleeding 1000 cc, urine 1200 cc, intravenous fluid was given a total lactate ringer of 1500 cc, and PRC 480 cc. Hemodynamics during surgery were stable without periods of hypotension or shock. IOM evaluation, monitoring process without a period of SSEP and MEP wave disappearance and confirmed no change from baseline.

Post-surgical Management

After the surgery was completed, the patient was positioned supine and anesthesia was terminated. Evaluation of adequate spontaneous ventilation without a period of desaturation and tachypneu, so extubation was carried out, then post-operative care was carried out in the ICU. Physical examination in ICU, patent airway, spontaneous breathing, breath rate 18x/min, SpO_2 98% O_2 nasal 2–3 L/min, symmetrical chest wall movement, vesicular +/+ without ronkhi and wheezing, red dry warm acral, CRT < 2 seconds, blood pressure 102/61 mmHg (MAP 75), pulse rate 62x/min, regular strong lift, single S1/S2. GCS 456, without neurological deficits, was fitted with a 600 cc/6 hour urine catheter, 2.2 cc/kgbw/hour urine production. From the postoperative support examination, laboratory results were obtained Hb 9.5 g/dL, leukocytes 15,400/µL, hematocrit 29.4%, platelets 166,000/µL, sodium electrolyte 136 mmol/L, potassium 4.18 mmol/L, chloride

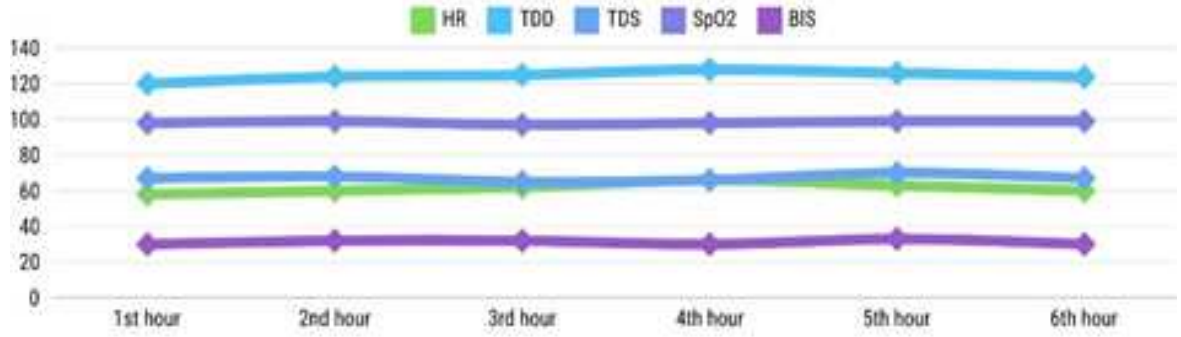

Figure 2. Hemodyna mic monitoring I[st] case

105 mmol/L, albumin 2.83 g/dL, urea 12.2 mg/dL, creatinine 0.31 mg/dL. Medica mentosa was given IV tranexamic acid 500 mg/8 hours for 24 hours, IV ondansentron 4 mg/12 hours, analgesic IV Paracetamol 1 gr/8 hours and continuous dexmedetomidine 0.3 mcg/kgbb/hour. Evaluate pain with an NRS of 0-1 for 24 hours in the ICU and without any change in neurological status.

Case 2

Anamnesis

A 27-year-old female, weighing 50 kg, 160 cm tall, BMI 19.5 kg/m2 with a diagnosis of Adolescent Idiophatic Scoliosis Lenke 3B (N) Cobb angle 96° and Risser V underwent a scoliosis reconstruction procedure. No history of allergies or other diseases was obtained. Patient complained of asymmetrical backs since 16 years ago, accompanied by back pain during activity and sitting positions. Shortness of breath was complained to be disappearing during activities and rest.

Figure 1. Preoperative Radiology 1st Case

Physical examination

It was obtained that the airway was patented, spontaneous breathing, breath frequency 18x/minute, SpO_2 98% of the air space, vesicular breath sound +/+, no ronkhi or wheezing was obtained, evaluation of mallampati 2, mouth opening 3 fingers, thyromental distance of 6 cm, neck flexi movement and free extension. Red dry warm core, CRT < 2 seconds, blood pressure

Table 2. Laboratory result 2nd case

Hemoglobin	15.3 g/dL
Leucocytes	8.220/µL
Hematocrit	43.6 %
Platelets	323.000/µL
Sodium	134 mmol/L
Potassium	4.00 mmol/L
Chloride	102 mmol/L
Hemostatic	In the normal range PPT 10.7/11.1 INR 1.03 APTT 28.7/24.7
Albumin	3,88 g/dL
SGOT	16 U/L
SGPT	18 U/L
Ureum	18.5 mg/dL
Creatinine	0.68 mg/dL

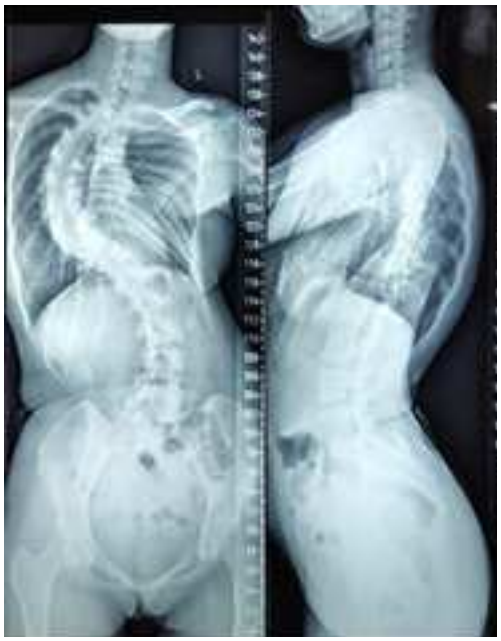

Figure 4. Perioperative Radiology 2nd Case

117/79 mmHg, pulse frequency 97x/min, regular pulse strong lift, single S1/S2. GCS 456, sensory and motor normal without deficits, without pathological reflexes.

Supporting examination
Radiological results of scoliosis view and AP pelvis were obtained dextroscoliosis thoracolumbal (major), structural, thoracal modifier (N), lumbar modifier A, Coronal Balance (+), Sagital Balance (-), Ossification Risser type V.
Spirometry examination results obtained a diagnosis of moderate restriction, FEV1/FVC 78.3%, FEV1 29.6%, COPD classification with moderate COPD stage II. TV 340 ml. The patient was assessed as ASA 3, dextroscoliosis main thoracal angle Cobb 96°, COPD moderate stage II.
Anesthesia management
In the preoperative phase, IV refinement of ranitidin 50 mg, metoclopramide 10 mg was given. Preemptive analgesics are administered IV paracetamol 1 g. A hemodynamic monitor and a bispectral index (BIS) monitor are installed prior to induction. Anesthesia induction was performed with TCI propofol schneider mode 4 µg/mL, sedation with loading dexmedetomidine 1 mcg/kgbw in 10 minutes followed by maintenance of 0.3 mcg/kgbw/hour. Analgesic with fentanyl 100 mcg, intubation facilitation is used muscle relaxant atracurium 25 mg. After intubation, ventilation control was carried out through an anesthesia machine with a pressure control target tidal volume of 340 ml (5–8 ml/kgbw). CVC in the subclavia dextra, arterial line in the radial artery of the sinistra. Intraoperative monitoring for SSEP and MEP evaluation was installed by the neurologist.

The patient was positioned in a prone position with attention to the emphasis on the soft organs of the eye, positioning the neck without hyperreflexion-extension, evaluating the achievement of ventilation targets, and installing pads on areas that were potentially injured due to pressure. The evaluation of SSEP and MEP was carried out at the beginning to determine the baseline. TCI propofol 4–5 µg/mL, intravenous dexmedetomidine 0.3–0.7 mcg/kgbb/hour, and continuous fentanyl 50 mcg/hour as anesthesia maintenance with BIS-guided anesthesia depth with a target of 25–40 during surgery. Scoliosis reconstruction was carried out with an operation duration of 10 hours,

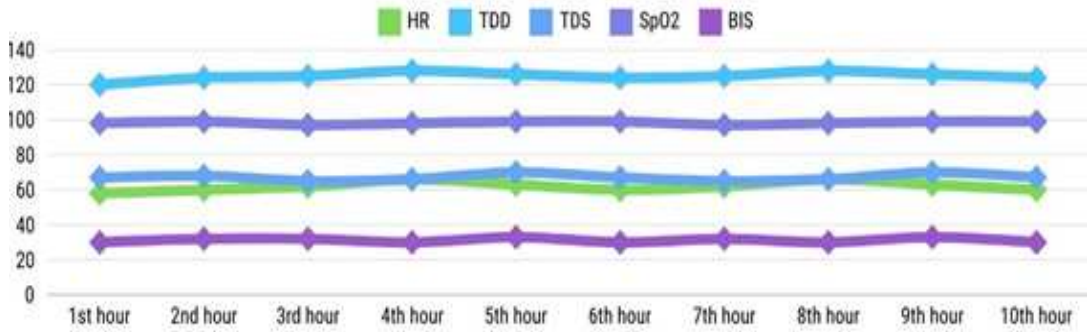

Figure 4. Hemodynamic Monitoring 2nd Case

bleeding 1800 cc, urine 1000 cc, intravenous fluid was given a total lactate ringer of 1500 cc, and PRC 520 cc. Hemodynamics during surgery were stable without periods of hypotension or shock. IOM evaluation, the monitoring process without a period of SSEP and MEP wave loss and confirmed no change from the baseline.

Post-surgical Management

After the surgery was completed, the patient was positioned supine and anesthesia was terminated. Evaluation of adequate spontaneous ventilation without a period of desaturation and tachypneu, so extubation was carried out, then post-operative care was carried out in the ICU. Physical examination in ICU, patent airway, spontaneous breathing, respiratory rate 18x/min, SpO_2 98% O2 simple mask 5-6 L/min, symmetrical chest wall movement, Vesicular +/+ without ronkhi and wheezing, red dry warm acral, CRT < 2 seconds, blood pressure 86/58mmHg, pulse rate 76x/min, regular strong lift, single S1/S2. GCS 456, without neurological deficits, was fitted with a 500 cc/6 hour urinary catheter, 1.5 cc/kgbb/hour urine production. From the postoperative support examination, laboratory results were obtained Hb 9.9 g/dL, leucocytes 18,050/µL, hematocrit 30.5%, platelets 149,000/µL, sodium electrolytes 139 mmol/L, potassium 4.25 mmol/L, chloride 109 mmol/L, albumin 2.17 g/dL, urea 13.4 mg/dL, creatinine 0.47 mg/dL. Medica mentosa was given IV tranexamic acid 500 mg/8 hours for 24 hours, IV ondansentron 4 mg/12 hours, transfuse albumin 20% 100 ml, analgesic IV paracetamol 1 gr/8 hours and continuous dexmedetomidine 0.3 mcg/kgbw/hour. Pain evaluation with NRS 1-2 for 24 hours in the ICU and without change in neurological status.

Case 3

Anamnesis

A 16-year-old female, weighing 35 kg, 150 cm tall, BMI 15.5 kg/m2 with a diagnosis of Adolescent Idiophatic Scoliosis Lenke 2B (N) Cobb angle 60° and Risser IV underwent a scoliosis reconstruction procedure. No history of allergies or other diseases was obtained. The patient complained of a crooked back that he realized since 3 years ago, accompanied by back pain during long activities, without complaints of shortness of breath.

Physical Examination

It was obtained patent airway, spontaneous breathing, breath frequency 18x/min, SpO_2 98% of the air space, vesicular breathing sound +/+, no ronkhi or wheezing obtained, evaluation of mallampati 1, mouth opening 3 fingers, thyromental distance 6 cm, neck flexi movement and free extension. Red dry warm akral, CRT < 2 seconds, blood pressure 114/77 mmHg,

Table 3. Laboratory result 3rd case

Hemoglobin	13.7 g/dL
Leucocytes	6.840/µL
Hematocrit	41.1%
Platelets	340.000/µL
Sodium	133 mmol/L
Potassium	4.40 mmol/L
Chloride	103 mmol/L
Hemostatic	In the normal range PPT 11.2/11.1 INR 1.08 APTT 35.1/23.2
Albumin	4.48 g/dL
SGOT	20 U/L
SGPT	8 U/L
Ureum	23.5 mg/dL
Creatinine	0.53 mg/dL

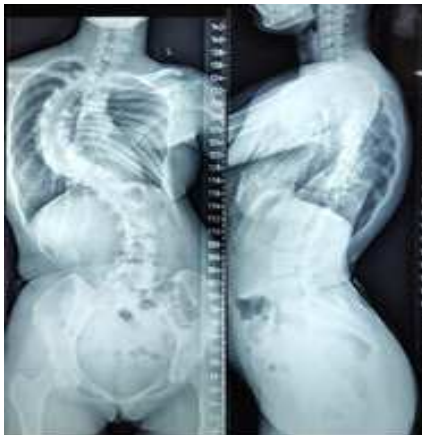

Figure 6. Preoperative Radiology 3rd Case

pulse frequency 83x/min, regular pulse strong lift, single S1/S2. GCS 456, sensory and motor normal without deficits, without pathological reflexes.

Supporting examination
Radiological results of scoliosis view and AP pelvis were obtained for thoracolumbal dextroscoliosis (major), non-structural, thoracal modifier (N), lumbar modifier C, coronal balance (N), sagital balance (N), type III Risser ossification. The results of the Spirometry examination were normal, FEV1 74%, FEV1/FVC 87.7%. The patient was assessed as ASA 2, Dextroscoliosis main thoracal Cobb angle 60°.

Anesthesia management
In the preoperative phase, IV refinement of Ranitidin 50 mg, Metoclopramide 10 mg was given. Preemptive analgesics were administered IV Paracetamol 1 g. a hemodynamic monitor and a bispectral index (BIS) monitor are installed prior to induction. Anesthesia induction was performed with TCI propofol schneider mode 4 µg/mL, sedation with loading dexmedetomidine 1 mcg/kgbb in 10 minutes followed by maintenance of 0.3 mcg/kgbb/hour. Analgesic with fentanyl 70 mcg, intubation facilitation was used muscle relaxant atracurium 20 mg. After intubation, ventilation control was carried out through an anesthesia machine with pressure control of a tidal volume target of 5–8 ml/kgbb. CVC in the subclavia dextra, arterial line in the radial artery dextra. Intraoperative Monitoring for SSEP and MEP evaluation was installed by the neurologist.

The patient was positioned in a prone position with attention to the emphasis on the soft organs of the eye, positioning the neck without hyperreflexion-extension, evaluating the achievement of ventilation targets, and installing pads on areas that were potentially injured due to pressure. The evaluation of SSEP and MEP was carried out at the beginning to determine the baseline. TCI propofol 4–5 µg/mL, intravenous dexmedetomidine 0.3–0.7 mcg/kgbw/hour, continuous fentanyl 50 mcg/hour as anesthesia maintenance with BIS guided anesthesia depth with a target of 25–40 during surgery. Scoliosis reconstruction was carried out with an operation duration of 8 hours, bleeding 900 cc, urine 1000 cc, intravenous fluid was given a total lactate ringer of 1500 cc, and PRC 450 cc. Hemodynamics during surgery were stable without periods of hypotension or shock. IOM evaluation, the monitoring process without a period of SSEP and MEP wave loss and confirmed no change from the baseline.

Post-surgical management
After the surgery was completed, the patient was positioned supine and anesthesia was terminated. Evaluation of adequate spontaneous ventilation without a period of desaturation and tachypneu, so extubation was carried out, then post-operative care was carried out in the ICU. Physical examination in ICU, patent airway, spontaneous breathing, respiratory rate 18x/min, SpO_2 98% O_2 nasal cannula 3 L/min, symmetrical chest wall movement, Vescicular +/+ without ronkhi and wheezing, red dry warm acral, CRT < 2 seconds, blood pressure 97/63 mmHg, pulse rate 96x/min, regular strong lift, single S1/S2. GCS 456, without neurological deficit, urine production is 2.1 cc/kgbw/hour. From the postoperative support examination, laboratory results were obtained Hb 13.7 g/dL, leucocytes 13,550/µL, hematocrit 41.5%, platelets 210,000/µL, sodium electrolyte 144 mmol/L, potassium 3.69 mmol/L, chloride 101 mmol/L, albumin 3.46 g/dL, medika mentosa given IV tranexamic acid 500 mg/8 hours for 24 hours, IV ondansentron 4 mg/12 hours, analgesic IV paracetamol 750 mg/8 hours and continuous dexmedetomidine 0.3 mcg/kgbw/hour. Pain evaluation with NRS 1–2 for 24 hours in the ICU and without change in neurological status.

Discussion

From the series of cases in 3 AIS patients, observation of spinal protection measures was carried out starting from preoperative management by understanding the patient's history, patient diagnosis, action plan carried out by the surgeon, and preparation for anesthesia. Anesthesia management begins with premedication, induction of anesthesia, maintenance of anesthesia, occurrence of durante

surgery, neuromonitoring and termination of anesthesia. Postoperative management observes hemodynamics, pain scales and postoperative neurological outcomes.

The three patients are female with the age of 16-27 years, according to epidemiological data, there are more women than men, while AIS patients are in the age category of 10-18 years.[1] The 27-year-old patient had been diagnosed with AIS since the age of 11 with a history of progression curve that interfered with activity.

Physical complaints during activities are important information to be followed up on physical examinations and support, in all patients there are complaints of back pain and some express shortness of breath during activities. The history of previous diseases is also explored to anticipate comorbidities such as asthma with perioperative management to prevent acute exacerbations. In the physical examination, an evaluation was carried out of intubation difficulties in the airway, arena, limitations in flexion and neck extension, ventilation disorders, and hemodynamics. Examination of neurological deficit symptoms before surgery is important as a basis for evaluating changes in neurological status after surgery. In all three patients, no motor or sensory abnormalities were obtained. Laboratory support examinations obtained normal values with hemoglobin values of >8 g/dL as a reference in anticipating surgical bleeding durante, where AIS reconstruction surgery has the potential for massive bleeding so that blood product preparation is carried out according to estimated blood volume and allowed blood loss patient.

Radiological support examinations were obtained in all three cases with a dextroscoliosis curve of >30°, including severe scoliosis, so an evaluation of pulmonary function was required. The results of the spirometry examination showed varying results, in case 1 the patient experienced severe COPD and a mixture of restriction and pulmonary obstruction, this is because the patient has comorbid asthma with severe dextroscoliosis, thus the patient's ventilation management adjusts to his physiological condition with the target tidal volume according to physiological. In case 2, the spirometry results showed moderate retraction with moderate COPD, in accordance with the physical condition of frequent tightness during activity. While case 3 with normal spirometry results. However, overall the three patients did not experience respiratory function disorders. In AIS, although the results of the examination showed that the condition varied, the respiratory function in general was not disturbed because the strength of the respiratory muscles did not decrease in function.[10]

In AIS surgery, anesthesia management has 2 purposes, namely to provide spinal protection to prevent secondary spinal injuries and facilitate intraoperative neuromonitoring (IOM) as a means of mitigating nerve damage due to decompression during surgery. Spinal protection is necessary because secondary spinal injuries have a poor prognosis for neurological status recovery conditions. Secondary spinal injuries can appear during surgery or appear 3–6 days after surgery. Some of the theories underlying the occurrence of secondary spinal injury include decreased perfusion in the microvascular, accumulation of neurotransmitters that contribute to excitotoxic cell injury, homeostasis ion dysregulation, release of arachidonic acid, free radicals and lipid peroxidation, edema and inflammation5. Some of these things contribute to nerve damage in the spinal medulla with the presence of ischemic zones in the spine. The surgical process itself will interfere with spinal cord blood flow. So that the target of anesthesia management to protect the spinal includes the management of the airway that is always free all the time, maintaining normoxemia, and normocapnia because arterial blood gas will have the same impact as in the brain if hypoxemia and hypercapnia will occur vasodilation, while hypocapnia will cause vasoconstriction.

Maintain spinal blood flow with a MAP range of 60–120 mmhg to keep spinal autoregulation normal. However, it is necessary to anticipate the occurrence of massive bleeding durante surgery. Using anesthetic drugs that keep the hemodynamics stable so that it has a

neuroprotective effect. The prone position still pays attention to the condition of preventing compression in the abdomen to reduce pressure on the vena cava, and compression on the thorax to facilitate good ventilation and reduce excessive pressure on the airway as well as adverse effects on cardiac output. Induction of anesthesia using propofol TCI with schneider mode with an effect concentration target of 4 μg/mL is expected not to decrease hemodynamics but can achieve the desired depth of anesthesia. The use of BIS is intended to observe the depth of anesthesia according to the effect of propofol with a target of BIS 25–40. The combination with dexmedetomidine 0.3–0.7 mcg/kgbb/hour is expected to reduce the dose of propofol during anesthesia maintenance and reduce the use of opioids during surgery with the sparring opioid effect of dexmedetomidin.[11] Fluid management is carried out by the use of crystalline fluids. Meanwhile, the use of blood products is in accordance with bleeding due to surgical wounds. During surgery in the 3 patients above, hemodynamic stability data was obtained with a MAP range of 70–90 mmHg.

In the management of anesthesia to facilitate IOM, some attention is needed to drugs and conditions that can suppress SSEP and MEP waves.12 In this surgery, we used intravenous drugs propofol, dexmedetomidine, fentanyl and rocuronium. Intravenous propofol provides excellent conditions in neuromonitoring, where the effect depends on the dose. Propofol was given continuously to ensure adequate levels of the drug in the patient's body. The administration of bolus can have an impact on the potential evoked wave (EP) response. Total control infusion (TCI) is an option to be used with depth of anesthesia monitoring (BIS) to achieve the desired effect and sufficient hypnotic level during surgery.[12] Dexmedetomidine has no effect on SSEP and MEP and is therefore often used with the TIVA technique to reduce the dose of propofol and as a sparring opioid.[11]

Dexmedetomidine is a selective alpha-2 agonist that has sympatholytic, anxiolytic and analgesic effects without the effects of respiratory depression thereby reducing the need for opioids.[11] Opioids do not suppress SSEP and MEP if given continuously, but EP will be affected if given bolus. Inhalation drugs are not used because they have a suppressive effect on MEPs and reduce the amplitude of SSEP.[12] Meanwhile, muscle relaxants are only used when facilitating intubation. From the three patients, optimal results were obtained without disturbances in the neuromonitoring process.

The termination of anesthesia is carried out after all surgical processes have been completed and the patient is repositioned supine. In the three patients, extubation was carried out with consideration of the results of spirometry, respiratory function did not experience severe disorders that required mechanical ventilation, evaluation of respiratory function was carried out before deciding on extubation, it appeared that the three patients were able to perform spontaneous breathing adequately and the hemodynamic condition was good even though there was a lot of bleeding. Postoperative care in the ICU takes into account the duration of the operation >6 hours, and the evaluation of the occurrence of neurological deficits. Multimodal analgesia is given in combination with paracetamol or metamizole with continuous dexmedetomidine, to prevent the occurrence of chronic pain. Opioids are only given as rescue analgesics in postoperative management.[9] In the three patients, an evaluation of the pain scale was obtained no more than NRS 5 so that no opioids were given. Evaluation of neurological status also did not change from preoperative.

Dexmedetomidine targets α2-adrenergic receptors in the CNS and reducing sympathetic outflow, lowering norepinephrine release, contributing to controlled hypotension during surgery. Dexmedetomidine inhibits glutamate release, stabilizes neuronal excitability, and enhances neuroprotection. Dexmedetomidine reducing inflammation and apoptosis, maintain hemodynamic stability, lowering blood loss and improving postoperative hemoglobin level.[13] Dexmedetomidine exerts central analgesic effects by activating alpha-2 receptors in the locus

coeruleus, reducing excitatory neurotransmitter release, enhancing inhibitory pain pathways and increasing pain threshold.[14] Peripherally, dexmedetomidine inhibits C-fibers and Aδ-fibers, reducing pain signal transmission.[9] Despite conflicting evidence, dexmedetomidine maintains intraoperative neurophysiological monitoring without suppressing MEP and SSEP.[7]

Conclusion

From the series of cases, it can be concluded that AIS reconstruction surgery is a surgery that has a risk of acute spinal injury or secondary spinal injury. The management of anesthesia that is important in AIS surgery is spinal protection and neuromonitoring facilitation. Spinal protection is a series of anesthetic measures to prevent secondary spinal injuries. Neuromonitoring is utilized to reduce the risk of spinal injuries during surgery, thus requiring anesthesia management that supports and facilitates effective monitoring.

Dexmedetomidine is used as an adjunct in anesthesia for scoliosis surgery, providing sedation and analgesia while minimizing hemodynamic fluctuations during the procedure. It aids in maintaining intraoperative neurophysiological monitoring without adversely affecting motor or sensory evoked potentials. Dexmedetomidine reduced blood loss, in these studies show that dexmedetomidine significantly decreases intraoperative blood loss and transfusion requirements. It effectively reduces postoperative wound pain, enhancing recovery outcomes. Dexmedetomidine promotes stable cardiovascular parameters, minimizing surgical stress response.

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