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Quality of Life During Pregnancy, Caesarean Section Rate, and Anesthesia in Women with a History of Anterior Correction Surgery for Lumbar Scoliosis: A Case-Control Study

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ADE 1 Yun Cao
BC 2 Shibin Shu
CF 2 Wenting Jing
DG 2 Zezhang Zhu
G 2 Yong Qiu
ADEG 2 Hongda Bao

1 Department of Obstetrics and Gynecology, Nanjing Drum Tower Hospital, Nanjing University Medical School, Nanjing, Jiangsu, P.R. China
2 Department of Spine Surgery, Nanjing Drum Tower Hospital, Nanjing University Medical School, Nanjing, Jiangsu, P.R. China

Corresponding Author: Hongda Bao, e-mail: baohongda123@gmail.com
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Background: This study investigated the prevalence and severity of low back pain (LBP), caesarean section (C-section) rate, and the anesthesia approaches among lumbar scoliosis patients undergoing anterior correction surgery, and compared them with a healthy control cohort.

Material/Methods: The inclusion criteria for adolescent idiopathic scoliosis (AIS) patients were: presence of lumbar scoliosis, history of 1 or more pregnancies after surgery, and underwent anterior-only surgery. Healthy women with a history of 1 pregnancy were included as the control group. We recorded the type of delivery, neonatal birth weight, and perinatal complications. The quality of life was also evaluated.

Results: New-onset LBP was reported in 65.6% of AIS patients, significantly higher than in the control group ($p<0.001$). C-section was performed in 11 scoliosis patients (34.4%) and 25 healthy controls (31.25%), and the rates were not significantly different between groups ($P=0.75$). No serious perinatal complications were reported in either group. General anesthesia was used for all C-section AIS patients. The rate of successful neuraxial anesthesia in the control group was significantly higher ($P<0.001$).

Conclusions: Compared with the healthy control group, lumbar AIS patients did not experience a higher risk of perinatal complications or C-section rate after anterior surgical correction, but general anesthesia was more commonly used than neuraxial regional anesthesia. LBP was more frequently observed in the post-operative AIS patients.

MeSH Keywords: Anesthesia • Cesarean Section • Scoliosis

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Background

Adolescent idiopathic scoliosis (AIS) is a three-dimensional spine deformity affecting approximately 1–3% of adolescents. According to the largest single-center analysis of AIS patients, 83% of patients were female [1]; therefore, issues related to women's health are of specific concern in this population. Although thoracolumbar/lumbar scoliosis is not as prevalent as single thoracic scoliosis, it still accounts for 28% of the whole patient cohort [1], and more patients required fusion to lumbar segments.

Considering that the AIS patients were young at the time of surgery, patients and their families have strong concern regarding the relationship between the scoliosis correction surgery and new-onset low back pain (LBP) during pregnancy. They also wonder if the correction surgery will cause more labor-related complications. The paucity of data limits preoperative communication with patients and patient satisfaction.

Many observational and retrospective studies have focused on the effect of pregnancy on scoliosis and the effect of scoliosis on pregnancy, but reached different conclusions [2–4]. Orvomaa et al. reported that 40% of women have increased LBP during pregnancy after posterior fusion with Harrington instrumentations [5]. According to a systematic literature review by Dewan et al., female AIS patients experience slightly increased rates of nulliparity, infertility treatment, LBP, and subsequent curve progression, but they are not at increased risk of pregnancy-related complications [3]. However, among the studies listed in Dewan's review, the location of curve and surgical strategies were heterogeneous, and no articles specifically focused on patients with lumbar scoliosis. Since an increased incidence of LBP is associated with lumbar scoliosis compared to thoracic scoliosis, the quality of life during pregnancy should be evaluated specifically for patients with lumbar scoliosis.

The scoliotic spine poses a unique challenge for the anesthesia provider, and may complicate general or regional anesthesia. Difficulty in performing neuraxial anesthesia can result in neural injury, spinal hematoma, post-dural puncture headache, or infection. Scoliosis patients without previous surgery can be managed with a paramedian approach on the convex side of the curve or a midline approach with angulation towards the convex side, or with the aid of imaging such as ultrasound. However, the use of spinal or epidural analgesia and anesthesia is also controversial in patients with a history of the previous scoliosis surgery [6,7]. Anesthesiologists have been reported to be less inclined to offer neuraxial regional anesthesia to patients in labor who underwent posterior scoliosis surgery due to the rods and altered anatomy of the spine [8], while data from patients with anterior scoliosis surgery are lacking.

This study investigated the prevalence and severity of LBP, caesarean section rate, and use of anesthesia among patients with lumbar scoliosis undergoing anterior correction surgery, and compared them with a matched healthy control cohort.

Material and Methods

Cohort

This was a retrospective cohort study with a cross-sectional comparison. The study was approved by the Ethics Committee of our hospital. The inclusion criteria for the AIS patients were: (1) AIS patients with thoracolumbar/lumbar scoliosis (Lenke 5C), (2) with a history of 1 or more pregnancies after scoliosis surgery, and (3) underwent anterior-only correction surgery. Healthy women with the history of 1 pregnancy were also included as the control group. The control group was screened for LBP and none of them did had LBP before pregnancy. Patients with other medical comorbidities or major spinal anomalies were excluded.

Clinical evaluation

Demographic data were obtained from a review of medical records and radiographic images using standardized data collection forms. Data collected included age at pregnancy, number of pregnancies, and the time from AIS surgery to pregnancy. The type of delivery (vaginal or caesarean), birth weight of baby, and perinatal complications were recorded.

The quality of life of AIS patients and control subjects were evaluated using 2 questionnaires. The Scoliosis Research Society-22 (SRS-22) questionnaire is a validated patient-reported outcome measure [9] that contains 22 questions organized in 5 domains covering different aspects of quality of life: function, pain, self-image, mental health (5 items each), and satisfaction with treatment (2 items). In the present study, the scoliosis patients and healthy controls did not answer the last 2 questions pertaining to satisfaction with the scoliosis surgery. The other was a questionnaire developed by the authors.

Statistical analysis

The independent *t* test, chi-square test, and Fisher's exact test were used to compare continuous or categorical parameters between AIS patients and control subjects. Statistical analysis was performed with SPSS 21.0 statistical software (SPSS, Inc., Chicago, IL). A *P* value less than 0.05 was considered statistically significant.

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Table 1. Descriptive characteristics of AIS and healthy pregnant women.

	Scoliosis group	Healthy controls	P valve
Number	32	80	–
Age at the last pregnancy (years)	26.2±1.0	24.5±0.8	<0.001*
Number of pregnancies	34	80	–
Period of gestation (weeks)	40.2±0.6	39.4±1.0	0.56
Birth weight of child (Kg)	3.38±0.50	3.21±0.38	0.64
Caesarean delivery (%)	34.4%	31.25%	0.75
Neuraxial anesthesia (%)	3.1%	81.25%	<0.001*
New back pain during pregnancy (%)	65.6%	15.00%	<0.001*
Back pain after delivery (%)	6.2%	0.00%	<0.001*

* p<0.05. AIS – adolescent idiopathic scoliosis; Kg – kilogram.

Results

Demographic information

We included 32 AIS patients with lumbar scoliosis and 80 healthy controls (Table 1). The mean age at the time of the anterior correction for scoliosis was 14.8 years old (range: 13–17 years old). The average Cobb angle was 47.8±9.3° before surgery and 12.6±3.2° after surgery. Lumbar lordosis averaged 51.4±7.4° before surgery and 45.5±8.2° after surgery. All patients underwent either anterior-only correction surgery with a single rod (23 patients) or dual rods (9 patients). The anterior correction surgeries were performed between 2005 and 2009, with a mean fusion level of 5.9. The lowest instrumented vertebra was L3 for all patients and UIV was at T10 (28 patients) or T11 (4 patients). The mean age at pregnancy in scoliosis patients was 26.2 years (range: 25–29 years old). The average time from surgery to labor was 11.4 years (range: 8–13 years). The average period of the gestation was 40.2 weeks (range: 39–41 weeks). Among the 32 AIS patients, 30 were nulliparous and 2 were parous. All 80 healthy controls were nulliparous and their average gestation was 39.4 weeks.

The average birth weight was 3.38 Kg in the scoliosis group, similar to that in the control group (3.38 kg *vs.* 3.21 kg, P=0.64). Apgar scores collected from 15 scoliosis patients were 9 to 10 based on questionnaire data, and Apgar scores for the healthy controls ranged from 8 to 10 based on hospital medical records.

Quality of life during pregnancy

New-onset back pain was reported in 65.6% of the AIS group (21 in 32 patients), which was significantly higher than in the control group (65.6% *vs.* 15%, P<0.001). Among scoliosis patients, 14 of 32 reported moderate back pain and 7 reported severe back pain. On the contrary, 8 healthy women reported mild back pain and 4 reported moderate back pain. The frequency of back pain was also higher in scoliosis patients: 10 scoliosis patients had back pain "often" or "very often", while 7 healthy controls chose "sometimes" and 5 chose "often". Two scoliosis patients reported sustained back pain that could affect work or life after delivery, and no such pain was found in healthy controls.

The prevalence of depression was similar between the 2 groups (1 in the scoliosis group and 2 in the healthy group, P=0.85). Based on the SRS-22 questionnaire responses, the scoliosis patients showed no deterioration after delivery compared to the healthy controls (P>0.05, Table 2), except in the function domain (P=0.02).

The impact of delivery methods on quality of life was also assessed (Table 3). The prevalence of back pain before and after delivery did not significantly differ between the 2 groups. The SRS-22 scores also showed no significant differences.

Delivery and anesthesia

C-section was performed on 11 scoliosis patients (34.4%) and on 25 healthy controls (31.25%), and the rate was not significantly different between the 2 groups (P=0.75). The reason for C-section was also recorded in scoliosis patients. As shown in Table 1, C-section was performed on 3 patients on patient's request, 5 on the obstetrician's recommendation, and on 2 patients due to previous C-section, while 1 patient received an unplanned C-section. Among the 5 patients who received recommendations from obstetricians, 2 of them did not know the reason why the obstetricians recommend C-section, in 1 patient it was due to potential fetal distress, in 1 patient it was due to intrauterine infection, and 1 patient said that she had a residual lumbar deformity after surgery and moderate LBP during pregnancy, so the obstetrician recommend C-section. No severe perinatal complications were reported in either group.

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Table 2. Scores of the Scoliosis Research Society-22 questionnaire.

Domains	Scoliosis group	Healthy controls	P valve
Function	4.0±0.4	4.5±0.5	0.02*
Pain	4.6±0.5	4.7±0.4	0.21
Self-image	3.8±0.6	3.9±0.6	0.39
Mental health	4.3±0.6	4.3±0.5	0.74
Total	4.1±0.4	4.3±0.4	0.52

* p<0.05.

Table 3. Comparisons between C-section and vaginal-delivery subgroups in AIS patients.

	C-section	Vaginal-delivery	P valve
Number	11	21	
New back pain during pregnancy (%)	72.7%	61.9%	0.48
Back pain after delivery (%)	9.1%	4.8%	–*
SRS scores			
Function	3.9±0.6	4.0±0.5	0.61
Pain	4.6±0.5	4.6±0.4	0.53
Self-image	3.9±0.4	3.8±0.5	0.27
Mental health	4.1±0.7	4.3±0.4	0.49
Total	4.1±0.5	4.2±0.5	0.36

* Statistical analysis not applicable.

Among all scoliosis patients, 1 patient received neuraxial anesthesia successfully. Epidural anesthesia was attempted in 3 vaginal-delivery AIS patients, and only 1 of them was successful. General anesthesia was used for all C-section AIS patients. Epidural anesthesia was attempted in 5 C-section AIS patients and none of them was successful. Epidural anesthesia was not attempted in the 6 other C-section AIS patients. In contrast, the rate of successful neuraxial anesthesia in the control group was significantly higher ($P<0.001$): 25 C-section women and 40 vaginal-delivery women. No failure of the neuraxial anesthesia was reported in the healthy control group.

Discussion

Fertility- and pregnancy-related questions are commonly asked by patients and their families before AIS correction surgery. The lumbar spine is the most important weight-bearing portion of the spine; however, flattened lumbar lordosis occurring in lumbar AIS patients, together with the coronal curvature, increases the incidence of LBP [10]. This situation is aggravated when the patient is pregnant, even after surgical correction. Our study revealed increased low back pain and depression in lumbar AIS patients during pregnancy, and their age at delivery was older compared to the control group. In addition, a higher C-section rate was found in AIS patients and regional anesthesia was less commonly used in patients undergoing anterior scoliosis correction surgery.

The severity of LBP and the incidence of new-onset LBP in pregnant AIS patients after anterior surgery was higher than in the healthy control group, which is consistent with previous studies. Falick-Michaeli et al. reported that 35% of AIS patients who had received surgical treatment had severe LBP during pregnancy, and 76% had sustained LBP even after delivery [11]. Bjerkreim et al. also reported that 62% of patients had increased back pain during pregnancy [12]. In the present study, the incidence of LBP in patients with AIS who received anterior surgery was 72%, similar to the previously reported incidence in patients with posterior surgery. This shows that the anterior approach, which preserves paraspinal muscles, is not associated with lower rates of low back pain during pregnancy compared to the posterior approach. This may be due to the location of the coronal curvature. Ascani et al. assessed the correlation of curve pattern with pain and found that women with thoracic curves were least likely to experience back pain, while those with a thoracolumbar curve reported the highest rates of pregnancy-related back pain [13].

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Our study also revealed that the delivery method (C-section *vs.* vaginal-delivery) did not affect the rates of LBP in AIS patients.

Regarding the method and complication rate of delivery, the AIS patients and healthy controls had similar C-section and complication rates. The C-section rates varied in previous reports. Five studies directly compared the C-section rate between surgically-treated AIS patients and healthy controls, and 3 of them reported similar C-section rates [6,14,15]; however, 2 of the 3 studies were published before 2001 [14,15]. In 2012, Lebel et al. reported an increased rate in AIS relative to controls (21% *vs.* 13%) in a retrospective population-based study that reviewed 229 116 pregnant subjects, of whom 98 had documented scoliosis [2]. However, the etiology of scoliosis, the curve pattern, and treatment of the scoliosis patients were not identified. Grabala et al. recently reported significantly higher C-section rates in AIS patients (64% *vs.* 33% in healthy controls) [16] and concluded that as the lowest instrumented vertebra moved caudally (L1, L2, L3, L4), the frequency of C-section increased. However, our data showed similar C-section rates in lumbar AIS patients following anterior correction (34.4% *vs.* 31.25% in healthy controls), even though the lowest instrumented vertebra in our cohort were all located at L3. In a previous study of patients who had undergone different kinds of anterior spinal surgery, Lavelle et al. reported that the C-section rate was 50% for anterior-only surgery and 28.6% for combined anterior and posterior surgery [17]. However, 75% of fracture patients delivered by C-section in their study.

In addition, according to the population-based reports on C-section rates in China, the overall C-section rate in China increased from 28.8% in 2008 to 34.9% in 2014 [18], and the C-section rates in urban areas of China are much higher than the national average. Ming et al. reported an overall C-section rate of 41.5% in Shanghai based on a survey in 2016 [19]. Compared to the national rate, the C-section rate of 34.4% in lumbar AIS patients in our study was not high.

For patients who delivered, neuraxial anesthesia was beneficial, but was also potentially difficult in AIS patients. Our data revealed only 1 successful neuraxial anesthesia in a lumbar AIS patient with previous anterior surgery. All AIS patients had communicated with the anesthetists before delivery, and according to the patient survey, the reason for choosing general anesthesia was concern about the curved spine. Regarding anesthetic method, the choice of anesthetic method depends on anesthesiologist preference. However, although the scoliosis patients underwent correction surgery in our hospital, they did not give birth in our hospital, so we could not evaluate the ability and preference of the anesthesiologist. Therefore, it was difficult to know the specific reason why the anesthesiologist did not attempt neuraxial anesthesia or why they failed neuraxial anesthesia.

However, as spine surgeons, we still recommend neuraxial anesthesia in patients undergoing anterior correction surgery. With an anterior approach, the spinous processes, which are the key landmarks for placement of neuraxial anesthetics, are intact. Unlike the posterior approach, no scar tissue or bone graft restricts the needle placement. In addition, after anterior surgery, most of the scoliosis and vertebral rotation can be corrected. Finally, the spinal canal is intact, and no post-operative adhesions or obliteration of the epidural space interfere with local anesthetic spread or increase the chance of inadvertent dural puncture. In previous studies, epidural placement above or below the surgical site has been shown to be an effective alternative [20,21].

This study is limited because of the small sample size, since we only included lumbar AIS patients with anterior-only approach. Thus, we excluded a larger portion of patients with traditional Harrington instrumentation or Cotrel-Dubousset instrumentation. We did not include AIS patients with posterior correction because the modern posterior correction for lumbar scoliosis with all-pedicle-screw system was popularized after 2010, when most of our patients had not reached pregnancy. Also, prospective research is needed with a multidisciplinary team (MDT) of spine surgeons, gynecologists, obstetricians, and anesthetists to develop a protocol for treatments of patients with idiopathic scoliosis after corrective surgery. In addition, we did not compare general anesthesia *vs.* neuraxial anesthesia due to the small number of patients receiving neuraxial anesthesia in the AIS group.

Conclusions

Following anterior surgical correction, lumbar AIS patients did not experience higher rates of perinatal complications and C-section. However, general anesthesia was more commonly performed than neuraxial regional anesthesia. Low back pain was more common in post-operative AIS patients. These data may help surgeons counsel patients and families regarding expected lifetime effects of scoliosis correction surgery.

Conflict of interest

None.

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