Risk Factors for Postoperative Ileus after Scoliosis Surgery

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Abstract:

Introduction: One complication after scoliosis surgery is ileus; however, few reports have described the frequency of and risk factors for this complication. We conducted a retrospective clinical study with logistic regression analysis to confirm the frequency of and risk factors for ileus after scoliosis surgery.

Methods: After a retrospective review of data from patients who underwent surgical correction of spinal deformity from 2009 to 2014, 110 cases (age range, 4-73 yr; median, 14 yr) were included in the study. We defined postoperative ileus (POI) as a surgical complication characterized by decreased intestinal peristalsis and the absence of stool for more than 3 days postoperatively. Various parameters were compared between patients with POI and those without POI. Logistic regression analysis was performed to assess the risk factors associated with ileus; a P value of <0.05 was considered statistically significant.

Results: Fifteen of 110 (13.6%) cases developed POI. The median height, weight, operation time, and blood loss volume of the patients with versus without POI were 146 versus 152 cm, 39.0 versus 44.0 kg, 387 versus 359 min, and 1590 versus 1170 g, respectively. There were no significant differences between patients with versus without POI in the measured parameters, with the exception of patient height, bed rest period, and presence of neuromuscular scoliosis. Multiple logistic regression analysis revealed neuromuscular scoliosis as a significant risk factor for POI (odds ratio, 4.21; 95% CI, 1.23-14.40).

Conclusions: Our findings indicate a high probability of POI after scoliosis surgery, with an incidence of 13.6%. Neurogenic scoliosis, but not lowest instrumented vertebra or correction rate, was a risk factor for POI after scoliosis surgery. Digestive symptoms should be carefully monitored after surgery, particularly in patients with neuromuscular scoliosis.

Keywords:

Postoperative ileus, Scoliosis surgery, Neuromuscular scoliosis

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Introduction

Scoliosis surgery is increasingly common, and the occurrence of associated postoperative complications has accordingly risen[1)]. Some reports have described postoperative superior mesenteric artery (SMA) syndrome following scoliosis surgery[2,3)], but few have described postoperative ileus (POI).

Distinguishing ileus from SMA syndrome is difficult because both are associated with vomiting and abdominal pain within 1 week postoperatively[3)]. Therefore, it is important to identify risk factors for POI after scoliosis surgery. The actual incidence of and risk factors for POI after scoliosis surgery are unclear. In this study, we analyzed the incidence of and associated risk factors for POI after scoliosis surgery.

Materials and Methods

In this single-center study, we retrieved data from our hospital database for all patients who underwent surgical correction of spinal deformity at our institution from 2009 to 2014. A total of 110 cases underwent surgical correction of spinal deformity. All records were reviewed; patients who did not meet the criteria for POI were excluded from the

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Table 1. Demographic Data.

Factor	Ileus (+)	Ileus (-)	P value
Patients	15 (13.6)	95 (86.4)	
Age (years)	14 (12-17)	15 (12-20)	0.45
Height (m)	1.46 (1.38-1.50)	1.52 (1.42-1.59)	0.04
Weight (kg)	39.0 (28.5-45.8)	44.0 (34.1-51.3)	0.13
Body mass index (kg/m^2)	17.1 (15.0-21.4)	18.5 (16.4-20.6)	0.60
Preoperative Cobb angle (°)	59.0 (49.5-97.0)	58.0 (50.0-76.9)	0.27
Postoperative Cobb angle (°)	20.0 (16.5-30.0)	21.0 (12.0-38.7)	0.99
Correction rate (%)	70.7 (56.4-73.9)	60.0 (38.4-74.6)	0.33
Operation time (min)	387 (300-452)	359 (296-405)	0.38
Anesthetic time (min)	592 (489-653)	523 (450-600)	0.11
Blood loss (g)	1590 (520-2790)	1170 (480-2245)	0.44
Postoperative fentanyl administration period (days)	7.0 (3.0-8.0)	5.5 (3.0-7.8)	0.30
Bed rest period (days)	10.0 (7.5-21.5)	8.0 (5.0-12.0)	0.04
Male	6	32	0.41
Intellectual disability	4	12	0.15
Anterior operation	2	19	0.42
Epidural tube	14	75	0.17
Postoperative fentanyl administration	13	73	0.46
Thoracic single curve	8	50	0.59
Thoracolumbar/lumbar single curve	5	28	0.49
Double major curve	2	17	0.50
LIV T12-L2	5	34	0.55
LIV L3-5	9	46	0.29
LIV S1-iliac	1	2	0.10

Data are presented as n (%), median (interquartile range), or n.

Boldface text indicates statistical significance.

Mann-Whitney U-test, Fisher's exact probability test. LIV, lowest instrumented vertebra

study. Patients who underwent instrumentation removal or growing rod placement were excluded. We defined neurofibromatosis and its associated syndrome as syndromic scoliosis.

We evaluated the following variables: patient demographics (age, sex, height, weight, and body mass index), disease-related factors (according to the classification of scoliosis, curve type), surgery-related factors (preoperative Cobb angle, postoperative Cobb angle, surgical approach, correction rate, surgical time, anesthesia, and blood loss), postoperative factors (bed rest period and postoperative fentanyl administration period), and psychosocial factors. POI was defined as impairment of coordinated propulsive intestinal peristalsis occurring after surgery and lasting for more than 3 days. The main cardinal features of POI are nausea, vomiting, inability to tolerate an oral diet, abdominal distension, and delayed passage of flatus and stool. This study was approved by the ethics committee of our institution.

Statistical Analysis

Using Fisher's exact test and the Mann-Whitney *U*-test, we conducted an analysis to identify any differences between patients with versus without POI after scoliosis surgery. Multivariate logistic regression analysis was then performed to assess the risk factors identified among the patients with POI. A P value of <0.05 was considered statistically significant. The software used for analyses was BellCurve for Excel (Social Survey Research Information Co., Ltd., Tokyo, Japan), which is add-in software for statistical evaluation in Excel.

Results

In total, 110 cases underwent spine surgery procedures from December 2009 to March 2014. POI was documented in 15 (13.6%) of these patients. We compared each parameter in patients with versus without POI (Table 1). Analysis revealed that patients with POI had shorter height and longer bed rest than did those without POI. We evaluated the relationships between the lowest instrumented vertebra (from T5 to the sacroiliac region) and curve type and the occurrence of POI; there were no significant differences in these parameters between patients with versus without POI (Table 1).

Table 2 compares the cases according to type of scoliosis. A statistically significant difference in the number of cases of neuromuscular scoliosis (NMS) was present between patients with versus without POI (6 vs. 14, respectively; P = 0.029). Patients with NMS tended to have a more severe preoperative Cobb angle and lower correction rate (Table 2).

Finally, we performed a multivariate analysis (Table 3).

Table 2. Comparison by Type of Scoliosis and Multiple Factors.

Disease	Cases (n)	Ileus (+)	P*	Age (years)	Male	Height (m)	Preoperative Cobb angle	Postoperative Cobb angle	Correction rate (%)
Idiopathic scoliosis	44	4	0.199	16.0 (13.0-20.0)	5	1.54 (1.49-1.59)	58.0 (51.8-71.0)	15.5 (9.0-29.3)	72.7 (58.2-82.4)
Congenital scoliosis	19	1	0.219	11.0 (10.0-14.5)	10	1.41 (1.35-1.56)	52.0 (50.0-71.0)	24.0 (16.5-51.0)	53.7 (0.0-61.4)
Neuromuscular scoliosis	20	6	0.029	14.0 (12.0-16.5)	13	1.38 (1.27-1.49)	80.0 (63.8-98.0)	33.0 (22.0-49.3)	56.3 (37.8-71.5)
Degenerative scoliosis	7	1	0.653	57.0 (55.5-66.0)	0	1.55 (1.49-1.56)	36.0 (10.5-49.5)	10.0 (4.5-18.5)	64.6 (15.3-77.7)
Syndromic scoliosis	20	3	0.542	16.0 (12.8-20.8)	10	1.52 (1.47-1.62)	47.0 (35.0-70.8)	25.5 (16.3-30.8)	54.6 (36.0-67.8)

Data are presented as n or mean (range).

*Fisher's exact probability test

Table 3. Multivariate Analysis.

Factor	OR (95% CI)	P value
Neuromuscular scoliosis	4.21 (1.23-14.40)	0.022
Bed rest period	1.05 (0.99-1.12)	0.133

OR, odds ratio; CI, confidence interval

The results indicated that NMS was a risk factor for the development of POI after scoliosis surgery (odds ratio, 4.21; 95% CI, 1.23-14.40; $P = 0.022$).

Discussion

Scoliosis surgery is among the most complicated spine surgeries. Complications of this surgery are common and may be very serious. Several complications have been reported after scoliosis surgery, including infection, pneumonia, urinary tract infection, *Clostridium difficile* infection, sepsis, stroke, delirium, deep venous thrombosis, pulmonary embolism, myocardial infarction, arrhythmia, congestive heart failure, pneumothorax, atelectasis, adult respiratory distress syndrome, bowel obstruction, and renal failure[1,4,5]. POI is also a reported complication, although it is regarded as an early and minor complication following spine surgery. Early prediction and detection of POI is critical because of its severe consequences, including lengthy hospital stays, increased costs[6,7], and effect on patients' quality of life.

Few studies have focused on the risk factors for POI following scoliosis surgery. Most have reported the incidence of POI following spine surgery, which ranges from 0.6% to 16.7%[8-11]. The present study is the first to identify the incidence of and risk factors for POI after scoliosis surgery, and it revealed two important findings. First, the incidence of POI following scoliosis surgery was 13.6%. Second, multivariable analysis showed that NMS was a risk factor for POI.

Multiple studies have evaluated the risk factors for POI following spine surgery. Such risk factors include a low body mass index, general anesthesia, gastroesophageal reflux disease, intraoperative administration of >2 L/day of crystalloid solutions, and severe constipation[9,10,12,13]. In the present study, the presence of NMS was identified as the main risk factor for POI following scoliosis surgery. Modi et al.[14] reported that three of 50 patients with NMS who underwent surgery developed POI; two had a Cobb angle of <90° and one had an angle of >90°. NMS is closely associated with a high complication rate after correction surgery compared with other types of scoliosis[14-16].

The mechanism underlying the association between NMS and POI remains unknown; however, the findings of previous studies indicate possible mechanisms. Following scoliosis surgery, the stretching of nerve roots caused by correction maneuvers for severe curves can activate inhibitory spinal and sympathetic reflexes, leading to POI[17]. Additionally, kyphosis is usually present in patients with NMS; hence, patients tend to have a more flexed than extended posture. A flexed posture in a lumbar kyphotic model was shown to inhibit stomach myoelectric activity[18]. Plasma catecholamines increase after surgery[19], which can also lead to inhibition of gastrointestinal motility[20]. Gastric myoelectric activity increases after surgical correction of a poor, stooped spinal balance in patients with spastic NMS. However, this increase does not correlate with gastric emptying[21].

Because the correction maneuvers needed to achieve a higher correction rate can cause stretching of the nerve roots, we hypothesized that the correction rate would be a risk factor for POI. However, no significant difference in the correction rate was found between patients with versus without POI (median, 70.7% vs. 60.0%, respectively; $P = 0.33$). The correction rate was not a risk factor for POI. This lack of association may have resulted from the fact that we performed the correction after adequate detachment.

SMA syndrome is defined as prolonged nausea lasting more than 1 week with vomiting. The condition is diagnosed by radiological confirmation of constriction of the third part of the duodenum and delayed gastric emptying on upper gastrointestinal series[2]. Gastroduodenal distension with a relative absence of gas in the distal bowel is occasionally found on plain radiographs.

In this study, three patients were unable to eat anything for more than 1 week after surgery. These patients did not have evidence of SMA on plain radiographs, and all three improved with conservative treatment. However, SMA syndrome might have been missed because an upper gastrointestinal series was not performed.

The main limitations of this study are its retrospective design, the lack of sagittal balance evaluation, and the small

number of cases.

Conclusion

The main risk factor for POI after scoliosis surgery was NMS, not the correction rate. The present study provides evidence of the ability to predict a patient's risk for the development of POI, which may in turn improve medical optimization and make scoliosis surgery safer.

Conflicts of Interest: The authors declare that there are no conflicts of interest.

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