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ORIGINAL ARTICLE

# Factors influencing cesarean delivery operative times: a prospective observational cohort study

S.H. Wilson, K. Fecho, J. Marshall, F. Spielman

Department of Anesthesiology, University of North Carolina, Chapel Hill, North Carolina, USA

## ABSTRACT

**Background:** This study aimed to determine the distribution of operative delivery times for uncomplicated parturients undergoing elective cesarean delivery with neuraxial anesthesia. A secondary aim was to explore patient and surgical factors associated with longer cesarean delivery times.

**Methods:** A prospective observational study of 331 parturients undergoing elective cesarean delivery with neuraxial anesthesia was conducted. Factors examined included age, body mass index, ethnicity, number of previous cesarean deliveries, stretch mark and scar severity and surgical experience.

**Results:** Operative times ranged from 13 to 108 min with a mean (SD) of 43.4 ( $\pm 15.7$ ) min. Only 6 (1.8%) parturients had operative times  $>90$  min and none were converted to general anesthesia. As the number of previous cesarean deliveries increased, the mean operative time increased linearly from 39.5 ( $\pm 13.0$ ) min in subjects with no previous cesarean deliveries to 52.8 ( $\pm 18.1$ ) min in subjects with 3 or 4 previous cesarean deliveries ( $P < 0.0005$ ). For parturients with previous cesarean deliveries, operative times were longer for those with scar scores  $\geq 5$  than for those with scores  $< 5$  ( $P < 0.01$ ). Stretch mark scores were not associated with operative times. Tubal ligation prolonged the total operative time by a mean of 7 min ( $P < 0.0005$ ), and attending staff required a mean of 6 more min than residents or fellows ( $P < 0.01$ ). There was no correlation between operative times, age and body mass index and little variation with ethnicity.

**Conclusions:** These findings identify previous cesarean deliveries, increased scar intensity, tubal ligation and surgical experience as factors that increase operative times for cesarean delivery. The data also suggest that neuraxial anesthesia lasting 90 min should provide adequate analgesia for most uncomplicated parturients undergoing elective cesarean delivery.

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**Keywords:** Cesarean delivery; Operative time; Neuraxial anesthesia; Tubal ligation

## Introduction

In 1997, Hawkins and colleagues reported a decrease in anesthesia-related morbidity and mortality in obstetric patients that was associated with the increased use of neuraxial anesthesia and analgesia.<sup>1</sup> Consequently, general anesthesia is avoided for cesarean delivery when contraindications to neuraxial techniques do not exist. The ability to predict the duration is crucial in determining the choice of neuraxial anesthetic technique for cesarean delivery in uncomplicated parturients.

Several studies have shown that operative times are longer for parturients with multiple previous cesarean deliveries,<sup>2,3</sup> although these studies were complicated by inclusion of parturients with concurrent hysterectomies and/or midline abdominal incisions. Other studies

found a relationship between the number of previous cesarean deliveries and the degree of intra-abdominal adhesions, but not operative times.<sup>4-7</sup> The primary aim of the present study was to determine the distribution of operative times for uncomplicated parturients undergoing cesarean delivery with a low transverse uterine incision under neuraxial anesthesia. A secondary aim was to determine the influence of various factors on cesarean delivery operative times. These included the number of previous cesarean deliveries, the severity of scarring and stretch marks, tubal ligation, level of experience of operating surgeon, race/ethnicity, age and body mass index (BMI).

## Methods

After Institutional Review Board approval, a prospective observational cohort study was conducted on 331 parturients undergoing elective cesarean delivery with a low transverse uterine incision and a transverse skin incision under neuraxial anesthesia. Parturients receiving

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Correspondence to: Fred Spielman, M.D. Department of Anesthesiology, University of North Carolina at Chapel Hill, CB# 7010, Chapel Hill, NC 27599-7010, USA.

E-mail address: fspielman@aims.unc.edu

general anesthesia and those with a history of other abdominal surgery were excluded. Routinely used agents were 2% lidocaine with 1:200,000 epinephrine for epidural anesthesia and 12 mg bupivacaine, with or without glucose, 100 µg morphine and 10 µg fentanyl for spinal anesthesia. Nearly all patients were in the sitting position for neuraxial block placement and received 1 L of intravenous lactated Ringer's solution. For all parturients, the level of neuraxial blockade was checked before skin incision. Ice, alcohol and pin prick were employed, depending on clinicians' choice and circumstance. Neuraxial block was considered satisfactory when sensory blockade was present at the T4 dermatome, after which the surgeons were called to prepare for the operation.

Data collected by the anesthesiologist included age, height and weight at time of delivery, ethnicity/race (White, Black, Hispanic, Other), number of previous cesarean deliveries, time of skin incision and uterine incision, time of skin closure and experience of the senior surgeon (attending, resident, fellow). Data were not collected on specific anesthetic drugs and dosages, nor the position of the patient when the neuraxial block was placed. Attending surgeons had completed all medical training; fellow surgeons were in specialty obstetric surgery training; and resident surgeons were in medical training. The severity of stretch marks and skin scars (for parturients who had previous cesarean deliveries) at the incision site was rated by the senior operating surgeon using a 1 (minimal) to 10 (severe) scale. Scores were based on the appearance of the stretch marks and scars. A scar score was used in lieu of other measures of assessing tissue damage, such as intra-abdominal adhesions,<sup>4-7</sup> on advice of the obstetric surgeons, who believed that a scar score would provide a more objective assessment of tissue damage.

The total operative time was defined as the time of skin closure minus the time of skin incision and expressed in minutes. Stretch mark and scar scores were categorized into classes of <5 or ≥5, at the third quartile. Data were analyzed using SPSS (v. 17.0; SPSS, Inc. Chicago, IL) and presented using Sigma Plot (v. 11.0; SPSS, Inc.). Descriptive statistics were generated. Analysis of variance was used to compare operative times across categorical factors and Pearson's correlation analysis was used to examine the association between operative times and continuous variables, with  $\alpha = 0.05$ .

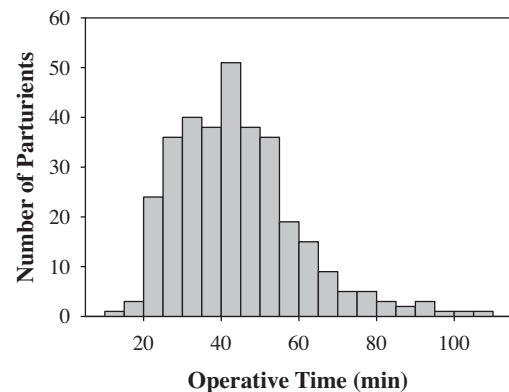
## Results

The characteristics of the 331 parturients and cesarean deliveries are provided in Table 1. Operative times ranged from 13 to 108 min with a mean (SD) of 43.4 (±15.7) min (Fig. 1). Only 6 (1.8%) parturients had operative times greater than 90 min and none were converted from neuraxial to general anesthesia. The total operative time increased linearly as the number of previous cesarean deliveries increased, from 39.5 (±13.0) min in

**Table 1 Clinical characteristics of parturients and cesarean deliveries**

Age (years)	30.1 ± 6.2
BMI (kg/m <sup>2</sup> )	33.1 ± 6.0
Operative time (min)	43.4 ± 15.7
Race	
Non-Hispanic White	134 (40.5%)
Black	59 (17.8%)
Hispanic	119 (36.0%)
Other	19 (5.7%)
Number of previous cesarean deliveries	
0	99 (29.9%)
1	150 (45.3%)
2	68 (20.5%)
3 or 4	14 (4.2%)
Scar score (n = 232)	
<5	163 (70.3%)
≥5	69 (29.7%)
Stretch mark score	
<5	222 (67.1%)
≥5	109 (29.7%)
Tubal ligation	
Yes	97 (29.3%)
No	234 (70.7%)
Surgeon experience	
Attending	211 (63.7%)
Resident/fellow	118 (35.6%)
Missing	2 (0.6%)

Data are mean (± standard deviation) or number (%).



**Fig. 1** Distribution of operative times for parturients undergoing elective cesarean delivery.

subjects who had no previous cesarean deliveries to 52.8 (±18.1) min in subjects who had 3 or 4 previous cesarean deliveries ( $P < 0.0005$ ; Fig. 2A). For parturients who had previous cesarean deliveries, operative times were significantly longer for those with a scar score 5 or greater, than for those with a scar score less than 5 ( $P < 0.01$ ; Fig. 2B). Operative times were similar for all parturients irrespective of stretch mark score (Fig. 2C). Tubal ligation prolonged the total operative time by a mean of 7 min ( $P < 0.0005$ ; Fig. 2D) and attending sur-

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