ORIGINAL ARTICLE

A Single-Center Retrospective Cohort Study on Cesarean Section under General Anesthesia

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Objective Neuraxial block is the most common anesthesia method for cesarean section (CS). However, for some urgent and high-risk cesarean delivery, general anesthesia (GA) also plays a very important role. We aimed to find out the reasons of choosing GA for CS in our center and the factors that may be related to the maternal and fetal outcomes.

Methods We retrospectively selected and analyzed parturients who had CS procedures under GA in Peking Union Medical College Hospital from January 1, 2014 to December 31, 2016. Clinical data (baseline maternal status, preoperative status, perioperative information, maternal and fetal outcomes) of parturients and neonates were collected. We summarized the common reasons for applying general anesthesia, and compared the back-to-ICU ratio and hospital stay time between parturients with different maternal ASA grade, gestational week and intraoperative blood loss, as well as the fetal one-minute Apgar score between different maternal ASA grade and gestational week.

Results There were 98 cases of CS under GA enrolled in the study. Among the maternal and fetal factors, pregnancy with internal and surgical diseases is the most common reason (59 cases, 60%) for applying GA, followed by placenta and fetal membrane abnormalities (38 cases, 39%) and pregnancy-specific disorders (36

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cases, 37%) . ASA grade III-IV of parturients (92% vs. 24%, $\chi^2=44.3$), gestational week < 37 weeks (74% vs. 25%, $\chi^2=23.4$), and blood loss > 800ml (80% vs. 47%, $\chi^2=5.5$) were related to the higher postoperative intensive care unit (ICU) care rate of parturients ($P<0.05$). ASA grade III-IV of parturients (11.0 ± 7.5 day vs. 6.9 ± 3.3 day, $t=-2.99$), gestational week < 37 weeks (11.0 ± 8.4 day vs. 7.5 ± 5.1 day, $t=2.47$) were related to the longer hospital stay ($P<0.05$). Higher ASA grade of parturients (6.37 ± 2.9 day vs. 7.64 ± 2.1 day, $t=2.21$, $P=0.01$), gestational week < 37 weeks (6.46 ± 2.4 day vs. 8.02 ± 2.2 day, $t=-3.21$, $P=0.002$) were related to lower one-minute Apgar score of neonates.

Conclusion Pregnancy with internal and surgical diseases is the most common reason for choosing GA for CS. The high ASA grade and short gestation were the related factors of high postoperative ICU care ratio for parturients and low one-minute Apgar score for neonates.

NEURAXIAL block is the common choice for cesarean section (CS) procedure. It could provide effective pain control, mobility control and fast recovery to daily activities, which is important for new mothers' life quality.¹ The latest obstetric anesthesia guidelines still recommend spinal anesthesia as the preferred anesthesia for most cesarean section.²

However, in some circumstances (e.g., profound fetal bradycardia, ruptured uterus, severe hemorrhage, severe placental abruption, umbilical cord prolapse, and preterm footling breech), general anesthesia (GA) may be the most appropriate choice because it can provide better circulation and airway control. GA even is routinely chosen for CSs in some hospitals.²

In our Hospital, the routine anesthesia method for CS is neuraxial block, mainly using combined subarachnoid and epidural anesthesia (CSEA). GA is considered when parturients have contraindications for neuraxial block, in emergency, or under certain urgent circumstances such as concurrent severe heart diseases. In this retrospective study, we focused on the reasons for choosing GA for CS, and tried to find factors related to poor outcome of parturients and neonates after CS under GA.

MATERIALS AND METHODS

Patient selection and data collection

This retrospective cohort study was approved by the Ethics Committee of PUMC Hospital (S-K882). Written informed consent was waived. The inclusion criteria are maternity patients receiving CS under GA in our hospital from January 1, 2014 to December 31, 2016. Those with gestational week less than 28 weeks were excluded from the study. We retrospectively collected

data including the following aspects: 1) the baseline maternal information: age, height, weight, body mass index (BMI), and gestation week; 2) preoperative status: maternal diseases (i.e., preexisting cardiac, hypertension, respiratory, renal, hematologic, neurologic, and neoplastic disorders), pregnancy-related complications, American Society of Anesthesiologists' Physical Status (ASA) grade; 3) perioperative information: the indications for GA, urgency of case, fasting time, mode of airway management, anesthetic medications used for induction and maintenance; 4) maternal outcomes: whether or not admitted to the Intensive Care Unit (ICU), time stayed in ICU; 5) fetal outcomes: neonatal Apgar scores, whether or not admitted to the Neonatal ICU (NICU). The follow-up of the maternal and fetal outcomes lasted till parturient and neonate were discharged from hospital.

Data analysis

Categorical data were presented as counts and percentage. The distribution of continuous variables was checked using visual inspection of the histogram. Variables normally distributed were reported as means and standard deviation (SD). The gestational week was reported as means and quartiles. The t-test was performed to compare the hospitalization time of the parturients, the fetal's one-minute Apgar score between different ASA grades or gestational weeks. The chi-square test was performed on the postoperative ICU ratio of parturients with different ASA grades, gestational weeks, and intraoperative blood loss. The analyses were performed using the SPSS software (version 19.0, SPSS, Inc., Chicago, IL, USA).

RESULTS

Patients and characteristics

Upon data from the electronic medical record system, totally there were 3789 patients receiving cesarean sections from January 1, 2014 to December 31, 2016. Among them 3680 cases were under neuraxial block, 109 cases were under GA. The patient selection procedure is illustrated in Figure 1. In total, 98 cases were enrolled in the study, with mean age of 31.3 ± 4.6 years old, ranging from 14-48 years old. The median gestational week was 36.6[34.3, 38.7] weeks. There were 58(59.2%) cases of ASA grade I-II, 40(40.8%) cases of ASA grade III-IV. Regarding intra-operative blood loss, there were 83(84.7%) and 15(15.3%) case whose blood loss were less than 800ml, and more than 800ml, respectively.

Factors related to GA for cesarean section

The details of clinical characteristics for the enrolled cases who had GA for cesarean section regarding maternal and fetal factors were shown in **table 1**.

Maternal and fetal outcomes

Outcomes of parturient

In 98 cases of CS under GA, compared with ASA grade III-IV, gestational week <37 and intraoperative blood loss ≥ 800 ml cases, the postoperative ICU ratio was lower in parturients with ASA grade I-II, gestational week ≥ 37 and intraoperative blood loss <800ml

Figure 1. Flowchart of patients enrolling in this study.

Table 1. Pathogenies of cesarean section under general anesthesia in PUMC Hospital (n=98)

Category	Pathogenies	n	%
Maternal Factors			
Pregnancy-specific disorders: eclampsia, HELLP syndrome, gestational diabetes.		36	36.7
Pregnancy with internal and surgical diseases: anemia, thrombocytopenia, idiopathic thrombocytopenic purpura, acute fatty liver; fatty liver, acute pancreatitis; systemic lupus erythematosus, antiphospholipid antibody syndrome, hyperthyroidism; maternal hypothyroidism.		59	60.2
Pregnancy with placenta and fetal membrane abnormalities: placenta previa, placental abruption, premature rupture of membranes.		38	38.8
Pregnancy with amniotic fluid and umbilical cord abnormalities: amniotic fluid, oligohydramnios, umbilical cord abnormalities.		21	21.4
Abnormal delivery: abnormal birth canal, abnormal force of labor abnormal fetal position.		8	8.2
Complications during parturient period: uterine rupture.		2	2.0
Pregnancy with orthopedic diseases: spine scoliosis, lumbar disc herniation.		7	7.1
Pregnancy with infection: colpitis mycotica, vaginal <i>Candida albicans</i> infection.		3	3.1
Pregnancy with mental illness: epilepsy, bi-directional affective disorder.		3	3.1
Fetal Factors			
Intrauterine distress		19	19.4
Stillbirth		6	6.1
Macrosomia		4	4.1
Fetal congenital malformation		1	1.0
Fetal growth restriction		1	1.0

Table 2. Relationship of ASA score, gestation week and blood loss with the post-operative ICU care in parturients of cesarean section under general anesthesia ($n=98$)

Characteristics	Back to GW n (%)	Back to ICU n (%)	χ^2	P
ASA score			44.3	<0.05
I-II	44(76)	14(24)		
III-IV	3(8)	37(92)		
Gestation (week)			23.4	<0.05
< 37	14(26)	40(74)		
≥ 37	33(75)	11(25)		
Blood loss (ml)			5.5	<0.05
< 800	44(53)	39(47)		
≥ 800	3(20)	12(80)		

ASA, American Society of Anesthesiologist; ICU, intensive care unit; GW, general ward

(**Table 2**). The average hospitalization time of parturients with ASA score I-II were 6.9 ± 3.3 days, which is significantly shorter than that of parturients with ASA score III-IV (11.0 ± 7.5 days, $t = -2.99$, $P < 0.05$). The average hospitalization time of parturients with gestational week less than 37 weeks were 11.0 ± 8.4 days, which is significantly longer than that of parturients with gestational week more than 37 weeks (7.5 ± 5.1 days, $t = 2.47$, $P < 0.05$).

Outcomes of neonates

In the 98 cases of CS under GA, 5 neonates were stillborn, no Apgar score was collected. Of 12(12.2%) neonates who had one-minute Apgar score of 1-3, 6 (50.0%) died after surgery, and 6 (50.0%) neonates entered into the Neonatal Intensive Care Unit (NICU). Of 31(31.6%) neonates who had one-minute Apgar scores of 4-7, 1 (3.2%) neonate died, 22 (71.0%) neonates entered the NICU. In 50(51%) neonates whose one-minute Apgar score was 8-10, no postoperative neonatal death, 12 (24%) neonates entered the NICU.

Among the 5 stillborn neonates, the shortest gestational weeks was 26^{+6} weeks and the longest one was 38^{+5} weeks; 2 of parturients with ASA score II, 2 with ASA score III, and 1 with ASA score IV. Among these 5 cases, 4 cases with placental abruption; 1 case with uterine rupture and hemorrhagic shock. The fetal one-minute Apgar scores of parturients with ASA grade I-II and whose gestational week <37 weeks were significantly lower than that of parturients with ASA grade III-IV ($t = 2.21$, $P < 0.05$), and gestational week ≥ 37 group ($t = -3.21$, $P < 0.05$) (**Table 3**).

Table 3. Relationship of maternal ASA score, gestation week and neonate one-minute Apgar score in cesarean section under general anesthesia ($n=98$)

Characteristics	n	One-minute Apgar score	t	P
ASA score			2.21	0.01
I-II	58	7.64 ± 2.1		
III-IV	40	6.37 ± 2.9		
Gestational (week)			-3.21	0.002
< 37	54	6.46 ± 2.4		
≥ 37	44	8.02 ± 2.2		

ASA, American Society of Anesthesiologist

DISCUSSION

Indications of GA for CS: factors of parturients

1. Pregnancy with internal or surgical diseases

Among internal and surgical diseases, women who have heart disease during pregnancy often present to the emergency center with obvious symptoms, eg., wheezing, orthopnea, hypoxemia, and etc. The heart diseases include perinatal cardiomyopathy, decreased systolic function of left and right ventricular myocardium, pericardial effusion, pulmonary hypertension. These women need to undergo cesarean section to terminate pregnancy in order to reduce the burden on heart and lungs and save the mother and child.

Hypotension during spinal and epidural anesthesia is mainly a result of sympathetic blockade, which causes pooling of blood into the lower extremities³ and sometimes can cause instability of breathing and circulation. Compared with neuraxial block, general anesthesia can achieve a steadier adjustment of anesthesia depth by adjusting the dosage of anesthetic, which being able to reduce the impact of anesthesia on cardiopulmonary function and ensure the safety of mother and child as much as possible. So in most of these cases, we chose general anesthesia, which was consistent with other medical groups.⁴

Besides, there are parturients with digestive diseases, acute pancreatitis, even systemic inflammatory response syndrome, ect. Pregnant women with these diseases often took urgent visit. The obstetricians needed time to collect clinical data to determine whether patients need emergent cesarean section or not. Sometimes, parturients fail to cooperate with anesthesiologists for neuraxial block due to a variety of reasons, such as pain or irritability. In this situation,

general anesthesia may be more beneficial to women with high possibility of puncture failure, or those need exploratory laparotomy after cesarean section.

Other common internal diseases are platelet and coagulation disorders. Previous data has shown the thrombocytopenia (TP) affects 7-10% of pregnant women. In recent years, many experts believe that the platelet count in a range of $(75-100) \times 10^9$ is safe for spinal anesthesia applied to CS, and the platelet count under 50×10^9 requires careful assessment on the overall situation whether spinal anesthesia can be applied.⁵ In the current study, as some parturients were concurrent with idiopathic thrombocytopenic purpura, hemophilia, neuraxial block might cause serious consequences such as epidural hematoma, we applied GA to ensure patient's safety and reduce the risks of postoperative complications.⁶

2. Pregnancy with pregnancy-specific disorder

Experts from World Health Organization mentioned that about 6-10% pregnant women developed pregnancy induced hypertension (PIH),⁷ which is a common cause of death for parturients and neonates. In the cohort of our study, 31% cases had pregnancy-specific hypertensive disorders, including pre-eclampsia, eclampsia, pregnancy with chronic hypertension, and chronic hypertension complicated by pre-eclampsia. For patients with poor controlled disease or in emergent situation, treatment should be cautious under close monitoring the condition of mother and neonates; and when necessary, terminate pregnancy at an appropriate time. In this situation, GA can achieve rapid induction and comprehensive effects of sedation, analgesia and muscle relaxant for the operation.

Another pregnancy-specific disease in this cohort is gestational diabetes mellitus (GDM). GDM is a risk factor for emergency CS.⁸ Women with GDM had relatively higher possibilities to develop macrosomia, cephalopelvic disproportion, and dystocia. Therefore, GDM is a good indication of GA, especially for those who have to receive emergent CS or have unsuccessful neuraxial block due to obesity.

3. Pregnancy with placenta and fetal membrane abnormalities

Premature rupture of membranes (PROM) is a common disease during pregnancy and the incidence is about 4 per thousand. The subsequent complica-

tions include chorioamnionitis, pulmonary hypoplasia, restriction deformities, fetal loss, and complications of extreme prematurity among surviving neonates.⁹ The preferred method for labor induction in the patient with PROM remains controversial.¹⁰

4. Pregnancy with orthopedic diseases

Because the orthopedic department of our hospital is well recognized for treating idiopathic scoliosis, there were 7 parturients with orthopedic diseases (all were spine-related diseases) in our cohort, which was relatively high. At present, contraindications for intraspinal anesthesia associated with the spine include: deformity, trauma, spinal tuberculosis, tumors, multiple sclerosis of the spinal cord, meningitis, and skin infection near the puncture site. The 7 parturients above were all concurrent with lumbar disc herniation and scoliosis. Symptomatic lumbar disc herniation is the most common spinal pathology in pregnancy. Therefore, for parturient with spine-related orthopedic diseases, anesthesiologists need to be cautious about the contraindications of neuraxial block and carefully choose anesthetic method. GA is always a good option in this situation.

5. Pregnancy with mental illness

The prevalence of epilepsy in pregnant women was reported to be 0.3%-0.7%.¹¹ Over 90% of pregnancies in women with epilepsy did not develop any complication.¹² Although epilepsy is not a contraindication to any mode of anesthesia or analgesia, anesthesiologists should be alert about the effects of narcotics on epileptic patients.¹³ It is reasonable to take the GA with Rapid Sequence Intubation (RSI) to terminate delivery quickly, because some commonly used anesthetics for GA, such as high-dose propofol¹³ and midazolam¹⁴ are antiepileptic.

Indications of GA for CS: factors of neonates

Stillbirth mainly relates with labor dystocia (prolonged obstructed labor and/or uterine rupture) and obstetric hemorrhage. Also, compared with cesarean delivery, women who have spontaneous vaginal delivery are with higher odds of stillbirth.¹⁴ Therefore, for parturient with serious complications or in emergency situations, the proper surgical procedures, timing for surgery, parturients' physical and mental conditions, and their individual will should be considered comprehensively. It may be more appropriate to choose CS under GA.

Fetal distress occurs in 19% of the current cohort. Rapid reaction is crucial to achieve a delivery under urgent situation, and measures should be taken decisively to improve the fetal hypoxia status.¹⁵ There has been no universal consensus on an acceptable time to achieve delivery by caesarean section or vaginal assistance in condition of fetal distress.¹⁶ At present, there is no conclusion about the influence of anesthetic methods on the prognosis of parturients and neonates after CS. A variety of anesthetic methods seem to be safe, but regional blockade shows more advantages on neonatal outcome.¹⁷

Maternal and fetal outcomes

In 98 cases of CS under GA, we found that for the parturients, ASA grade III-IV, gestational week <37 and intraoperative blood loss ≥ 800 ml cases were related to high post-operative ICU care ratio. As the ASA grade defines the condition of the parturients, the overall mortality and complication mobility increase with increase of ASA grade. The shorter gestational week, the more urgent of the operation, and the higher risk of parturient. With increase of intraoperative blood loss, the postoperative risk of a parturient increases.

For neonates, we chose the one-minute Apgar score to evaluate the outcome. The result showed ASA grade III-IV and gestational week <37 were also the factors that related to the low one-minute Apgar score.

As we didn't compare the neonatal outcome between neuraxial block and GA, we can't provide evidence in which anesthetic method is better for the maternal and fetal outcomes. Some literatures showed no difference in neonatal outcomes between general and regional anesthesia for caesarean section when only out-of-risk newborns were analyzed.¹⁸ But for the very preterm infants (27-32 weeks), multivariate analysis showed that neuraxial block was associated with an increased risk of neonatal mortality compared to GA, disregarding the gestational age, characteristics of pregnancy, delivery and neonates.¹⁹

In conclusion, pregnancy with internal and surgical diseases, including anemia, thrombocytopenia, idiopathic thrombocytopenic purpura, acute fatty liver; fatty liver, acute pancreatitis; systemic lupus erythematosus, antiphospholipid antibody syndrome, hyperthyroidism; maternal hypothyroidism, etc., was the most common reasons for choosing GA for CS. The indication of the anesthetic method is consistent

with the Practice Guidelines for Obstetric Anesthesia,² in which the consultants and ASA members strongly suggested that (1) the decision to use a particular anesthetic technique for CS should be individualized, based on anesthetic, obstetric, or fetal risk factors (e.g., elective vs. emergency), patient's preferences, and anesthesiologist's judgement; (2) consider selecting neuraxial techniques in preference to GA for most CS; (3) GA may be the most appropriate choice in some circumstances (e.g., profound fetal bradycardia, ruptured uterus, severe hemorrhage, severe placental abruption, umbilical cord prolapse, and preterm foetling breech). For the parturients, with the increase of maternal ASA scores, the post-operative ICU care rate increased. For the neonates, with the increase of Apgar scores, neonates showed better prognosis.

Conflict of interest statement

All authors declared no conflicting interests.

REFERENCES

1. Ghaffari S, Dehghanpisheh L, Tavakkoli F, et al. The effect of spinal versus general anesthesia on quality of life in women undergoing cesarean delivery on maternal request. *Cureus* 2018; 10(12): e3715. doi: 10.7759/cureus.3715.
2. Jeffrey LA, Joy LH, Madhulika A, et al. Practice guidelines for obstetric anesthesia: an updated report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia and the Society for Obstetric Anesthesia and Perinatology. *Anesthesiology* 2016; 124(2):270-300. doi: 10.1097/ALN.0000000000000935.
3. Sun HL, Ling QD, Sun WZ, et al. Lower limb wrapping prevents hypotension, but not hypothermia or shivering, after the introduction of epidural anesthesia for cesarean delivery. *Anesth Analg* 2004; 99(1):241-5. doi: 10.1213/01.ane.0000121346.33443.5a.
4. Turnbull J, Bell R. Obstetric anaesthesia and peripartum management. *Best Pract Res Clin Obstet Gynaecol* 2014; 28(4):593-605. doi: 10.1016/j.bpobgyn.2014.03.008.
5. Şule Ö, Bahar KB, Belkıs Ş. Anaesthesia for caesarean section of pregnant women with idiopathic thrombocytopenic purpura. *Turk J Anaesthesiol Reanim* 2013; 41(5): 175-177. doi: 10.5152/TJAR.2013.21
6. Linden OL, Brian TB, Sachin K, et al. Risk of epidural hematoma after neuraxial techniques in

- thrombocytopenic parturients: a report from the multicenter perioperative outcomes group. *Anesthesiology* 2017;126: 1053-63. doi: 10.1097/ALN.0000000000001630.
7. WHO Recommendations for Prevention and Treatment of Pre-Eclampsia and Eclampsia. Geneva: World Health Organization; 2011. Summary of recommendations. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK140555/>. Accessed 2019 November 21.
 8. Rosário G, Ângela M. Gestational diabetes mellitus: A risk factor for non-elective cesarean section. *J Obstet Gynaecol Res* 2012; 38(1):154-9. doi: 10.1111/j.1447-0756.2011.01659.x.
 9. Waters TP, Mercer BM. The management of preterm premature rupture of the membranes near the limit of fetal viability. *Am J Obstet Gynecol* 2009; 201(3):230-40. doi: 10.1016/j.ajog. 2009.06.049.
 10. Packard RE, Mackeen AD. Labor induction in the patient with preterm premature rupture of membranes. *Semin Perinatol* 2015; 39(6):495-500. doi: 10.1053/j.semperi.2015.07.015.
 11. Borthen I, Eide MG, Veiby G, et al. Complications during pregnancy in women with epilepsy: population-based cohort study. *Br J Obstet Gynaecol* 2009; 116(13):1736-42. doi: 10.1111/j.1471-0528.2009.02354.x
 12. Viinikainen K, Heinonen S, Eriksson K, et al. Community-based, prospective, controlled study of obstetric and neonatal outcome of 179 pregnancies in women with epilepsy. *Epilepsia* 2006; 47(1):186-92. doi: 10.1111/j.1528-1167.2006.00386.x.
 13. Voss LJ, Sleigh JW, Barnard JPM, et al. The howling cortex: seizures and general anesthetic drugs. *Anesth Analg* 2008; 107(5):1689-703. doi:10.1213/ane.0b013e3181852595.
 14. Olagbuji BN, Ezeanochie MC, Igbaruma S, et al. Stillbirth in cases of severe acute maternal morbidity. *Int J Gynecol Obstet* 2012; 119(1):53-6. doi: 10.1016/j.ijgo.2012.05.032.
 15. Murphy KW, Johnson P, Moorcraft J, et al. Birth asphyxia and the intrapartum cardiotocograph. *Br J Obstet Gynaecol* 1990; 97(6):470-9. doi: 10.1111/j.1471-0528.1990.tb02515.x.
 16. Olagundoye V, Black R, Mackenzie IZ. Impact of the severity of fetal distress on decision-to-delivery intervals for assisted vaginal delivery. *J Obstet Gynaecol* 2008; 28(1):51-5. doi:10.1080/01443610701812132.
 17. Mancuso A, De Vivo A, Giacobbe A, et al. General versus spinal anaesthesia for elective caesarean sections: effects on neonatal short-term outcome. A prospective randomised study. *J Matern Fetal Neonatal Med* 2010; 23(10):1114-8. doi: 10.3109/14767050903572158.
 18. Harazim H, Stourac P, Blaha J, et al. The influence of mode of anaesthesia for caesarean delivery on neonatal Apgar scores in the Czech Republic and Slovakia: secondary analysis of the results of an international survey in 2015. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub* 2019; 163(2):147-54. doi: 10.5507/bp.2019.008.
 19. Laudénbach V, Mercier FJ, Rozé JC, et al. Anaesthesia mode for caesarean section and mortality in very preterm infants: an epidemiologic study in the EPIPAGE cohort. *Int J Obstet Anesth* 2009; 18(2):142-9. doi: 10.1016/j.ijoa.2008.11.005.