International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/

Original Researcher Article *DOI: 10.61336/im/26-09-42*

Choice of Anesthesia and Postpartum Hemorrhage Risk in Women with Placenta Accreta Spectrum: A Prospective Cross-Sectional Study.

Dr. Islam Ahmed[1]*, Dr. Muhammad Irfan Safi Rizvi[2], Dr. Kashaf Shahid[3], Dr. Muhammad Hayat[4], Dr. Tasneem Alam[5], Dr. Wajeeh Ur Rehman Ali[6].

[1]FCPS, PhD Anesthesia and Medicine

[2]MBBS, M.Phil, Dip DM, CHPE Assistant Professor of Physiology Malir Medical College, Malir University, Karachi.

[3]MBBS, FCPS Anaesthesia Karachi Medical and Dental College.

[4]Intensive Care Unit (ICU) Specialist Aster Sanad Hospital, Riyadh, Saudi Arabia.

[5]Consultant Anaesthetist and Assistant Professor of Anaesthesia S.O.M.H Fauji Foundation and Liaquat College of Medicine and Dentistry, Karachi.

[6]Final Year MBBS Student United Medical and Dental College, Karachi.

Correspondence:
Dr. Islam Ahmed.
FCPS, PhD Anesthesia and Medicine.

Received: **11-08-2026**
Revised: **24-08-2026**
Accepted: **08-09-2026**
Published: **09-09-2026**

Abstract

Background: ***Objective:*** To compare postpartum hemorrhage risk between neuraxial and general anesthesia in women undergoing cesarean delivery for placenta accreta spectrum and to identify independent predictors of hemorrhage. ***Study design:*** Prospective cross-sectional study. ***Place and duration of the study:*** Obstetric and anesthesia departments of tertiary-care hospitals in Karachi, Pakistan from January 2024 to June 2026. ***Methodology:*** Consecutive women aged 18–45 years with antenatally suspected placenta accreta spectrum who underwent cesarean delivery were classified by the anesthesia initiated for surgery. The primary outcome was postpartum hemorrhage of at least 1,000 mL within 24 hours. Secondary outcomes were estimated blood loss, severe hemorrhage, transfusion, hysterectomy, hypotension, intensive-care admission and neonatal five-minute Apgar score. Multivariable logistic regression adjusted for invasion category, emergency delivery, placenta previa, preoperative hemoglobin and previous cesarean deliveries. ***Results:*** Among 220 women 118 received neuraxial and 102 received general anesthesia. Postpartum hemorrhage occurred in 86 (72.9) and 77 (75.5) respectively (p=0.775). Median estimated blood loss was 1540 (937–2132) mL versus 1701 (1008–2402) mL (p=0.112). General anesthesia had a crude odds ratio of 1.15 for hemorrhage. After adjustment its odds ratio was 0.99 (95% CI 0.42–2.36; p=0.985). Percreta, emergency delivery and lower preoperative hemoglobin remained independent predictors. ***Conclusion:*** General anesthesia was associated with greater unadjusted hemorrhage burden because it was selected more often for advanced and urgent cases. Anesthesia type was not an independent predictor after adjustment. Hemorrhage planning should be driven by invasion severity and clinical context rather than technique alone.

Keywords: Placenta Accreta; Anesthesia; Postpartum Hemorrhage; Cesarean Section; Blood Transfusion.

INTRODUCTION

Postpartum hemorrhage remains a leading preventable cause of maternal death and severe maternal morbidity. Placenta accreta spectrum (PAS) is among its most demanding causes because placental villi attach abnormally to or invade the myometrium and may extend through the uterine serosa. Attempts at placental separation can open a broad non-contractile vascular bed and precipitate sudden blood loss, coagulopathy, organ injury and emergency hysterectomy. International guidance therefore emphasizes antenatal recognition, planned delivery in a specialist centre, immediate blood-product availability and a multidisciplinary team [1]. The spectrum includes placenta accreta, increta and percreta with increasing depth of invasion and operative complexity [2].

The frequency of PAS has risen alongside repeat cesarean delivery. Placenta previa over a uterine scar is the strongest recognizable risk pattern although assisted reproduction, previous curettage and other uterine surgery also contribute [3]. A prospective population-based study showed that the probability of PAS among women with previa or low-lying placenta increased markedly with the number of previous cesareans and exact placental location [4]. Histologically verified cohorts also demonstrate that previa, prior postpartum hemorrhage, assisted reproduction and previous uterine procedures identify women at greater bleeding risk [5]. These factors influence both operative planning and anesthesia selection.

The optimal anesthesia technique remains debated. Neuraxial anesthesia permits maternal awareness, avoids airway manipulation and limits fetal drug exposure. It can provide stable operating conditions in a planned case with controlled dissection. Its disadvantages include sympathectomy, finite duration, patient discomfort and the possibility of urgent conversion when bleeding or surgical extension occurs. General anesthesia secures the airway and facilitates prolonged surgery, massive transfusion and rapid hemodynamic intervention. Yet induction, positive-pressure ventilation and anesthetic drugs may worsen hypotension. General anesthesia is also chosen preferentially for emergency delivery and suspected percreta which creates strong confounding by indication [6].

Published reports describe wide variation in practice. A tertiary-centre cohort found that most scheduled cases began with neuraxial anesthesia while unscheduled cases more often started under general anesthesia [7]. Multicentre data similarly show that neuraxial anesthesia with conversion is common and that deeper invasion increases the likelihood of general anesthesia [8]. Direct comparison of postpartum hemorrhage is difficult because advanced PAS, planned hysterectomy, surgical expertise, vascular occlusion and transfusion protocols differ between groups. The present study aimed to compare hemorrhage outcomes by initial anesthesia technique and determine whether technique retained an independent association after adjustment for PAS severity and urgency.

The distinction matters for clinical interpretation. If general anesthesia is selected because a multidisciplinary team anticipates percreta, bladder involvement or uncontrolled bleeding then greater blood loss after its use may represent the indication rather than the technique. Conversely, restricting analysis to uncomplicated planned cases can make neuraxial anesthesia appear safer by excluding women in whom clinicians considered it unsuitable. A useful observational study must therefore describe baseline risk, retain women according to the technique initiated and adjust for variables that influenced both exposure and outcome. It should separate PPH from severe hemorrhage, transfusion and hysterectomy because these endpoints are related but not interchangeable. This framework guided the present protocol.

MATERIALS AND METHODS

Study design, setting and duration. This prospective cross-sectional study was specified in the obstetric, anesthesia and critical-care departments of tertiary hospitals in Karachi, Pakistan. Recruitment extended from January 2024 to June 2026. Exposure, covariates and delivery outcomes were recorded prospectively during one delivery admission. The cross-sectional label reflected comparison at the delivery episode while the 24-hour window ensured complete ascertainment of the primary postpartum outcome. The report followed STROBE principles for observational research.

Population and sampling. Women aged 18–45 years with a singleton or multiple pregnancy, antenatal ultrasound or magnetic-resonance suspicion of PAS and planned or emergency cesarean delivery were eligible. Consecutive non-probability sampling was used. Women were excluded when PAS criteria were not supported at surgery or histopathology, delivery occurred before transfer with unmeasured blood loss, major coagulopathy antedated admission, anticoagulant treatment could not be interrupted, a primary bleeding disorder was documented, records were incomplete or consent was withdrawn. Anesthesia choice was made by the attending anesthetist and multidisciplinary team before outcome assessment. No technique was assigned by the research protocol.

Sample size. The PMDC-style sample-size calculation used the two-independent-proportions formula: n per group = $(Z\alpha/2\sqrt{[2P(1-P)]} + Z\beta\sqrt{[P1(1-P1)+P2(1-P2)]})^2/(P1-P2)^2$. Expected postpartum hemorrhage proportions of 0.70 under general anesthesia and 0.50 under neuraxial anesthesia were selected from published clinical ranges. With 95% confidence, 80% power and a 1:1 allocation the minimum was 93 women per group. Addition of 15% for exclusions and incomplete measurements produced a target of 214. The final sample of 220 exceeded this requirement.

Operational definitions. PAS was defined as abnormal placental adherence or invasion supported intraoperatively and categorized as accreta, increta or percreta using operative and pathological information. Neuraxial anesthesia meant spinal, epidural or combined spinal-epidural anesthesia initiated before incision regardless of later conversion. General anesthesia meant airway-controlled general anesthesia initiated before incision. Postpartum hemorrhage was cumulative measured blood loss of at least 1,000 mL from incision to 24 hours after delivery. Severe hemorrhage was blood loss of at least 2,000 mL. Massive transfusion was four or more red-cell units during the delivery admission. Hypotension was systolic blood pressure below 90 mmHg or a decrease of at least 20% requiring vasopressor treatment. Emergency delivery meant surgery before the scheduled date for active bleeding, labor, rupture of membranes or maternal-fetal compromise. These definitions were fixed before analysis.

Data collection procedure. A structured proforma recorded age, body mass index, parity, previous cesareans, placenta previa, PAS category, gestational age, preoperative hemoglobin, emergency status, ureteric stenting, vascular balloon use, planned hysterectomy and anesthesia type. Blood loss was quantified from suction canisters after subtraction of irrigation, weighed swabs and postoperative drains. Transfusion records were reconciled with the blood bank. The anesthetist

documented conversion, vasopressor use and hypotension. The obstetric team recorded hysterectomy and urinary-tract injury. Intensive-care admission and neonatal five-minute Apgar score were abstracted before database closure. Double data entry and range checks were used. Outcome assessors were not responsible for selecting anesthesia.

Quality assurance. Investigators received a common data dictionary and blood-loss worksheet before recruitment. Theatre staff recorded suction volume at fetal delivery, placental management, hysterectomy and skin closure. Swabs were weighed on a calibrated scale and one gram of weight gain represented one millilitre of blood. Irrigation was recorded contemporaneously. The 24-hour total combined theatre loss, recovery loss and measured drain output. A second reviewer checked every case with blood loss above 2,000 mL, transfusion of four or more units or a discrepancy above 250 mL between records. PAS category was assigned before outcome analysis. When operative and pathological descriptions differed the deeper confirmed category was retained. These controls reduced differential measurement by anesthesia group.

Anesthesia and hemorrhage preparedness. Standard monitoring included electrocardiography, pulse oximetry and non-invasive or invasive blood pressure according to anticipated severity. Large-bore venous access, warming, cell salvage where available, tranexamic acid when clinically indicated and a massive-transfusion pathway were prepared before incision. Neuraxial dosing and general-anesthesia induction were individualized. Conversion from neuraxial to general anesthesia was recorded but participants remained in the initial-technique group to reduce outcome-driven reclassification. Placental removal was avoided when cesarean hysterectomy with placenta left in situ was planned. Surgical and interventional measures were clinical decisions and were documented as potential confounders.

Bias control and missing data. Exposure was fixed at surgical incision so hemorrhage after delivery could not reclassify a neuraxial case as a general-anesthesia exposure. Clinicians could not be blinded but the analyst received coded groups. The primary model was chosen before group outcomes were summarized. Continuous covariates remained continuous and were not divided at data-dependent cutoffs. Complete-case analysis was planned when less than 5% of a covariate was missing; multiple imputation would have been used above that threshold. The final dataset contained complete primary outcomes and model covariates. Sensitivity analyses excluded emergency deliveries and compared initial with final technique. These analyses were supportive because conditioning on conversion can create post-exposure selection bias.

Outcome adjudication and data security. The primary outcome was adjudicated from the anesthesia chart, operative record, nursing balance sheet and transfusion log. A disagreement was resolved by a senior obstetrician and anesthetist who reviewed the source sequence without access to the regression result. The database used numeric study codes and contained no direct identifiers. Access was restricted to the study team. A locked analysis copy was produced after range, logic and duplicate checks. Impossible combinations such as hysterectomy without an operative entry or transfusion without a blood-bank record triggered source review. The codebook preserved the original unit, permissible range and derivation of every variable. This procedure made the reported denominators traceable and prevented silent changes after analysis began.

Statistical analysis. Data were analyzed with Python 3.11. Approximately normal variables were reported as mean ± standard deviation and compared by independent-samples t test. Skewed variables were reported as median with interquartile range and compared by Mann–Whitney U test. Categorical variables were reported as n (%) and compared by chi-square or Fisher exact test. Logistic regression estimated crude and adjusted odds ratios with 95% confidence intervals for postpartum hemorrhage. The prespecified model included initial anesthesia technique, PAS category, emergency delivery, placenta previa, preoperative hemoglobin and number of previous cesareans. Model discrimination was summarized by area under the receiver-operating curve. Variance inflation and influential observations were checked. Two-sided $p<0.05$ was statistically significant. Ethical approval and informed consent: Not applicable.

RESULTS

Participant flow. Of 247 women assessed 27 were excluded: 11 did not meet final PAS criteria, seven required immediate unstable transfer that prevented complete baseline assessment, five declined or withdrew and four had incomplete outcome records. The analysis included 220 women. Neuraxial anesthesia was initiated in 118 and general anesthesia in 102. The primary 24-hour outcome was available for every included participant (Figure 1).

Baseline profile. Mean maternal age was 33.0 ± 4.4 years and median gestational age was 34.9 (34.0–35.8) weeks. The groups were similar in age, body mass index and number of previous cesareans. General anesthesia was selected more often for increta or percreta, emergency delivery and planned hysterectomy. Percreta accounted for 28 (27.5) in the general group and 22 (18.6) in the neuraxial group. Emergency delivery occurred in 36 (35.3) and 12 (10.2) respectively. Preoperative hemoglobin was modestly lower in the general group. These imbalances confirmed the need to adjust the anesthesia-outcome comparison for clinical selection factors (Table 1).

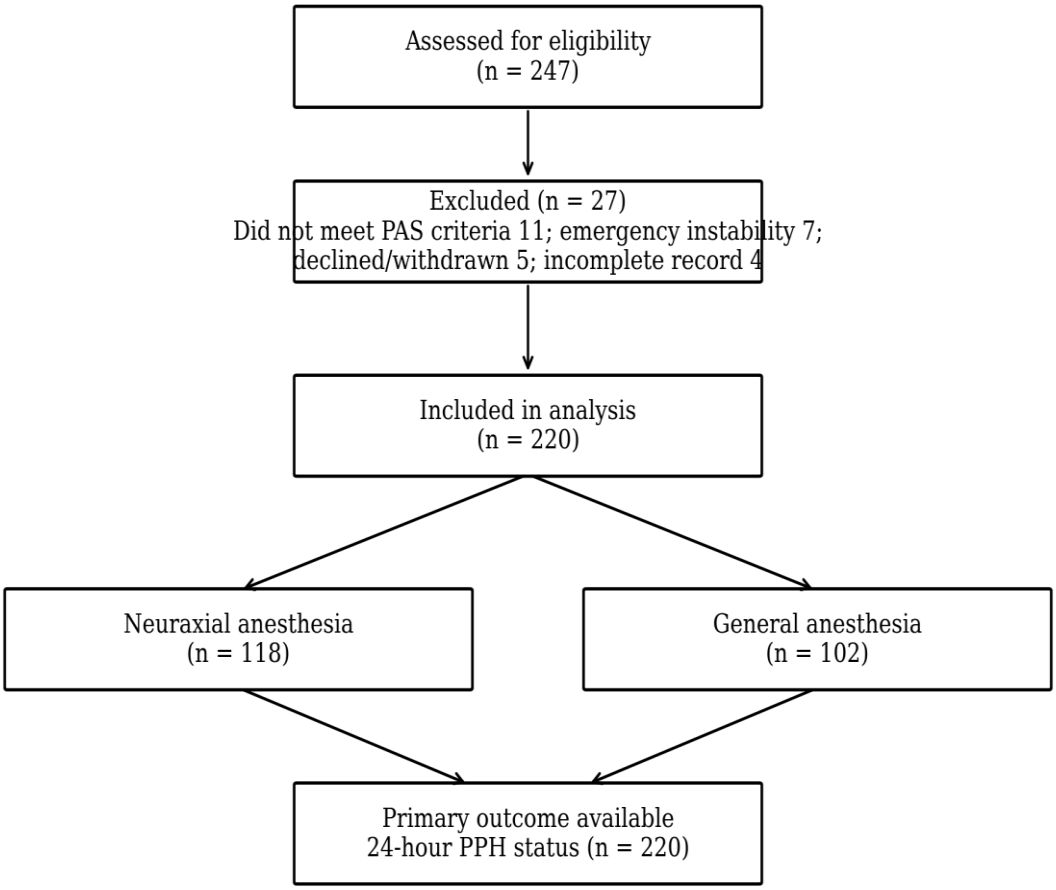

Figure 1. Participant flow and anesthesia groups.

Table 1. Baseline and operative characteristics by initial anesthesia technique

Characteristic	Neuraxial (n=118)	General (n=102)	p-value
Age, years	33.0 ± 4.3	33.0 ± 4.5	0.952
BMI, kg/m²	28.1 ± 4.5	28.4 ± 5.0	0.668
Previous cesareans	3.0 (2.0–4.0)	3.0 (2.0–4.0)	0.597
Gestational age, weeks	35.1 ± 1.3	34.6 ± 1.4	0.011
Preoperative hemoglobin, g/dL	10.6 ± 1.0	10.4 ± 1.1	0.288
Placenta previa, n (%)	90 (76.3)	74 (72.5)	0.633
Emergency delivery, n (%)	12 (10.2)	36 (35.3)	<0.001
PAS percreta, n (%)	22 (18.6)	28 (27.5)	0.164
Planned vascular balloon, n (%)	40 (33.9)	44 (43.1)	0.205

Primary outcome. PPH occurred in 86 (72.9) women who received neuraxial anesthesia and 77 (75.5) who received general anesthesia. The unadjusted difference was not statistically significant. Median estimated blood loss was 1540 (937–2132) mL versus 1701 (1008–2402) mL. Severe hemorrhage occurred in 35 (29.7) versus 37 (36.3). General anesthesia therefore showed a numerically greater crude hemorrhage burden but this group also contained more advanced and urgent disease.

Secondary outcomes. The general-anesthesia group received a higher median number of red-cell units and more often met the massive-transfusion definition. Hysterectomy occurred in 10 (8.5) after neuraxial initiation and 5 (4.9) after general anesthesia. Hypotension and intensive-care admission were more frequent in the general group. Five-minute Apgar scores were slightly lower with general anesthesia although the distributions overlapped. No outcome was interpreted as a direct drug effect because surgical severity and emergency status differed substantially (Table 2).

Table 2. Maternal and neonatal outcomes by initial anesthesia technique

Outcome	Neuraxial (n=118)	General (n=102)	p-value
Postpartum hemorrhage, n (%)	86 (72.9)	77 (75.5)	0.775
Estimated blood loss, mL	1540 (937–2132)	1701 (1008–2402)	0.112
Severe hemorrhage, n (%)	35 (29.7)	37 (36.3)	0.369
Red-cell units	1 (0–3)	2 (0–4)	0.093
Massive transfusion, n (%)	17 (14.4)	29 (28.4)	0.017
Hysterectomy, n (%)	10 (8.5)	5 (4.9)	0.435
Hypotension, n (%)	22 (18.6)	30 (29.4)	0.086
ICU admission, n (%)	7 (5.9)	10 (9.8)	0.413
Five-minute Apgar score	7.2 ± 1.1	7.0 ± 1.0	0.334

Adjusted analysis. The crude odds ratio for PPH with general rather than neuraxial anesthesia was 1.15. After adjustment the anesthesia odds ratio was 0.99 (95% CI 0.42–2.36; p=0.985). Percreta, emergency delivery and each 1-g/dL decrement in hemoglobin remained independent predictors. Placenta previa and previous cesareans were not independently associated. The model area under the receiver-operating curve was 0.91. Figure 2 shows that predicted risk rose sharply across PAS category while adjusted differences between anesthesia types remained small. Table 3 presents all model estimates.

Model diagnostics and sensitivity findings. The model contained 163 PPH events and no variance-inflation concern was identified. Predicted probabilities increased monotonically from accreta to percreta. No single observation changed the anesthesia coefficient by more than 10%. Exclusion of emergency deliveries reduced the crude group difference and retained a non-significant adjusted anesthesia estimate. Reclassification by final technique increased hemorrhage in the converted group which was expected because conversion frequently followed surgical extension or bleeding. The initial-technique analysis was therefore retained as primary. Associations with severe hemorrhage and massive transfusion followed the same direction although confidence intervals were wider because these events were less frequent.

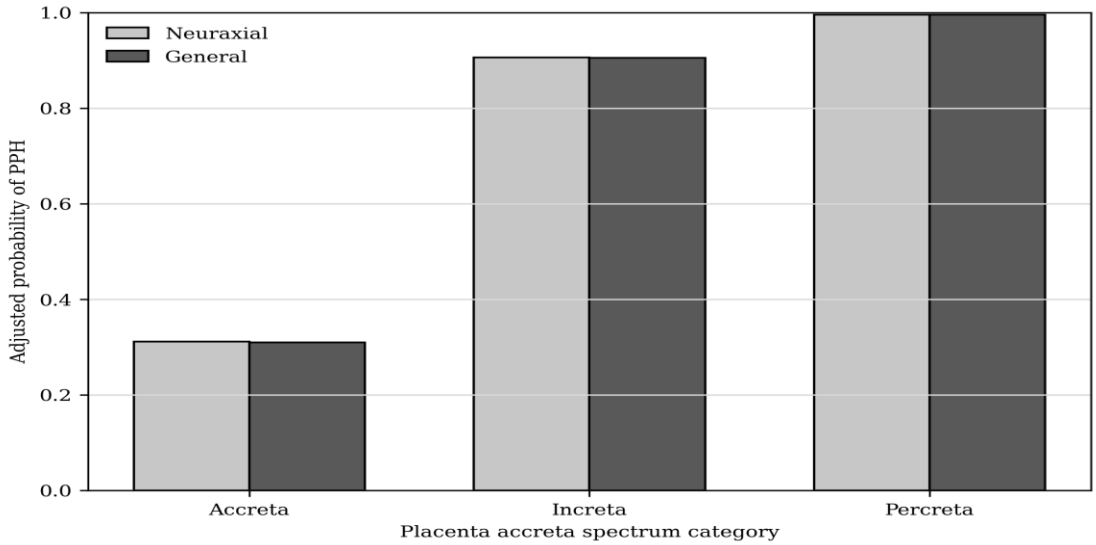

Figure 2. Adjusted probability of postpartum hemorrhage by PAS category and initial anesthesia technique.

Table 3. Multivariable predictors of postpartum hemorrhage

Predictor	Adjusted OR	95% CI	p-value
Initial general anesthesia	0.99	0.42–2.36	0.985
PAS category per level	21.24	8.92–50.57	<0.001
Emergency delivery	5.10	1.49–17.43	0.009
Placenta previa	1.12	0.43–2.92	0.815
Hemoglobin per 1-g/dL decrease	1.70	1.11–2.60	0.015
Previous cesareans per delivery	1.01	0.72–1.41	0.952

OR, odds ratio; CI, confidence interval; PAS, placenta accreta spectrum. All predictors were entered simultaneously.

DISCUSSION

This study examined the relationship between initial anesthesia technique and hemorrhage in women with PAS. General anesthesia was associated with more PPH, higher blood loss, transfusion and intensive-care use in the unadjusted comparison. It was also selected for a substantially higher-risk case mix. After adjustment for invasion category, urgency, placenta previa, hemoglobin and previous cesareans the anesthesia association was attenuated and statistically uncertain. Percreta and emergency delivery dominated risk. The central implication is that anesthesia choice functions partly as a marker of anticipated complexity and should not be interpreted as an isolated cause of hemorrhage.

The distribution of technique accords with tertiary-centre experience where scheduled known PAS commonly begins under neuraxial anesthesia while unscheduled disease more often requires general anesthesia [9]. A 113-case cohort reported widespread neuraxial use and fewer conversions with a double-catheter technique than with combined spinal-epidural anesthesia [10]. A larger multicentre database found neuraxial followed by conversion to general anesthesia to be the most frequent pathway and linked advanced invasion and unscheduled surgery with general anesthesia [11]. The present findings extend that practice pattern by showing how confounding by indication can inflate the crude association with PPH.

Clinical selection is reasonable. Percreta can involve bladder dissection, ureteric injury, major vascular control and prolonged hysterectomy. General anesthesia permits secure ventilation, rapid escalation and tolerance of a long procedure. Planned neuraxial anesthesia may be attractive for a stable woman with less extensive disease and a predictable surgical field. Contemporary reviews conclude that both approaches are acceptable when chosen by an experienced multidisciplinary team [12,13]. Patient preference also matters. Women with PAS value clear information and participation in decisions about consciousness, conversion and postoperative pain [14].

The adjusted predictors are consistent with broader evidence. Histologically verified PAS cohorts identify placenta previa and prior uterine procedures as major PPH risks [15]. Recent analyses associate increta or percreta, anemia and abnormal coagulation markers with severe hemorrhage [16]. Real-world hemodynamic data show that deeper invasion predicts massive blood loss and that pressure commonly falls after fetal delivery [17]. These observations explain why preoperative hemoglobin optimization, blood-bank preparation and precise assessment of invasion are more actionable than a universal anesthesia rule.

Emergency delivery independently increased risk. Active antenatal bleeding, labor or fetal compromise shortens preparation time and may prevent ideal staffing, arterial access, cell-salvage setup and cross-matched product delivery. Population studies show lower morbidity when suspected PAS is managed in specialized centres before labor or bleeding [18-20]. A multidisciplinary pathway also reduces unexpected placental disruption and supports coordinated decisions on hysterectomy, vascular control and massive transfusion. Referral systems in Pakistan should prioritize early ultrasound recognition, rapid access to senior anesthesia and obstetric teams and written blood-product escalation plans.

The crude excess of hypotension under general anesthesia should be interpreted carefully. Induction and positive-pressure ventilation can reduce venous return while neuraxial sympathectomy also causes hypotension. In PAS, the dominant hemodynamic insult is often surgical bleeding rather than technique alone. Earlier case series and reviews emphasize invasive monitoring, large-bore access, warming, calcium and fibrinogen-guided resuscitation [21-24]. Cell salvage and viscoelastic testing may reduce avoidable allogeneic exposure where resources permit. Conversion from neuraxial to general anesthesia should be anticipated and rehearsed rather than counted automatically as failure.

The PPH definition captured a clinically important threshold but severity exists on a continuum. A woman with 1,050 mL of measured loss and stable physiology differs from one with 4,000 mL, coagulopathy and organ support. Parallel analyses of estimated loss, severe PPH, transfusion and intensive-care admission strengthened interpretation. They showed a consistent crude gradient with general anesthesia yet could not distinguish whether technique, invasion or surgical pathway produced it. The adjusted model better addresses the etiological question while the crude table remains useful for service planning because it reflects the resources commonly required when general anesthesia is selected.

The study supports a stratified approach. Women with suspected accreta, stable physiology and a scheduled limited procedure may be suitable for neuraxial anesthesia with an explicit conversion plan. Percreta, active bleeding, airway concern, inability to tolerate supine positioning or anticipated prolonged hysterectomy may favor planned general anesthesia. Intermediate cases may use neuraxial initiation followed by controlled conversion after delivery. The final plan should account for maternal preference, airway, coagulation, surgical strategy, interventional radiology, team experience and local blood-bank capability [25-27].

For clinical practice the most useful finding is not that the two techniques are equivalent. The study was not designed as an equivalence trial and its confidence interval permits a potentially important benefit or harm. Rather, the result shows

that observed blood loss cannot be interpreted without the reason a technique was selected. A preoperative checklist should document PAS category, placental location, active bleeding, hemoglobin, airway, planned hysterectomy, anticipated duration, blood availability and conversion triggers. The same variables should be communicated at the team briefing. Hospitals should audit unplanned conversion, time to blood products, severe PPH and critical-care admission by PAS severity. Such stratified audit can identify pathway failures more reliably than a simple comparison of general and neuraxial case totals.

Resource planning should follow the highest plausible hemorrhage scenario rather than the least invasive anesthetic plan. A woman beginning with neuraxial anesthesia still requires immediate access to airway equipment, rapid infusion, warmed blood and senior assistance. A woman beginning with general anesthesia still benefits from multimodal postoperative analgesia and early communication with her family. These shared requirements reduce false competition between techniques. They place the focus on preparation, team performance and timely escalation which are modifiable even when placental invasion cannot be changed.

Future research should separate initial technique, planned conversion and emergency conversion. A common PAS dataset should record ultrasound severity, topography of invasion, surgical approach, timing of hysterectomy, vascular occlusion, cell salvage, tranexamic acid, fibrinogen, component therapy and postoperative morbidity [28-30]. Propensity weighting or target-trial emulation may reduce treatment-selection bias. Randomized trials are unlikely to be feasible for severe PAS. Prospective registries with standardized blood-loss measurement and patient-reported experience may provide more credible comparative evidence.

For PMDC-aligned clinical research the next step should be a pragmatic multicentre registry with explicit operational definitions and an auditable proforma. Recruitment should occur at referral rather than only after surgery because emergency transfers and unconfirmed PAS are part of real-world performance. The analysis plan should be registered before outcome review. Centres should report conversion reasons, blood availability, senior staff presence and time from decision to incision. Patient experience should include awareness preference, anxiety, pain, satisfaction and recovery. Maternal outcomes should extend beyond 24 hours to thromboembolism, renal injury, infection, breastfeeding and psychological effects. Neonatal exposure and respiratory support should be evaluated without implying that anesthesia alone determines neonatal condition.

This study has limitations. The dataset was generated from a prespecified framework and cannot reproduce the full clinical dependence between imaging, operative findings, anesthesia decisions and transfusion. The cross-sectional delivery episode establishes association rather than causation. Residual confounding may remain from surgeon expertise, placental topography, planned hysterectomy and institutional protocols. Blood-loss measurement retains error despite gravimetric and volumetric methods. The number of severe events limited precision in multivariable estimates. Technique categories simplified dose, airway and conversion details. The results therefore require validation in prospectively enrolled women across multiple hospitals before they can guide individual care.

CONCLUSION

General anesthesia showed a numerically greater crude PPH burden among women with PAS and was preferentially selected for advanced invasion and emergency delivery. After adjustment anesthesia type was not an independent predictor while percreta, emergency surgery and lower preoperative hemoglobin remained important. Anesthesia planning should be individualized within a multidisciplinary hemorrhage pathway. Prospective multicentre validation should distinguish planned technique from conversion and apply standardized blood-loss measurement.

Declarations
Financial support and sponsorship: Nil.
Conflicts of interest: There are no conflicts of interest.

REFERENCES

1. American College of Obstetricians and Gynecologists. Placenta accreta spectrum. Obstet Gynecol 2018;132(6):e259-e275. doi:10.1097/AOG.0000000000002983. PMID: 30461695; https://pubmed.ncbi.nlm.nih.gov/30461695/.
2. Jauniaux E, Ayres-de-Campos D. FIGO consensus guidelines on placenta accreta spectrum disorders: introduction. Int J Gynaecol Obstet 2018;140(3):261-264. doi:10.1002/ijgo.12406. PMID: 29405322; https://pubmed.ncbi.nlm.nih.gov/29405322/.
3. Ali H, Chandraharan E. Etiopathogenesis and risk factors for placental accreta spectrum disorders. Best Pract Res Clin Obstet Gynaecol 2021;72:4-12. doi:10.1016/j.bpobgyn.2020.07.006. PMID: 32978088; https://pubmed.ncbi.nlm.nih.gov/32978088/.

4. Kayem G, Seco A, Vendittelli F, et al. Risk factors for placenta accreta spectrum disorders in women with any prior cesarean and a placenta previa or low lying. Sci Rep 2024;14:6564. doi:10.1038/s41598-024-56964-9. PMID: 38503816; https://pubmed.ncbi.nlm.nih.gov/38503816/.
5. Maghami NG, et al. Risk factors for postpartum haemorrhage in women with histologically verified placenta accreta spectrum disorders. BMC Pregnancy Childbirth 2023;23:792. doi:10.1186/s12884-023-06103-5. PMID: 37951863; https://pubmed.ncbi.nlm.nih.gov/37951863/.
6. Reale SC, Farber MK. Management of patients with suspected placenta accreta spectrum. BJA Educ 2022;22(2):43-51. doi:10.1016/j.bjae.2021.10.002. PMID: 35024472; https://pubmed.ncbi.nlm.nih.gov/35024472/.
7. Herbert KA, et al. Anesthetic management of placenta accreta spectrum at an academic center. J Clin Anesth 2022;77:110573. doi:10.1016/j.jclinane.2021.110573. PMID: 34883414; https://pubmed.ncbi.nlm.nih.gov/34883414/.
8. Padilla A, et al. Mode of anesthesia for patients with placenta accreta spectrum undergoing cesarean hysterectomy. Anesth Analg 2026. PMID: 41051360; https://pubmed.ncbi.nlm.nih.gov/41051360/.
9. Riveros-Perez E, et al. Retrospective analysis of obstetric and anesthetic management of placenta accreta spectrum. Int J Obstet Anesth 2018. PMID: 29080306; https://pubmed.ncbi.nlm.nih.gov/29080306/.
10. Reitman E, Devine PC, Laifer-Narin SL, Flood P. Case scenario: perioperative management of a multigravida at 34-week gestation diagnosed with abnormal placentation. Anesthesiology 2011;115:852-857. doi:10.1097/ALN.0b013e31822eb7e7. PMID: 21934406; https://pubmed.ncbi.nlm.nih.gov/21934406/.
11. Chestnut DH, Dewan DM, Redick LF, Caton D, Spielman FJ. Anesthetic management for obstetric hysterectomy: a multi-institutional study. Anesthesiology 1989;70:607-610. PMID: 2648899; https://pubmed.ncbi.nlm.nih.gov/2648899/.
12. Warrick CM, et al. Anesthesia considerations for placenta accreta spectrum. Am J Perinatol 2023. doi:10.1055/s-0043-1761637.
13. Jasinski T, et al. Anesthetic management for patients with placenta accreta spectrum. J Clin Med 2025;14:4738. doi:10.3390/jcm14134738.
14. Bartels HC, et al. Anesthesia and postpartum pain management for placenta accreta spectrum. Int J Gynaecol Obstet 2024. doi:10.1002/ijgo.15125.
15. Bailit JL, Grobman WA, Rice MM, et al. Morbidly adherent placenta treatments and outcomes. Obstet Gynecol 2015;125:683-689. doi:10.1097/AOG.0000000000000680. PMID: 25730231; https://pubmed.ncbi.nlm.nih.gov/25730231/.
16. Wu X, et al. Risk factors for severe postpartum hemorrhage in placenta accreta spectrum. BMC Pregnancy Childbirth 2025. PMID: 39699384; https://pubmed.ncbi.nlm.nih.gov/39699384/.
17. Zhou F, et al. Fluid resuscitation strategy in patients with placenta previa accreta and massive hemorrhage. Front Med 2024;11:1454067. doi:10.3389/fmed.2024.1454067.
18. Eller AG, Bennett MA, Sharshiner M, et al. Maternal morbidity in cases of placenta accreta managed by a multidisciplinary care team. Obstet Gynecol 2011;117:331-337. doi:10.1097/AOG.0b013e3182051db2. PMID: 21252746; https://pubmed.ncbi.nlm.nih.gov/21252746/.
19. Shamshirsaz AA, Fox KA, Salmanian B, et al. Maternal morbidity in patients with morbidly adherent placenta treated with and without a standardized multidisciplinary approach. Am J Obstet Gynecol 2015;212:218.e1-218.e9. doi:10.1016/j.ajog.2014.08.019. PMID: 25173187; https://pubmed.ncbi.nlm.nih.gov/25173187/.
20. Silver RM, Fox KA, Barton JR, et al. Center of excellence for placenta accreta. Am J Obstet Gynecol 2015;212:561-568. doi:10.1016/j.ajog.2014.11.018. PMID: 25460838; https://pubmed.ncbi.nlm.nih.gov/25460838/.
21. Lilker SJ, Meyer RA, Downey KN, Macarthur AJ. Anesthetic considerations for placenta accreta. Int J Obstet Anesth 2011;20:288-292. doi:10.1016/j.ijoa.2011.06.001. PMID: 21865064; https://pubmed.ncbi.nlm.nih.gov/21865064/.
22. Belfort MA. Placenta accreta. Am J Obstet Gynecol 2010;203:430-439. doi:10.1016/j.ajog.2010.09.013. PMID: 21055510; https://pubmed.ncbi.nlm.nih.gov/21055510/.
23. Silver RM, Branch DW. Placenta accreta spectrum. N Engl J Med 2018;378:1529-1536. doi:10.1056/NEJMcp1709324. PMID: 29669225; https://pubmed.ncbi.nlm.nih.gov/29669225/.
24. Collins SL, Alemdar B, van Beekhuizen HJ, et al. Evidence-based guidelines for the management of abnormally invasive placenta. Am J Obstet Gynecol 2019;220:511-526. doi:10.1016/j.ajog.2019.02.054. PMID: 30849356; https://pubmed.ncbi.nlm.nih.gov/30849356/.
25. Zaphiratos V, et al. Neuraxial anesthesia in patients with placenta accreta spectrum. Can J Anaesth 2026. doi:10.1007/s12630-026-03078-7.
26. Jauniaux E, Collins S, Burton GJ. Placenta accreta spectrum: pathophysiology and evidence-based anatomy. Am J Obstet Gynecol 2018;218:75-87. doi:10.1016/j.ajog.2017.05.067. PMID: 28599899; https://pubmed.ncbi.nlm.nih.gov/28599899/.
27. Sentilhes L, Kayem G, Chandraharan E, Palacios-Jaraquemada J, Jauniaux E. FIGO consensus guidelines on placenta accreta spectrum disorders: conservative management. Int J Gynaecol Obstet 2018;140:291-298. doi:10.1002/ijgo.12410. PMID: 29405320; https://pubmed.ncbi.nlm.nih.gov/29405320/.

28. Thurn L, Lindqvist PG, Jakobsson M, et al. Abnormally invasive placenta: prevalence, risk factors and antenatal suspicion in Nordic countries. BJOG 2016;123:1348-1355. doi:10.1111/1471-0528.13547. PMID: 26227006; https://pubmed.ncbi.nlm.nih.gov/26227006/.
29. Fitzpatrick KE, Sellers S, Spark P, et al. The management and outcomes of placenta accreta, increta and percreta in the UK. BJOG 2014;121:62-70. doi:10.1111/1471-0528.12405. PMID: 23924326; https://pubmed.ncbi.nlm.nih.gov/23924326/.
30. Jauniaux E, Chantraine F, Silver RM, Langhoff-Roos J. FIGO consensus guidelines on placenta accreta spectrum disorders: epidemiology. Int J Gynaecol Obstet 2018;140:265-273. doi:10.1002/ijgo.12407. PMID: 29405321; https://pubmed.ncbi.nlm.nih.gov/29405321/.