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Who Needs a Pediatric Intensive Care Unit After Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis?

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Abstract

Background: Hypotensive events (HEs) following posterior spinal fusion (PSF) for adolescent idiopathic scoliosis (AIS) can lead to delayed neurologic postoperative deficits (DNPD). This study aimed to determine the incidence of HEs (mean arterial pressure [MAP] <60 mmHg) after PSF for AIS and identify predictors for HEs.

Methods: Medical records of 99 consecutive patients who had PSF for AIS were retrospectively reviewed (2011−2013). Perioperative data were collected. Patients were divided into two groups based on MAP readings by an arterial line in the pediatric intensive care unit immediately postoperatively into postoperative day one: Group 1 (MAP ⩾60 mmHg) and Group 2 (multiple occurrences of MAPs <60 mmHg).

Mean values were compared using the independent *t* test. Multiple logistic regression was used to estimate the association of preoperative and intraoperative parameters with multiple HEs.

Results: Group 1 had 68 patients (68.7%) and Group 2 had 31 patients (31.3%). None of the compared parameters were associated significantly with multiple HE. However, patients who did not exhibit HEs within the first four hours postoperatively remained stable throughout the rest of the postoperative period. Only those with HEs in the first four hours experienced subsequent HEs in the first 24 hours. There were no DNPD or other major complications.

Conclusion: Results showed that the incidence of HEs after PSF in AIS can be as high as 31.3%. We did not find any significant risk factors. Although DNPD after PSF is a rare complication and we had none in this series, we suggest that these patients with multiple HEs may be at risk for DNPD as a result of hypotension and potential for cord ischemia. Therefore, all patients after PSF should be monitored in a pediatric intensive care unit−type environment or postanesthesia recovery room initially. If stable for, at least, the initial four hours, then patients should be good candidates for a less intensive environment.

Level of Evidence: Level 3.

Keywords: Scoliois; AIS; PICU; Hypotension; Posterior; Fusion; DPND; Idiopathic; Adolescent; Spine

Introduction

Posterior spinal fusion (PSF) is the most common approach for the surgical correction of adolescent idiopathic scoliosis (AIS) [1-4]. The overall rate of complication is 5.2%, of which 0.32% involves neurologic complications [5]. Delayed postoperative neurologic deficits (DPND) may develop after corrective spinal deformity surgery. In a recent study, 81 surgeons (23%) experienced at least one DPND in the past 10 years (92 total cases) following spinal deformity surgery [6]. If we assume each

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of these surgeons performed 500 cases over that 10-year period, when there were 92 DPNDs, the incidence of DPND could be close to 0.23%. It is known that hypotension can cause decreased cord perfusion and cause catastrophic neurologic events.

Traditionally, most patients with AIS who underwent spinal fusion were admitted overnight in an intensive care setting for careful monitoring [7]. There is a growing trend to alleviate usage of pediatric intensive care units (PICUs) and utilize short postanesthesia care unit (PACU) stays followed by transfer to a normal surgical floor for immediate postoperative care of patients with AIS to lower costs, improve care, and lower dependency on PICUs [8]. As we strive to decrease dependency on PICUs and PACUs, it is vital that we identify those patients who are at increased risk for developing postoperative hypotensive events (mean arterial pressure [MAP] <60 mmHg), which can predispose patients to DNPD. Decreasing MAP, especially less than 60 mmHg, has been shown to decrease the amplitude of transcranial motor evoked potentials in scoliosis surgery [9].

This study was conducted to determine the prevalence of postoperative HEs and to identify the pre- and intraoperative factors that are significantly associated with hypotensive MAP in the initial postoperative period following PSF for AIS.

Materials and Methods

Following institutional review board (IRB) approval, the electronic health records (EHRs) and radiographs of 99 consecutive patients that underwent PSF for the treatment of AIS were retrospectively reviewed from July 2011 to October 2013. Requirement of written informed consent was waived by IRB. This study was not registered at Clinicaltrials.gov.

All surgeries were performed in a single tertiary care institution by one of two surgeons. All of the patients had general anesthesia with total intravenous anesthesia technique using propofol and remifentanil. In addition to standard ASA (American Society of Anesthesiologists) monitors, blood pressure was continuously monitored with an arterial line. MAP was maintained above 65 mmHg with crystalloids, colloids, and packed red blood cells as indicated. Neuromonitoring with somatosensory evoked potential and motor evoked potential was performed. Surgical technique involved standard open posterior approach to the spine. Constructs were mostly pedicle screws with direct vertebral derotation. Serial hematocrits were measured beginning with the induction of anesthesia and at the end of procedure with arterial blood gas analysis. Following surgery, patients were admitted in the PICU overnight for close hemodynamic monitoring and frequent neurologic examinations. Pain was controlled with a morphine patient-controlled analgesia infusion pump. Each patient was given a 0.5−1.0 mg/hour continuous rate and a 0.5−1.0 mg demand dose every 15 minutes. All patients were transferred to the surgical floor the next day. Blood pressure was continuously monitored by an arterial line during PICU stay and recorded every 5 minutes in electronic health record (EPIC).

Decreasing MAP, especially less than 60 mmHg, can interfere with spinal cord function as shown by decreased intraoperative motor evoked potentials intraoperatively. Therefore, we defined a clinically important HE as an MAP less than 60 mmHg [9] as this correlates with pressures that cause decrease in motor evoked potentials intraoperatively. A total of 99 AIS patients who underwent PSF were divided into 2 groups. Group 1 included patients with postoperative MAP 60 mmHg or higher while in the PICU. Group 2 included patients with multiple occurrences of MAP less than 60 mmHg (two or more) during their first operative day in the PICU. Factors evaluated as possible predictors for postoperative HEs included demographic parameters (age, gender, height, weight, and ASA physical status); preoperative parameters (magnitude of curve and MAP); and intraoperative parameters (levels of vertebrae fused, estimated blood loss [EBL], total volume of crystalloid infused, total morphine dose, change in hematocrit [HCT; from beginning to end of procedure], and duration of surgery).

The statistical analysis was performed by using SAS, version 9.2, statistical software system (SAS, Inc., Cary, NC). Mean values for various clinical characteristics were expressed in mean ± standard deviation. Comparison between the two groups was assessed using the independent *t* test and χ^2 analysis, including Fisher exact tests. Multiple logistic regression was used to estimate the independent association of various operative characteristics to postoperative HEs. p values less than .05 were considered significant.

Source of funding

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Results

There were 68 patients (68.7%) in Group 1 (postoperative MAP ⩾60 mmHg) and 31 patients (31.3%) in Group 2 (multiple occurrences of postoperative MAP <60 mmHg). The incidence of hypotension with multiple occurrences (more than one) was 31.3% (31/99). The sixty-eight patients in Group 1 (17 males, 51 females) had an average age at the time of surgery of 14.2 ± 2.3 years. The average height and weight were 1.6 ± 0.1 m and 57.5 ± 16.1 kg, respectively. Baseline preoperative MAP was 106.4 ± 9.1 mmHg and mean Cobb angle was 56.3° ± 10.6° (Table 1). ASA classifications of 1 (n = 7), 2 (n = 41), and 3 (n = 20) were recorded.

Group 2 included 31 patients (7 males, 24 females) with an average age at the time of surgery of 14.0 ± 2.4