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Original Article

Factors Associated with Conversion to General Anesthesia among Parturients Undergoing Cesarean Section with Neuraxial Anestheisa: A Case-Control Study

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Abstract:

Objective: Pain during cesarean under neuraxial anesthesia is a concern for parturients. Some must convert to general anesthesia due to intense pain, increasing risks for the mother and neonate. The risk factors for this conversion are not well understood. We conducted a retrospective case-control study to identify potential independent factors.

Methods : We reviewed medical records to identify parturients who switched to general anesthesia during cesarean sections under initial neuraxial anesthesia and matched them 1:2 to the neuraxial anesthesia group. Univariate and multivariate binary logistic regression were used to analyze risk factors for conversion.

Result: Between 2016 and 2025, 30,692 parturients at our hospital had cesarean sections with initial neuraxial anesthesia. Of these, 3102 experienced intraoperative pain, and 56 (1.8%) required conversion to general anesthesia due to severe discomfort. Univariate binary logistic regression identified risk factors including advanced age, BMI < 30, primigravidity, epidural anesthesia, repeat puncture, emergency surgery, and fatal weight. Multivariate regression showed advanced age, epidural anesthesia, repeat puncture, and emergency surgery as independent factors; fatal weight was marginally significant.

Conclusion: In conclusion, intraoperative pain is a common issue. The incidence of parturients converting from neuraxial to general anesthesia during cesarean delivery is low. Advanced age, multiple puncture attempts, initial epidural anesthesia, and emergency surgery are independent predictors of conversion to general anesthesia.

Keywords: Neuraxial anesthesia, General anesthesia, Cesarean section, Conversion

Introduction

Cesarean section (CS) is among the most frequently performed surgical procedures globally [1]. Anesthesia methods for CS are categorized as either neuraxial anesthesia (NA) or general anesthesia (GA). General anesthesia is correlated with a markedly higher risk of adverse outcomes for both mother and neonate [2, 3], whereas neuraxial anesthesia is typically the preferred technique for CS in the absence of contraindications [4-7].

Pain during cesarean section (PDCS) occurs in parturients undergoing neuraxial anesthesia, increases morbidity and postpartum depression, and should be avoided when possible.[3, 8, 9]. When PDCS occurs, analgesic supplementation should be provided, and most cases are alleviated [10].

However, a few parturients convert to GA due to severe pain during cesarean section[10-14]. Given the low incidence of conversion to GA, the risk factors for conversion to GA in parturients undergoing CS under NA remain unclear.

The primary aim of this study is to determine the incidence of conversion to GA among parturients undergoing cesarean section under neuraxial anesthesia at our institution, identify potential risk factors, and develop a predictive model using a relatively large sample.

Materials and Methods

Study Design

This study was conducted as a retrospective case-control cohort study. The general anesthesia group was identified and matched to the neuraxial anesthesia group at a 1:2 ratio. Our study was approved by the Ethics Committee of Chengdu Jinjiang Hospital for Women and Children Healthcare.

Study Population

Parturients who underwent cesarean section with neuraxial anesthesia and experienced intraoperative pain from July 1, 2016, to December 31, 2025, at Chengdu Jinjiang Hospital for Women and Children Healthcare were identified through the electronic medical record system. Finally, 56 Parturients were identified who converted to general anesthesia due to severe intraoperative pain. Thus, 112 Parturients who had undergone cesarean section under NA with intraoperative pain were randomly selected and stratified by admission year.

Anesthesia Procedure

During the study period, spinal anesthesia (L3-4) was performed in a lateral position with 0.5% ropivacaine (14-16 mg). During elective cesarean section, blocks were assessed preoperatively with bilateral cold-sensation testing, and surgery was permitted to proceed once the sensory level reached T4. If the sensory level did not reach T4 within 5 minutes, the parturient was placed in the Trendelenburg position. This position was maintained until the desired sensory level was achieved. If spinal anesthesia failed to achieve an adequate sensory level before surgery, epidural anesthesia was administered. Parturients receiving epidural anesthesia who converted from labor epidural analgesia for intrapartum cesarean delivery were assessed for sensory level as described. For mild pain during cesarean section, intravenous ketamine and Sufentanil were administered at the anesthetist's discretion. For severe pain, anesthesia was converted to general anesthesia. The decision to administer medications and/or convert to general anesthesia was at the anesthetist's discretion.

Clinical Characteristics

We conducted a comprehensive review of medical records to collect data on age, height, weight, obstetric history, prior cesarean section history, ASA grade, initial anesthesia type, number of repeat puncture attempts, adjuvant medication, surgery type, duration of surgery, volume of bleeding, combined surgical procedures, gestational age, number of fetuses, and fetal birth weight. Advanced age is defined as maternal age greater than 35 years. Obesity is defined as a BMI greater than 30. Initial neuraxial anesthesia includes epidural, spinal, and combined spinal/epidural (CSE) anesthesia. Surgery type is classified as elective or emergency. Sufentanil and Esketamine were administered to manage intraoperative pain during cesarean section. Combined surgery refers to tubal ligation, uterine balloon placement, and uterine tying. Uterine balloon placement and uterine tying were performed to reduce blood loss during cesarean section. These combined procedures may affect intraoperative pain. In cases of multiple fetuses, the fetal birth weight is the total weight of all fetuses.

Statistical Analysis

Continuous variables are presented as means ± standard deviations. Categorical variables are described using frequencies and percentages. The Man-Whitney U test is used for non-normally distributed data, whereas the t-test is used for normally distributed data. Univariate binary logistic regression was conducted to identify potential risk factors for general anesthesia among parturients undergoing cesarean section with intraoperative pain. Variables with a P-value < 0.05 were considered statistically significant and included in the multivariate binary logistic regression model. All statistical analyses were performed using SPSS version 20.

Results

Between 2016 and 2025, 3102 parturients experienced intraoperative pain, and 56 (1.8%) required conversion to general anesthesia because of severe intraoperative pain (Table 1).

Table 1 Total number of intraoperative pain and conversion to GA

Year	Cesarean section	Intro-operative pain	GA	NA
2016	3869	464	6	458
2017	3844	412	8	404
2018	3802	435	6	429
2019	3784	383	5	378
2020	3296	305	10	295
2021	2692	242	4	238
2022	2900	254	6	248
2023	2485	231	7	224
2024	2384	250	2	248
2025	1636	126	2	124
Total	30692	3102	56	3046

The average age of parturients in the general anesthesia (GA) group was 35.45 years, whereas in the neuraxial anesthesia (NA) group it was 30.79 years. The average age in the GA group was statistically significantly higher than that in the NA group ($p < 0.001$, Table 2). The median gestational age was 39 weeks for both the NA and GA groups. Notably, the gestational age in the GA group was lower than in the NA group ($p = 0.007$, Table 2); however, the fetal birth weight was markedly higher in the GA group ($p < 0.001$, Table 2). There were no statistically significant differences between the two groups in surgical duration and bleeding volume.

Table 2 Characteristics of parturients with intraoperative pain

variables	NA	GA	P value
Age (year), mean	30.79	35.45	**< 0.001**
BMI, mean	26.56	27.51	0.058
Surgery duration (min), mean	44.25	40.01	0.198
Bleeding volume (ml), mean	432.04	443.30	0.716
Gestational age(week), median	39	39	**0.007**
Fatal weight(g), mean	3208.57	3641.96	**< 0.001**

There were 33 parturients of advanced age in the GA group and 32 in the NA group. 52 parturients in the GA group were non-obese, and 86 had a BMI lower than 30. 68 parturients in the NA group were primigravida, and 42 in the GA group were primigravida. In the NA group, 32

parturients had a prior cesarean section, and 10 had the same experience. All parturients were ASA grade II or III. Five parturients in the NA group underwent emergency surgery, and 30 in the GA group received emergency surgery. Initial epidural anesthesia was performed in 7 parturients in the NA group and 18 in the GA group. Four parturients received repeat puncture in the NA group and 20 in the GA group. Seventy-two and thirty parturients in the NA and GA groups used Sufentanil, respectively. One hundred and six parturients in the NA group delivered full-term fetuses, and forty-nine parturients in the same group were in a similar condition. Macrosomia was observed in two parturients in the GA group, and fifteen parturients delivered macrosomic infants. Six parturients in the NA group and five in the GA group received combined surgery.

To identify factors associated with the transition to general anesthesia (GA) among parturients experiencing intraoperative pain during cesarean section, a univariate binary logistic regression analysis was conducted. The results of this analysis are presented in Table 3. The findings indicated that potential predictors for transition to GA included advanced age, higher BMI, epidural anesthesia, repeat puncture attempts, and emergency surgical procedures. Primigravida status and fetal overweight did not reach statistical significance but were marginally significant and thus were incorporated into the subsequent multivariate binary logistic regression analysis.

Table 3 Univariate binary logistic regression

Variables	NA	GA	P value	OR (95% CI)
Advanced age	32	33	< **0.001**	3.587 (1.832 - 7.023)
Non-obesity (BMI < 30)	86	52	**0.015**	0.254 (0.084 - 0.77)
Primigravida	68	42	0.069	0.515 (0.252-1.052)
Prior caesarean section	32	10	0.134	0.543 (0.245-1.206)
ASA grade (II)	109	54	0.749	1.346 (0.218-8.294)
Epidural anesthesia	7	18	< **0.001**	7.105 (2.752-18.347)
Repeat puncture attempt	4	20	< **0.001**	15 (4.808-46.801)
Adjuvant medication (Sufentanil)	72	30	0.181	1.560 (0.813-2.994)
Emergency surgery	5	30	< **0.001**	26.750 (9.407-76.071)
Long surgery duration	46	21	0.656	0.861 (0.445-1.664)
Massive hemorrhage	1	2	0.904	0.958 (0.472-1.944)
Combined surgery	6	5	0.383	1.732 (0.505-5.943)
Full-term fetus	106	49	0.112	0.396 (0.126-1.241)
Polyembryony	6	1	0.299	0.321 (0.038-2.735)
Fetal overweight	15	2	0.064	0.240 (0.053-1.087)

The results of the multivariate analysis (Table 4) demonstrated that advanced age, epidural anesthesia, repeat puncture attempts, and emergency surgery were significantly associated with the transition to GA. Fetal overweight may also constitute a potential risk factor for this transition.

Table 4 Risk factors for conversion to GA

Variables	P value	OR (95% CI)

Advanced age	**<0.001**	10.289 (2.912-36.354)
Non-obesity	0.69	0.795 (0.257-2.459)
Primigravida	0.121	0.301 (0.066-1.372)
Epidural anesthesia	**0.003**	9.604 (2.190-42.117)
Repeat puncture	**<0.001**	15.594 (3.295-73.795)
Emergency surgery	**<0.001**	30.013 (7.210-124.935)
Fatal weight	0.073	0.012 (0.008-1.239)

Discussion

Neuraxial anesthesia is the primary choice for cesarean section; however, intraoperative pain remains a significant limitation. The incidence of intraoperative pain ranges from 3.1% to 30% 11. Anesthesiologists and obstetricians frequently encounter challenges in identifying women who report intraoperative pain, resulting in inconsistent reported conversion rates [15, 16]. In the present study, intraoperative pain was observed in 10.11% of parturients, aligning with previous findings. Sharp pain induces discomfort and may render surgical procedures intolerable. Although neuraxial anesthetics are employed to mitigate intraoperative pain during cesarean delivery, a small number of parturients still require conversion to general anesthesia (GA). Prior research reports conversion rates ranging from 1.2% to 1.7%[13, 14]. In our study, the incidence was 1.8%, which is comparable to existing data. Given the infrequency of conversion to GA, further research is warranted to better understand its incidence.

Stav et al. identified the dose of anesthetic drugs, surgery time, emergency cesarean section, and postpartum hemorrhage as independent risk factors for conversion to general anesthesia (GA) in parturients undergoing cesarean section (CS) under neuraxial anesthesia (NA). In our study, we also identified emergency surgery as a potential risk factor for conversion to GA. The dose of anesthetic drugs was not included in our study. Epidural anesthesia, spinal anesthesia, and combined spinal-epidural (CSE) anesthesia were adopted as the standard protocols for parturients undergoing CS, and the dose of ropivacaine varied. Surgery duration did not differ statistically between the two groups and showed no statistical significance in univariate regression analysis; thus, it was not included in the multivariate logistic regression analysis. The low incidence of conversion to GA may lead to different results in surgery duration. In our study, a few parturients experienced postpartum hemorrhage. We analyzed the intraoperative bleeding volume, which did not differ statistically between the two groups.

In our study, advanced age was identified as an independent risk factor for the conversion; a study conducted by Vallejo also drew similar conclusion[17]. Some previous studies have reported that epidural anesthesia is a risk factor for failed neuraxial anesthesia [13, 17], which is consistent with our findings. Compared with other forms of neuraxial anesthesia, epidural anesthesia is more likely to fail[9, 18-20]. Our study also found that repeat puncture attempts were associated with conversion, consistent with previous research[17].

In our study, ketamine and Sufentanil are employed as adjunct medications to mitigate intraoperative pain. There is no discernible difference in their adjuvant analgesic efficacy.

This study represents one of the most comprehensive retrospective analyses aimed at identifying risk factors for conversion. Nevertheless, it possesses several limitations. One such limitation is its retrospective design. Additionally, a case-control study was conducted at a 1:2 ratio due to the low incidence of conversion, which may introduce selection bias. The assessment of intraoperative pain is contingent on parturient perception and lacks

standardized methodologies, thereby affecting the accuracy of pain assessment and subsequent decisions to convert to general anesthesia (GA). All parturients included in the study were classified as ASA II or III; none with ASA IV classification were included, which may impact the results of the regression analysis. Furthermore, because conversion is infrequent, the small sample size is another constraint on this investigation. Larger-scale studies, including retrospective, prospective, randomized, or multicenter clinical trials, are necessary to more accurately evaluate prognostic factors in parturients with NA undergoing cesarean sections.

Conclusion

In conclusion, It is our professional assessment that intraoperative pain should not be considered insignificant, and the rate of conversion from neuraxial anesthesia to general anesthesia during cesarean section remains low. Advanced age, multiple puncture attempts, initial epidural anesthesia, and emergency surgical procedures are identified as risk factors for such conversion. Additionally, higher maternal weight may elevate the likelihood of requiring general anesthesia.

Conflict of Interest Statement

The authors declare no conflict of interest.

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