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ANESTHESIA MANAGEMENT IN PEDIATRIC SCOLIOSIS PATIENTS: A RETROSPECTIVE CLINICAL STUDY

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ABSTRACT

***Introduction*:** Neurological, cardiovascular and respiratory system pathologies are frequently accompanied by pediatric scoliosis surgery. The aim of this retrospective clinical study was to evaluate the demographic characteristics, operation characteristics, and complications associated with anesthesia and surgery in pediatric patients undergoing scoliosis surgery.

Material and Methods: In this study, 33 pediatric patients undergoing elective scoliosis surgery were reviewed retrospectively. Demographic characteristics, surgical procedure data, complications related anesthesia or surgery were examined in terms of anesthesia management. Medications, concomitant diseases, laboratory values, postoperative service and intensive care unit records were obtained from the university database.

Results: The mean age of thirty-three patients was 13.09 ± 2.98 years. Three patients had meningomyelocele and one had neuromuscular disease. 72.7 % of patients (24 patients) have thoracolumbar scoliosis. The duration of anesthesia and surgery was 241.21 ± 55.55 min and 214.84 ± 54.55 min, respectively. The mean number of instrumented level was 10.78 ± 3.54. Blood transfusion was performed in 97 % of the patients (32 patients). All patients were transferred to the intensive care unit in the postoperative period. In each two patients, bradycardia and hypotension were observed. In the perioperative period, the mean blood loss of the patients was 843.93 ± 246.14 mL.

Conclusion: Pediatric scoliosis surgery; is an important orthopedic procedure which may results in serious intraoperative blood loss and postoperative pain and can be accompanied by syndromes, difficult airway management, serious respiratory and circulatory system complications during perioperative and postoperative period. Evaluation of localization and the extent of curvature, length of surgery, concomitant diseases and congenital anomalies are important for the management of anesthesia in patients undergoing pediatric scoliosis surgery.

Key words: Anesthesia management, Pediatric scoliosis, Spinal surgery, Kyphoscoliosis

INTRODUCTION

The curvature of the spine is measured by the Cobb angle and the curvature of more than 10° is considered as scoliosis [(2)]. It is often seen with rotation and causes anatomical changes in the thorax over time. This structural disease is a complex condition that causes rotation of the spine in its axis, so the deformity is not only in the coronal plane but also in axial and sagittal planes. Scoliosis is the most common deformity of the spine. About 80 % of the structural coronal deformities are idiopathic scoliosis. Prevalence of scoliosis is 4 % in the population. It is 4 times more in females [(13)]. Lok et al reported that scoliosis prevalence rate is 1.3-1.5 % in Turkey [(7)].

Neurological, cardiovascular and respiratory system pathologies are frequently associated with pediatric patients undergoing scoliosis surgery. Difficult airway management, invasive arterial and central venous monitoring difficulties, long-term surgery, intraoperative blood loss, neurologic deficits secondary to surgery and severe postoperative pain are challenging both anesthesiologists and surgeons during surgery [(3)]. Due to the accompanying comorbidities, preoperative evaluation,

perioperative follow-up and postoperative care are important and serious in this patient group. The aim of this retrospective clinical study was to evaluate the demographics, operation characteristics, and complications related to the anesthesia and surgery in pediatric patients undergoing scoliosis surgery.

MATERIAL AND METHODS

In this study, 33 pediatric patients undergoing elective scoliosis surgery between January 2015 and January 2018 in Inonu University Medical Faculty operating room were reviewed retrospectively. Demographic characteristics, surgical procedure data, complications related to anesthesia or surgery and hospital records were reviewed. Medications, comorbid diseases and treatments, laboratory values, service and intensive care follow-up information were obtained from the university patient database. This study was prepared with the guidelines of the CONSORT study group [9].

Pediatric patients under the age of 18 undergoing scoliosis surgery were included in the study. Patients with uncontrolled diabetes mellitus, lung disease or cerebrovascular disease and patients without written informed consent or lack of preoperative anesthesia evaluation were excluded from the study.

Premedication was performed with midazolam for all patients except the ones with difficult airway. After the patients were taken to the operation room, heart rate (HR), noninvasive blood pressure (NIBP), electrocardiogram (ECG), peripheral oxygen saturation (SpO2), body temperature measurement and bispectral index (BIS) were performed. Because of the high intraoperative blood loss risk, preoperative blood samples were drawn before the surgery for each patient.

A standard general anesthesia protocol was applied to all patients by an experienced anesthesiologist. After pre-oxygenation (100 % 4 L / min O2, at least 3 min), intravenous (IV) anesthesia induction was performed with propofol (0.5–2 mg / kg), rocuronium (0.4–0.6 mg / kg), and fentanyl (1 µg / kg). After the orotracheal intubation, the patients were ventilated with Dräger Primus anesthesia device (Dräger AG, Lübeck, Germany) with 8 mL / kg tidal volume, 10-24 breathing frequency and 5 mmHg positive end-expiratory pressure (PEEP). End-tidal carbon dioxide (EtCO2) monitoring was performed after intubation. Tidal volume and respiratory frequency were adjusted so that the partial pressure of EtCO2 was between 35-45 mmHg in arterial blood gas analysis. Patients were given 50 % oxygen in the oxygen-air mixture. Since neuromonitoring was applied to scoliosis patients, maintenance of anesthesia was provided by total intravenous anesthesia (TIVA) with propofol and remifentanil infusion at appropriate doses.

Foley catheterization, at least 2 large intravenous catheterization, invasive arterial monitoring to the radial artery, central venous catheterization to the internal jugular or subclavian vein was performed to all patients. Arterial blood gas analysis and hemogram were performed at frequent intervals. Patients were transferred to the intensive care unit with orotracheal intubation after surgery. Postoperative analgesia management of all patients was provided by multimodal analgesia technique with appropriate doses of paracetamol (20 mg / kg, IV) and tramadol (0.5-1 mg / kg, IV).

The duration of anesthesia was defined as the time from admission in operating room until the transfer of the patient to the intensive care unit. The duration of the surgery was defined as the time from the first skin incision until the closure of last skin suture. Mortality indicates the mortality rate associated with anesthesia or surgery during the patient's stay in the hospital.

Data were analyzed using SPSS (Statistical Package for Social Sciences Statistics for Windows, Version 22.0 Software. Armonk, NY: IBM Corp.). Quantitative data were expressed as mean and standard deviation, and qualitative data was expressed as number and percentage. P value less than 0.05 was considered significant.

RESULTS

The mean age of the 33 patients was 14.09 ± 1.98 years. 42.4 % of the patients were male (14 patients) and 57.6% were female (19 patients). ASA scores were I in 51.5 % (17 patients) and II in 48.5 % (16 patients). The Mallampati classification was I in 75.8 % (25 patients) and II in 24.2% (8 patients). Mean hemoglobin value was 12.75 ± 0.66 mg / dL and mean hematocrit value was 37.90 ± 3.50 %. Of the patients, 9.1 % (3 patient) had meningomyelocele and 3 % (1 patient) had neuromuscular disease. Demographics are shown in Table-1.

The scoliosis was at thoracic spine in 24.2 % (8 patients), at lumbar spine in 3 % (1 patient) and at thoracolumbar spine in 72.7 % (24 patients). The duration of anesthesia and surgery was 241.21 ± 55.55 min and 214.84 ± 54.55 min, respectively. The mean number of instrumented level was 12.78 ± 3.54. All of the patients undergoing surgical procedure were followed by invasive arterial monitoring, central venous catheterization, nasogastric catheterization, bladder catheterization with foley catheter and bispectral index (BIS) monitoring to measure the depth of anesthesia. The total consumptions of crystalloid and colloid were 1854 ± 403 mL and 393 ± 102 mL, respectively. Blood transfusion was performed in 97% of the patients (32 patients). All patients were transferred to the intensive care unit in the postoperative period. No mortality occurred during

the hospital stay. The surgical procedure data of the patients are shown in Table-2.

Table-1. Demographics

	Range	Mean±SD
Age (years)	11 – 17	14.09 ± 1.98
Gender (M/F)	-	14/19
ASA, I/II/III/IV, n	-	17/16/0/0
Mallampati Score, I/II/III/IV, n	-	25/8/0/0
Medication, n	-	0
Habits, n	-	0
Hemoglobin, mg/dl	12 – 14	12.75 ± 0.66
Hematocrit, %	26 – 42	37.90 ± 3.50
Comorbid Disease		
Meningomyelocele, n (%)	-	3 (9.1%)
Neuromuscular disease, n (%)	-	1 (3%)

ASA: American Society of Anesthesiology, n: number

Table 2. Surgical procedure data.

	Range	Mean±SD
Scoliosis classification		
Thoracic, n (%)	-	8 (24.2%)
Lumbar, n (%)	-	1 (3%)
Thoracic + Lumbar, n (%)	-	24 (72.7%)
Duration of anesthesia (min)	150 – 420	241.21 ± 55.55
Duration of surgery (min)	140 – 400	214.84 ± 54.55
Instrumented Level, n	7 – 16	12.78 ± 3.54
Invasive arterial monitoring, n (%)	-	33 (100%)
Central venous catheter, n (%)	-	33 (100%)
Nasogastric tube, n (%)	-	33 (100%)
Foley catheter, n (%)	-	33 (100%)
Bispectral Index, n (%)	-	33 (100%)
Total consumption of crystalloid, mL	800 – 2800	1854 ± 403
Total consumption of colloid, mL	200 – 500	393 ± 102
Blood transfusion, n (%)	-	32 (97%)
Admission to the intensive care unit, n (%)	-	33 (100%)
In-Hospital mortality, n (%)	-	0

When the patients were examined in terms of complications, 6.1 % (2 patients) had bradycardia and 6.1 % (2 patients) had hypotension. In the perioperative period, 843.93 ± 246.14 mL bleeding was observed. None of the patients developed hypoxia, neurological deficits and surgical complications. Complications of patients are shown in Table-3.

Table-3. Complications.

	Range	Mean±SD
Bradycardia, n (%)	-	2 (6.1%)
Hypotension, n (%)	-	2 (6.1%)
Hypoxia, n (%)	-	0
Neurological deficit, n (%)	-	0
Blood loss, mL	300 – 1400	843.93 ± 246.14
Surgical complication, n	-	0

DISCUSSION

In this study, demographics, surgical procedure data, and complications related to anesthesia and surgery were reviewed in pediatric patients with scoliosis surgery. In the results obtained from this study; the mean age of the patients was 13, the rate of females was higher, the majority of patients had thoracic or thoracolumbar scoliosis, the duration of anesthesia and surgery were long, the consumptions of crystalloid and colloid were high and almost all patients required serious blood transfusion.

In pediatric patients undergoing scoliosis surgery, respiratory, cardiovascular and neurological systems should be evaluated in detail. In addition to the general airway assessment recommended by ASA, airway evaluation should be performed more carefully due to the anatomic changes in this patient group for difficult intubation. Difficult intubation is frequently accompanied by syndromes, especially in pediatric scoliosis patients [5]. For difficult airways, supraglottic airway vehicles such as video-laryngoscopy, fiberoptic intubation and, if necessary, laryngeal mask airway should be available. ECG should be evaluated with echocardiography due to the restriction effects of the thoracic cage in the preoperative evaluation [6]. In this study, we observed that although the mallampati scores were lower in the preoperative evaluation, detailed airway evaluation was performed for each patient.

Pediatric scoliosis surgery is a long-time surgery and serious blood loss can occur. In addition to standard monitoring, invasive arterial monitoring, central venous catheterization, nasogastric tube, bladder catheterization and BIS monitoring are indispensable in this patient group [3,11]. In addition, arterial blood gas analysis and hemograms should be taken at frequent intervals; blood loss, metabolic status and electrolyte balance provides very important information in the follow-

up [14]. In this study, we observed that all patients undergoing pediatric scoliosis surgery needs extensive monitoring.

In scoliosis surgery, when the main curvature is at the thoracic level, the respiratory system and its functions are severely affected. In particular, anatomical defects occurring in the ribcage cause restriction in lung volume and pulmonary functions [8]. The vital capacity, functional residual capacity and total lung capacity of the respiratory system of pediatric scoliosis patients are decreasing [4]. As the curvature increases, the chest cavity narrows. Especially in curves containing 8 or more thoracic vertebrae, the respiratory system is severely affected [12]. For this reason, pulmonary function tests and arterial blood gas analysis should be performed preoperatively. It will be useful to see the hypoxemia that may occur especially in the perioperative and postoperative periods. In this study, pulmonary function tests and arterial blood gas analysis were performed in all patients and evaluated in detail in terms of respiratory system.

In scoliosis surgery, the incidence of complications in the perioperative and postoperative periods is higher than others. Especially after the surgical interventions of congenital scoliosis, high degree curves or anterior-posterior approaches; severe respiratory system complications such as atelectasis, pleural effusion, and pulmonary edema occur. Prone positioning of patients, prolongation of the intervention time, hypotension, bleeding, acidosis and postoperative analgesia management should be noted [10]. In this study; bradycardia and hypotension were observed in four patients. None of the patients developed hypoxia and neurological deficits. Especially postoperative analgesia management is very important for increasing the quality and comfort of postoperative care [1].

This study has some limitations. First of all this study was based on the data obtained from the anesthesia records and the hospital database. Secondly, all patients consist of cases in a single center. And finally some parameters which is important for anesthesia management could not be reached.

CONCLUSION

Pediatric scoliosis; is an important orthopedic disease that can be accompanied by syndromes, with difficult airway management, with serious respiratory and circulatory system complications during perioperative and postoperative period, which may result in serious intraoperative blood loss and postoperative pain. In patients undergoing pediatric scoliosis surgery, the localization and the extent of curvature, length of surgery, concomitant diseases and congenital anomalies are important for the management of anesthesia.

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