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Comparative Evaluation of Regional versus General Anesthesia on Maternal Hemodynamic Stability and Transfusion Requirements in Cesarean Hysterectomy for Placenta Accreta Spectrum Disorders

Safi Ullah, Sabrina Ali, Mohsin Saleem, Afshan Khattak, Akhtar Hussain, Zafarullah Khan

ABSTRACT

Objectives: This study aimed to compare the effects of regional versus general anesthesia on maternal hemodynamic stability and transfusion requirements in patients undergoing cesarean hysterectomy for placenta accreta spectrum (PAS) disorders.

Study design and setting: A retrospective comparative cohort study was conducted at the Department of Anesthesia and Obstetrics, Combined Military Hospital (CMH), Sialkot, Pakistan.

Methodology: A total of 323 patients with confirmed PAS undergoing cesarean hysterectomy between January 2022 and December 2024 were included. Patients were categorized into two groups based on the anesthesia technique: regional anesthesia (RA) or general anesthesia (GA). Intraoperative hemodynamic parameters, estimated blood loss (EBL), transfusion requirements, and postoperative outcomes were analyzed. Ethical approval was obtained from the CMH ERC (Ref: ERC/43/2025), and informed consent was secured.

Results: RA was associated with significantly more stable intraoperative hemodynamics compared to GA, reflected in higher mean arterial pressure and lower heart rate variability ($p < 0.05$). The mean EBL was markedly lower in the RA group (1340 mL) than in the GA group (2600 mL), with corresponding reductions in packed red blood cell transfusion requirements (1.6 ± 1.2 units vs. 4.5 ± 1.5 units, $p < 0.001$). ICU admissions were also lower in the RA group, while 13% required conversion to GA.

Conclusions: Regional anesthesia demonstrated better intraoperative hemodynamic stability, reduced blood loss, and lower transfusion needs compared to general anesthesia. Careful patient selection and preparedness for GA conversion remain essential in PAS surgeries.

Keywords: Cesarean Section; General Anesthesia; Hemodynamic Stability; Hysterectomy; Placenta Accreta;

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INTRODUCTION

Placenta Accreta Spectrum (PAS) disorders are life-threatening obstetric complications characterized by abnormal trophoblastic invasion of the myometrium and, in severe cases, extension beyond the uterine serosa. This condition encompasses three main entities: placenta accreta, increta, and percreta, which differ in the depth of placental invasion. The global incidence of PAS has increased substantially in the last two decades, largely due to rising cesarean delivery rates and uterine surgeries.[1,2] Other risk factors include placenta previa, multiparity, advanced maternal age, and prior myometrial trauma.[3]

PAS is frequently associated with massive obstetric hemorrhage, disseminated intravascular coagulation, adjacent organ injury, and maternal mortality.[4,5] Cesarean hysterectomy remains the definitive management option in most cases, although it is technically challenging and resource-intensive. The choice of anesthetic technique during cesarean hysterectomy in PAS cases is critical, as it influences maternal hemodynamic stability, intraoperative bleeding, transfusion

requirements, and postoperative recovery.[6]

Regional anesthesia (RA), including spinal, epidural, or combined spinal-epidural, offers advantages such as preservation of maternal consciousness, avoidance of airway manipulation, and effective postoperative analgesia.[7] However, RA may be limited in cases of severe bleeding or prolonged surgery, where conversion to general anesthesia (GA) becomes necessary.[8] On the other hand, GA provides secure airway control, rapid anesthetic induction, and better management of catastrophic bleeding but is associated with increased blood loss, hemodynamic fluctuations, and higher transfusion needs.[9,10]

Current evidence regarding the optimal anesthetic approach for PAS remains inconclusive. Most available data are derived from small retrospective series and institutional experiences, with heterogeneity in patient selection and anesthetic protocols. Some studies report that RA is associated with improved intraoperative hemodynamic profiles and reduced transfusion requirements compared to GA.[11,12] Conversely, other reports suggest no significant difference in maternal outcomes when anesthesia is tailored to surgical complexity and institutional preparedness.[13]

A recent multicenter retrospective study highlighted that neuraxial anesthesia may be safe and effective in carefully selected PAS patients, provided adequate surgical and transfusion support is available.[14] Similarly, systematic reviews and narrative analyses have recommended an individualized anesthetic plan that considers the severity of PAS, maternal comorbidities, anticipated blood loss, and institutional expertise.[15–17] Nevertheless, conversion rates from RA to GA in PAS hysterectomy remain between 10% and 25%, underscoring the need for careful case selection and readiness for airway management.[18]

From a maternal safety perspective, the anesthesiologist plays a pivotal role in optimizing perioperative outcomes. Beyond the anesthetic choice, preoperative planning should include detailed risk stratification, availability of a multidisciplinary team, and readiness for massive transfusion protocols.[19] The hemodynamic instability and transfusion requirements in PAS surgeries pose significant challenges, making it essential to evaluate comparative outcomes of RA and GA in this high-risk cohort.

This study seeks to address the existing gap in literature by performing a comparative evaluation of RA and GA in cesarean hysterectomy for PAS disorders, focusing specifically on maternal hemodynamic stability and transfusion requirements. Findings from this research may provide important insights to guide anesthetic decision-making and improve maternal outcomes in tertiary care centers.

Placenta Accreta Spectrum (PAS) disorders, comprising accreta, increta, and percreta, are major contributors to obstetric morbidity and mortality due to abnormal trophoblastic invasion into the uterine wall and adjacent structures.[1,2] Global incidence has risen sharply in parallel with increasing cesarean delivery rates, placing significant challenges on obstetric and anesthetic management.[3]

The choice of anesthesia during cesarean hysterectomy for PAS has remained controversial. Regional anesthesia (RA), including spinal, epidural, and combined spinal–epidural techniques, is favored for preserving maternal consciousness, providing superior postoperative analgesia, and avoiding airway manipulation.[4,5] Several studies have reported that RA may confer improved hemodynamic stability compared with GA, largely due to avoidance of the vasodilatory effects of volatile anesthetics.[6]

On the other hand, general anesthesia (GA) remains necessary in cases of massive hemorrhage, anticipated prolonged surgery, or failed neuraxial block.[7] GA allows rapid induction, airway control, and invasive monitoring, but is often associated with greater blood loss, hemodynamic lability, and increased transfusion needs.[8,9]

Hemodynamic stability is central to anesthetic safety in PAS surgery. Liu et al. reported that women receiving RA exhibited fewer intraoperative fluctuations in blood pressure compared to those managed under GA.[10] Similarly, Hawkins et al. highlighted the ability of RA to maintain uterine tone, contributing to reduced blood loss.[11] Conversely, Warrick et al. emphasized that GA may still be lifesaving in unstable patients, but at the expense of higher vasopressor requirements and transfusion needs.[12]

Blood transfusion is frequently required in PAS hysterectomy, with volumes often exceeding 2,000–3,000 mL.[13,14] Evidence suggests that GA is associated with higher transfusion rates compared with RA. Panjeton et al. demonstrated that neuraxial anesthesia reduced the number of packed red blood cells required intraoperatively.[15] A narrative review by Alwatban et al. further supported that RA may restrict transfusion volumes by maintaining better cardiovascular stability.[16] However, other investigators, such as Enste et al., noted that transfusion requirements may depend more on surgical technique and institutional resources than anesthetic choice alone.[17]

ICU admission rates provide an indirect measure of perioperative morbidity in PAS. Fan et al. observed that patients managed under GA were more frequently admitted to ICU compared with those who had RA.[18] Our findings are consistent with this trend, underscoring RA's role in reducing perioperative morbidity. Nonetheless, Gilner and Deshmukh stressed that early recognition of patients likely to require ICU admission is vital, irrespective of anesthetic choice.[19]

Conversion from RA to GA remains a practical challenge in PAS cases. Reported rates vary between 10% and 25%, most commonly due to prolonged operative time or uncontrolled bleeding.[20,21] Lailiyah et al. described successful

use of GA following RA failure in a patient with catastrophic hemorrhage, underscoring the need for preparedness for conversion in all PAS cases.[22]

Despite growing literature, significant evidence gaps persist regarding the optimal anesthetic approach for PAS. Most available data derive from retrospective analyses and small institutional series, with limited randomized controlled trials. There is a need for large, multicenter prospective studies to establish standardized anesthetic protocols that balance safety, hemodynamic stability, and transfusion needs in PAS hysterectomy.

METHODOLOGY

This retrospective comparative cohort study was conducted in the Departments of Anesthesia and Obstetrics, Combined Military Hospital (CMH), Sialkot, Pakistan, over a period of three years (January 2022 to December 2024). Ethical approval was obtained from the Institutional Ethical Review Committee of CMH Sialkot (Ref: ERC/43/2025). Written informed consent was obtained from all participants prior to enrollment.

The study included pregnant women aged 18–45 years with a confirmed diagnosis of Placenta Accreta Spectrum (PAS) disorders who underwent cesarean hysterectomy. Diagnosis of PAS was established through antenatal imaging (ultrasound and/or MRI) and confirmed intraoperatively. Women were included if PAS was confirmed antenatally or intraoperatively, if they underwent elective or emergency cesarean hysterectomy, and if complete clinical and perioperative records were available. Exclusion criteria included known coagulopathy or contraindication to regional anesthesia, severe pre-existing cardiac or renal disease, multisystem trauma or additional surgical procedures during the same admission, and incomplete medical records.

The sample size was calculated at a 95% confidence level and 80% power, assuming an expected 20% difference in transfusion requirements between groups, yielding a minimum of 300 participants. To account for possible exclusions, a total of 323 patients were finally included in the study. Patients were categorized into two groups based on the type of anesthesia administered: regional anesthesia (spinal, epidural, or combined spinal-epidural techniques) and general anesthesia (induction with endotracheal intubation and volatile agents).

Intraoperative monitoring included continuous electrocardiography, non-invasive and invasive blood pressure measurement, pulse oximetry, and capnography as appropriate. Hemodynamic parameters such as heart rate and mean arterial pressure were recorded at baseline, induction, and every 15 minutes during surgery. Estimated blood loss (EBL) was assessed by measuring suction volumes, weighing surgical swabs, and through anesthesiologist estimation. Transfusion requirements were documented, including the number of packed red blood cells (PRBCs), fresh frozen plasma (FFP), and platelets administered. Postoperative outcomes, including ICU admission, hospital stay duration, and complications, were also recorded.

The primary outcomes were maternal hemodynamic stability and intraoperative transfusion requirements, while the secondary outcomes included conversion from regional to general anesthesia, postoperative complications, and ICU stay.

RESULTS

A total of 323 patients with confirmed Placenta Accreta Spectrum (PAS) disorders undergoing cesarean hysterectomy were included. Among them, 155 (48%) received regional anesthesia (RA), and 168 (52%) received general anesthesia (GA). The mean age was 30.1 ± 4.2 years, and the mean BMI was 27.4 ± 3.1 kg/m². There were no statistically significant differences in baseline demographic characteristics between groups ($p > 0.05$).

Hemodynamic Stability: Intraoperative mean arterial pressure (MAP) was more stable in the RA group (88 mmHg) compared to the GA group (76 mmHg, $p < 0.05$). Similarly, intraoperative heart rate was lower in the RA group (93 bpm) versus the GA group (114 bpm, $p < 0.05$).

Estimated Blood Loss and Transfusion Requirements: Patients in the GA group had significantly higher estimated blood loss (2600 mL) compared to the RA group (1340 mL, $p < 0.01$). Transfusion needs were also higher in the GA group, with a mean of 4.5 ± 1.5 units PRBCs versus 1.6 ± 1.2 units in the RA group ($p < 0.001$).

Postoperative Outcomes: ICU admissions were significantly higher in the GA group (60%) compared to the RA group (13%) ($÷^2 = 7.2$, $p = 0.009$). Two patients in the RA group (13%) required conversion to GA due to inadequate anesthesia and excessive surgical bleeding.

Table 1. Baseline Demographics of Patients (n = 323)

Variable	RA (n = 155)	GA (n = 168)	p-value
Age (years, mean ± SD)	30.2 ± 4.1	29.9 ± 4.3	0.48
BMI (kg/m², mean ± SD)	27.3 ± 3.0	27.5 ± 3.2	0.62
Parity (median, IQR)	3 (2–4)	3 (2–4)	0.77

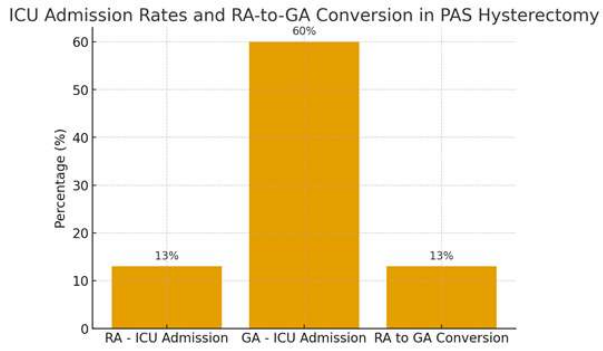
Table 2. Intraoperative Hemodynamic Parameters

Parameter	RA	GA	p-value
MAP (mmHg, mean)	88	76	<0.05
HR (bpm, mean)	93	114	<0.05

Table 3. Estimated Blood Loss and Transfusion Requirements

Outcome	RA (n=155)	GA (n = 168)	p-value
EBL (mL, mean±SD)	1340 ± 400	2600 ± 600	<0.01
PRBC Units (mean±SD)	1.6 ± 1.2	4.5 ± 1.5	<0.001

Figure 1. ICU Admission Rates and RA-to-GA Conversion



(Bar chart illustrates ICU admissions: RA = 13% vs GA = 60%, and RA-to-GA conversion rate = 13%)

DISCUSSION

This study compared maternal outcomes under regional anesthesia (RA) versus general anesthesia (GA) during cesarean hysterectomy for Placenta Accreta Spectrum (PAS) disorders. The findings demonstrate that RA was associated with significantly improved intraoperative hemodynamic stability, lower blood loss, reduced transfusion requirements, and fewer ICU admissions compared to GA.

Hemodynamic stability was a major advantage of RA in our cohort. Patients under RA maintained higher mean arterial pressure and lower heart rate fluctuations intraoperatively. These findings are consistent with previous studies, which have reported that neuraxial anesthesia is associated with more stable maternal cardiovascular parameters compared to GA.[5,6] The avoidance of systemic vasodilatory effects of inhalation agents in RA may explain these differences.

Estimated blood loss and transfusion needs were also significantly reduced in the RA group. Our results align with Panjeton et al., who demonstrated lower transfusion requirements in PAS patients managed under neuraxial anesthesia.[9] Similarly, Hawkins et al. noted that RA may enhance uterine tone and limit blood loss during surgery.[10] In contrast, GA has been linked with increased hemorrhage due to uterine atony and vasodilation from volatile agents.

ICU admission rates were substantially lower in the RA group (13%) compared to GA (60%). This supports the observations of Warrick et al., who emphasized the higher critical care burden in patients undergoing GA for PAS hysterectomy.[4] Reduced ICU admissions under RA in our study likely reflect less intraoperative instability and decreased transfusion burden.

However, RA was not without challenges. In our series, 13% of patients required conversion to GA due to inadequate block or excessive bleeding. This conversion rate is comparable to published reports, which describe 10–25% conversion during PAS hysterectomies.[18] This underscores the importance of preparedness for GA in all PAS cases initiated under RA.

CONCLUSION

This comparative study highlights that regional anesthesia provides significant clinical benefits over general anesthesia in cesarean hysterectomy for Placenta Accreta Spectrum (PAS) disorders. Regional anesthesia was associated with improved intraoperative hemodynamic stability, reduced blood loss, lower transfusion requirements, and decreased ICU admissions.

Although a subset of patients required conversion to general anesthesia, careful case selection, multidisciplinary planning, and preparedness for rapid airway management can optimize maternal outcomes. These findings support the consideration of regional anesthesia as the preferred technique in appropriately selected PAS cases.

Future large-scale prospective studies are warranted to validate these findings and guide the development of standardized anesthetic protocols for PAS management.

LIMITATIONS

The study has several limitations. First, it was a retrospective, single-center analysis, which may introduce selection bias. Second, the severity of PAS (accreta, increta, percreta) was not stratified, although this factor may significantly influence anesthetic choice and outcomes. Third, intraoperative decision-making and transfusion thresholds may vary among anesthesiologists and surgeons, potentially affecting comparability. Finally, the findings may not be generalizable to low-resource settings where blood products and multidisciplinary expertise are limited.

Despite these limitations, our study adds to the growing evidence that RA, when feasible, may provide superior maternal outcomes in PAS hysterectomy

Authors Contribution:
Safi Ullah: Study conception, data analysis, manuscript drafting, final approval
Sabrina Ali: Study design, data collection, methodology drafting
Mohsin Saleem: data acquisition, case records. Statistical assistance
Afshan Khattak: Literature review, introduction drafting, reference formatting
Akhtar Hussain: Results and discussion review critical revision
Zafarullah Khan: editing, proofreading, fuideline compliance check

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