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Research Article

Maternal and Neonatal Outcomes in Placenta Accreta Spectrum: An Eight-Year Retrospective Cohort Study at Saidu Group of Teaching Hospitals, Swat

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Abstract: ***Introduction:*** Placenta accreta spectrum (PAS) is a high risk obstetric condition which is linked with significant blood loss, transfusion, hysterectomy, damage to adjacent organs, intensive care unit admission, low birth weight, and poor fetal outcome. **Objective:** To assess the maternal, operative and neonatal results of women with PAS, focusing on the elective versus emergency delivery, primary surgical approach and the location of the placenta. **Methods:** A total of 210 women diagnosed with PAS and managed at Saidu Group of Teaching Hospitals, Swat between May 2018 to April 2026 were included in this retrospective cohort study. Data were collected regarding the demographics, obstetric, imaging, operative, maternal and neonatal outcomes. The outcomes of planned delivery and emergency delivery, primary hysterectomy and uterus preservation and anterior and posterior placenta were compared. The p value of <0.05 was considered statistically significant. **Results:** Of the 140 women (66.7%) that underwent planned surgery, 70 (33.3%) needed emergency surgery. Emergency delivery was also earlier than planned delivery (32.13 ± 4.57 weeks vs 36.01 ± 1.86 weeks, respectively, p<0.001), with a higher amount of blood loss during delivery (799.29 ± 414.28 mL vs 511.43 ± 311.49 mL, respectively, p<0.001), lower birth weight, poorer Apgar scores, longer stay in the neonatal intensive care unit (NICU) and higher perinatal mortality (20.0% vs 1.4%, respectively, p<0.001). Primary hysterectomy group showed more placenta percreta and complete invasion. Bladder involvement, complete invasion and early diagnosis were associated with anterior placentation.**Conclusion:** Substantially poorer neonatal outcome and higher loss of blood were found to be associated with emergency delivery. Prevention of invasion was important in determining the primary surgical approach and anterior placentation was correlated with more advanced disease. In PAS care, it is crucial to have early antenatal diagnosis, planned delivery, being prepared with blood products, and a coordinated multidisciplinary care.

Keywords: placenta accreta spectrum; emergency delivery; cesarean hysterectomy; obstetric hemorrhage; neonatal intensive care; placenta percreta; perinatal mortality; conservative surgery

INTRODUCTION

Placenta accreta spectrum refers to the spectrum of abnormal placental attachment or invasion that occurs when defective decidualization occurs at the endometrial-myometrial interface. Placenta accreta, in which chorionic villi become attached to the superficial myometrium, placenta increta, in which villi penetrate the myometrium, and placenta percreta, in which placental tissue grows through the uterine serosa and may invade adjacent pelvic organs are included within this spectrum (1-3). PAS is a leading cause of severe obstetric hemorrhages and can lead to peripartum hysterectomy, intensive care and complex pelvic surgery and massive transfusion.

There has been a rise in the incidence of PAS with the increase of cesarean delivery rates. The most prominent recognized risk factor is previous cesarean delivery,

especially if the placenta previa or low lying placenta is above a uterine scar. The chance that a woman will have PAS is higher if she has had a previous cesarean section. Other contributing factors are previous uterine curettage, myomectomy, uterine damage, advanced maternal age, multiparity, assisted reproductive techniques and history of PAS (1-3).

The main factors associated with maternal morbidity are bleeding and challenging surgery. Placenta percreta and anterior lower-segment disease can also cause a distortion of the vesicouterine plane and increase the potential for cystotomy, ureteral injury, parametrial bleeding, bowel injury, and a longer operation. Requirements for blood products and/or postoperative critical care can be significant. If PAS is diagnosed peri-natally, management can be planned at a facility that is well equipped and has a full complement of skilled obstetric, anesthetic, neonatal, critical care, blood-bank, urological, and surgical staffs (1,4,5).

The main imaging technique for PAS is ultrasonography. Some characteristic sonographic features are placental lacunae, disappearance of the retroplacental clear zone, thinning of the myometrium, disruption of the uterovesical interface, placental bulging, bridging vessels and abnormal uterovesical vascularity. Abnormal vascular pattern is better evaluated with Color Doppler. Magnetic resonance imaging may be helpful if ultrasound is equivocal, placentation is the posterior type or the involvement of adjacent organs or parametrium necessities more anatomical information, but not generally (4,5).

Cesarean hysterectomy with in situ placenta is considered the definitive treatment for most cases of PAS (1,11) because the separation of the placenta may lead to catastrophic bleeding. Uterus-sparing management options may be considered in individual women, but should be carefully selected, the surgery should be performed by a skilled surgeon, and extended monitoring needed. If these treatments are not successful, there may be a need for immediate or delayed hysterectomy due to uncontrolled bleeding, infection, or retained placental tissue (6).

Factors that influence the delivery are clinically significant. Planned delivery allows for a multidisciplinary preparation of the woman, hemoglobin optimization, blood product arrangement, the choice of uterine incision, and preparation of the newborn. Emergency delivery, due to haemorrhage, labour, ruptured membranes, maternal instability and foetal compromise, can be earlier than gestation, and can lead to maternal and foetal morbidity. The available data for planned delivery suggest that planned delivery is generally correlated with higher gestational age, lower transfusion rates, shorter hospital stay and lower incidence of severe maternal morbidity and intensive care unit admission (7,8).

Prematurity and the critical nature of the delivery of the patient with PAS are major determinants of neonatal outcome. Adverse outcomes can range from low birth weight, low Apgar scores, respiratory distress, respiratory support needs, admission to a neonatal intensive care unit (NICU), neurological conditions, stillbirth and perinatal death. The matched-cohort studies in recent years have confirmed an increased morbidity of the newborns of pregnancies complicated by PAS (9).

The results from the tertiary care hospitals in Pakistan are limited and local outcomes could be influenced by referral patterns, lateness of patient presentation, availability of blood products, surgical experience and neonatal care facilities. The present study was, therefore, a comparative evaluation of the maternal, operative and neonatal outcomes of women with PAS who were managed at Saidu Group of Teaching Hospitals, Swat. Analysis was focused on differences for planned delivery versus emergency delivery, primary surgical strategy, and position of the placenta.

MATERIALS AND METHODS

Study Design and Setting

This study was carried out as a retrospective cohort study in the Department of Obstetrics and Gynecology, Saidu Group of Teaching Hospitals, Swat, Khyber Pakhtunkhwa, Pakistan. The hospital group works as a tertiary referral center for high-risk obstetric patients, from Swat and surrounding districts. This work aimed to examine the period from May 2018 to April 2026.

Study Population and Sampling

All the women with confirmed diagnosis of PAS delivered or had definitive operative delivery at the study institute during the study period were assessed for eligibility. Consecutive census sampling was used due to the rarity of PAS. One hundred and one women and their maternal and neonatal records were finally analysed

Eligibility Criteria

Women were added in if PAS was diagnosed antenatally, intraoperatively or histopathologically and where enough obstetric, operative, maternal and neonatal data were available. Patients in whom PAS was suspected, but not confirmed, were excluded, as were those who had received definitive management at another hospital prior to referral, and those without essential outcome data or who had duplicate records, and those with retained placenta who did not have evidence of abnormal retention or penetration.

Diagnosis and Classification

Antenatal diagnosis was mainly made by grayscale ultrasonography and colour Doppler findings which included the presence of placental bulging, loss of clear zone in the retroplacental area, thinning of the myometrium, bridging vessels, abnormal uterovesical vascularity, and placental lacunae. If used for further evaluation, MRI was recorded. The last PAS category was based on imaging, operative and histopathological examination and was defined as accreta, increta, or percreta. The presence of adjacent organ invasion was also documented, as well as focal or complete placental involvement.

Data Collection and Variables

Antenatal records, ultrasound and magnetic resonance imaging reports, admission, operative notes, anesthesia notes, blood-bank records, laboratory reports, maternal intensive care records, neonatal records, discharge summaries and histopathology reports have been used for data extraction. Data were collected using a structured data collection form with the direct identifiers being removed for analysis.

Maternal and obstetric factors were age, parity, gravidity, BMI, IVF pregnancy.

Previous cesarean delivery, gestational age at diagnosis, gestational age at delivery, and preoperative hemoglobin and hematocrit levels, as well as whether or not the patient had received antenatal corticosteroid administration and what the delivery indication was. The operative variables were estimated blood loss, transfusion, primary surgical approach, uterine incision, placental subtype and location, depth of involvement, adjacent organ invasion and intraoperative complications. Maternal outcomes included admission to ICU, and length of stay, duration of hospital stay, postpartum hemoglobin, hematocrit, and maternal death. Neonatal outcomes were: birth weight, one and five minute Apgar scores, need for NICU admission and stay, respiratory distress, need for respiratory support, intracranial hemorrhage, hypoxic-ischemic encephalopathy, intrauterine fetal death and perinatal death.

Exposure and Comparison Groups

Planned and emergency deliveries were noted. The primary surgical approach (primary hysterectomy or initially uterus-preserving surgery) was analyzed for surgical management. Women who had an initially uterus-sparing procedure who went on to have immediate or delayed hysterectomy were considered to be in the primary uterus preserving strategy group for comparison. For the location-based comparison, the location of the placenta was either anterior or posterior.

Statistical Analysis

IBM SPSS Statistics was used for statistical analysis. Data for continuous variables were presented as mean ± standard deviation and median (min-max). Categorical variables were presented in terms of frequency and percentages. For continuous variables, the independent-samples t test or its nonparametric equivalent were used for between-group comparisons, and a chi-square test or Fisher exact test were used for categorical variables. Selected predictors and adjusted neonatal outcomes were analyzed using logistic regression. Odds ratios and 95% confidence intervals were reported. A two-sided p value <0.05 was considered statistically significant.

Odds ratios were reported with 95% confidence intervals. Statistical significance was defined as a two-sided p-value <0.05.

Ethical Considerations

Ethical clearance was taken from the Saidu Group of Teaching Hospitals, Swat institutional review committee. The number of approval should be put in place before submission. As this was a retrospective medical-record review, informed consent was handled as determined by the committee. The analytical data set was de-identified to allow confidentiality.

RESULTS

Study Population and Baseline Characteristics

210 women with PAS were included. Of the 140 women, 66.7% underwent planned operative management and 70 women (33.3%) were managed emergently. Forty-four women had PAS-related bleeding as the primary indication for emergency procedures and 26 women had other obstetric indications for urgent procedures. The mean maternal age was 33.81 ± 4.85 years, mean gravidity was 4.30 ± 1.49, mean parity was 2.83 ± 1.22, mean body mass index was 30.60 ± 4.05 kg/m², and the mean number of previous cesarean deliveries was 2.09 ± 0.98.

The mean gestation period at PAS diagnosis was 26.37 ± 5.62 and at delivery or definitive care 34.71 ± 3.54 weeks. Pre-operatively, the mean hemoglobin concentration was 11.23 ± 1.33 g/dl and the mean hematocrit was 34.21 ± 3.63%. In 166 women (79.05%) combined grayscale and color Doppler ultrasonography was performed. Placenta percreta was found in 84 cases (40.0%) with complete involvement in 152 cases (72.38%). The baseline data are presented in summary format in Table

Table 1. Baseline maternal, obstetric, diagnostic, and placental characteristics of the study population (N = 210)

Variable	Category	Overall statistics
Maternal and obstetric characteristics		
Maternal age (years)	—	33.81 ± 4.85
Gravidity	—	4.30 ± 1.49
Parity	—	2.83 ± 1.22
Body mass index (kg/m²)	—	30.60 ± 4.05
Previous cesarean deliveries	—	2.09 ± 0.98
Gestational age at diagnosis (weeks)	—	26.37 ± 5.62
Gestational age at delivery (weeks)	—	34.71 ± 3.54
Preoperative hemoglobin (g/dL)	—	11.23 ± 1.33
Preoperative hematocrit (%)	—	34.21 ± 3.63
Smoking status	Yes	30 (14.29)
	No	180 (85.71)
IVF pregnancy	Yes	5 (2.38)
	No	205 (97.62)
Diagnostic method		
Grayscale ultrasonography alone	—	43 (20.48)
Ultrasonography with color Doppler	—	166 (79.05)
Ultrasonography with MRI	—	1 (0.48)
Antenatal corticosteroid administration		
Not administered	—	70 (33.33)
Complete course	—	88 (41.90)
Incomplete course	—	24 (11.43)
Not clinically indicated	—	28 (13.33)
Timing of operative management		
Planned surgery	—	140 (66.67)
Emergency surgery	—	70 (33.33)
PAS subtype		
Placenta accreta	—	68 (32.38)
Placenta increta	—	58 (27.62)
Placenta percreta	—	84 (40.00)
Placental location		
Anterior low-lying	—	25 (11.90)
Posterior low-lying	—	22 (10.48)
Central over the internal cervical os	—	163 (77.62)
Extent of placental involvement		
Focal	—	58 (27.62)
Complete	—	152 (72.38)

Continuous variables are presented as mean ± standard deviation; categorical variables are presented as n (%). BMI: body mass index; IVF: in vitro fertilization; MRI: magnetic resonance imaging; PAS: placenta accreta spectrum.

Planned Versus Emergency Delivery Outcomes

The women who needed emergency surgery had significantly earlier onset of delivery than the women who had planned surgeries (32.13 ± 4.57 vs. 36.01 ± 1.86 weeks; $p<0.001$). The amount of blood loss was also greater in emergency cases (799.29 ± 414.28 mL) than in elective cases (511.43 ± 311.49 mL), but there was no significant difference in the number of packed red blood cells (PRBCs) needed.

The odds of worse neonatal outcomes were significantly higher for emergency delivery. One and five minute Apgar scores were lower, the mean birth weight was lower and NICU stay was longer. 70.0% of emergency deliveries were admitted to the NICU compared to 39.3% of planned deliveries. Respiratory support was needed in 68.6% compared with 33.6%, hypoxic-

ischemic encephalopathy in 10.0% compared with 2.1% and intracranial hemorrhage in 18.6% compared with 2.9%. Perinatal mortality was 20.0% after emergency delivery, and 1.4% after planned delivery (p<0.001).

Table 2. Comparison of maternal and neonatal outcomes between planned and emergency delivery groups

Variable	Planned delivery (n = 140)	Emergency delivery (n = 70)	p-value
Maternal age (years)	33.84 ± 4.70	33.77 ± 5.16	0.947
Gestational age at diagnosis (weeks)	26.78 ± 5.70	25.56 ± 5.41	0.126
Gestational age at delivery (weeks)	36.01 ± 1.86	32.13 ± 4.57	<0.001
Preoperative hemoglobin (g/dL)	11.35 ± 1.13	10.98 ± 1.64	0.174
Intraoperative blood loss (mL)	511.43 ± 311.49	799.29 ± 414.28	<0.001
Packed red blood cell transfusion (units)	2.42 ± 1.88	2.54 ± 2.01	0.300
Maternal ICU stay (days)	0.76 ± 1.46	1.04 ± 1.52	0.090
Maternal hospital stay (days)	5.36 ± 2.92	5.84 ± 3.32	0.198
Maternal ICU admission	42 (30.0)	29 (41.4)	0.098
Maternal mortality	1 (0.7)	0 (0.0)	0.478
Neonatal birth weight (g)	2,863.32 ± 455.17	2,147.91 ± 858.94	<0.001
One-minute Apgar score	7.35 ± 1.22	6.33 ± 1.63	<0.001
Five-minute Apgar score	9.11 ± 1.36	8.01 ± 1.94	<0.001
NICU stay (days)	2.13 ± 4.22	6.74 ± 8.14	<0.001
Neonatal respiratory distress syndrome	14%	47%	<0.001
NICU admission	55 (39.3)	49 (70.0)	<0.001
Neonatal respiratory support	47 (33.6)	48 (68.6)	<0.001
Intracranial hemorrhage	4 (2.9)	13 (18.6)	<0.001
Hypoxic-ischemic encephalopathy	3 (2.1)	7 (10.0)	0.012
Intrauterine fetal death	2 (1.4)	2 (2.9)	0.475
Perinatal death	2 (1.4)	14 (20.0)	<0.001

Continuous variables are presented as mean ± standard deviation and categorical variables as n (%). ICU: intensive care unit; NICU: neonatal intensive care unit.

Outcomes According to Primary Surgical Strategy

Ninety-five women were included in the primary hysterectomy group and 115 women were included in the initially uterus preserving group in the comparative surgical analysis. The hysterectomy group included women who were older and had more gravidity, parity and prior cesarean deliveries. The placenta percreta and complete placental involvement rates were significantly higher in the hysterectomy group (60.0%, 92.6%, respectively) than in the uterus-preserving group (23.5%, 55.7%, both p<0.001).

The classic and vertical uterine incisions were more common with the hysterectomy group and the high transverse incision was more common with the uterus-preserving group. There were no significant differences in blood loss, transfusion requirements, admission to maternal ICU, admission to NICU, and neonatal respiratory-support requirements. 23 women in the first uterus-preserving group needed immediate conversion to hysterectomy and three women needed delayed hysterectomy.

Table 3. Maternal, placental, operative, and neonatal characteristics according to primary surgical strategy

Variable	Primary hysterectomy (n = 95)	Initially uterus-preserving (n = 115)	p-value
Maternal age (years)	35.07 ± 4.14	32.77 ± 5.15	<0.001
Gravidity	4.59 ± 1.65	4.05 ± 1.31	0.024
Parity	3.08 ± 1.31	2.62 ± 1.10	0.012
Body mass index (kg/m²)	30.90 ± 4.14	30.35 ± 3.98	0.370
Previous cesarean deliveries	2.27 ± 0.93	1.94 ± 0.99	0.013
Gestational age at delivery (weeks)	34.71 ± 3.00	34.72 ± 3.95	0.091
Intraoperative blood loss (mL)	561.05 ± 333.52	645.65 ± 401.40	0.055
Packed red blood cell transfusion (units)	2.47 ± 1.74	2.45 ± 2.07	0.869
PAS subtype			
Placenta accreta	15 (15.8)	53 (46.1)	
Placenta increta	23 (24.2)	35 (30.4)	
Placenta percreta	57 (60.0)	27 (23.5)	<0.001
Extent of placental involvement			
Focal involvement	7 (7.4)	51 (44.3)	
Complete involvement	88 (92.6)	64 (55.7)	<0.001
Type of uterine incision			
Low transverse	10 (10.5)	34 (29.6)	
High transverse	12 (12.6)	75 (65.2)	
Classical	54 (56.8)	3 (2.6)	
Vertical	19 (20.0)	3 (2.6)	<0.001
Unintentional cystotomy	28 (29.5)	17 (14.8)	0.068
Maternal ICU admission	29 (30.5)	42 (36.5)	0.361
Intrauterine fetal death	4 (4.2)	0 (0.0)	0.026
Perinatal death	3 (3.2)	13 (11.3)	0.027
NICU admission	47 (49.5)	57 (49.6)	0.989
Neonatal respiratory support	44 (46.3)	51 (44.3)	0.775

Values are presented as mean ± standard deviation or n (%). The p-value for unintentional cystotomy relates to the overall intraoperative-complication distribution. ICU: intensive care unit; NICU: neonatal intensive care unit; PAS: placenta accreta spectrum.

Outcomes According to Placental Location

Of the 22 women who had posterior placentation, 188 had anterior placentation. Those in the anterior group were diagnosed at earlier gestation and had earlier gestations at delivery. Anterior placentation was significantly more likely to be complete, and posterior placentas more likely to be focal. A total of 27.66% of anterior cases and 4.55% of posterior cases were invaded by the bladder.

Low transverse incisions were more common with posterior placentas, high transverse and classical incisions more common with anterior placentation. There were no significant differences in maternal admission to intensive care unit, neonatal admission to intensive care unit, respiratory support and perinatal death based on placental location

Table 4. Selected maternal, diagnostic, operative, and outcome characteristics according to placental location

Variable	Anterior placenta (n = 188)	Posterior placenta (n = 22)	p-value
Maternal age (years)	33.70 ± 4.81	34.82 ± 5.22	0.345
Body mass index (kg/m²)	30.79 ± 4.04	28.95 ± 3.81	0.015
Gestational age at diagnosis (weeks)	25.88 ± 5.41	30.55 ± 5.77	0.001
Gestational age at delivery (weeks)	34.55 ± 3.68	36.14 ± 1.49	0.027
Maternal hospital stay (days)	5.41 ± 2.98	6.41 ± 3.65	0.045
Diagnostic method			
Grayscale ultrasound alone	36 (19.14)	7 (31.81)	
Ultrasound with color Doppler	152 (80.85)	14 (63.64)	
Ultrasound with MRI	0 (0.00)	1 (4.55)	<0.001
Compression sutures used	1 (0.53)	2 (9.09)	0.001
Extent of placental involvement			
Focal involvement	42 (22.34)	16 (72.73)	
Complete involvement	146 (77.66)	6 (27.27)	<0.001
Type of uterine incision			
Low transverse	29 (15.43)	15 (68.18)	
High transverse	85 (45.21)	2 (9.09)	
Classical	54 (28.72)	3 (13.64)	
Vertical	20 (10.64)	2 (9.09)	<0.001
Preoperative ultrasound performed	180 (95.74)	18 (81.82)	0.008
Adjacent organ invasion			
No adjacent organ invasion	131 (69.68)	21 (95.45)	
Bladder invasion	52 (27.66)	1 (4.55)	
Parametrial invasion	5 (2.66)	0 (0.00)	0.038
Maternal ICU admission	64 (34.04)	7 (31.82)	0.835
Perinatal death	16 (8.51)	0 (0.00)	0.155
NICU admission	94 (50.00)	10 (45.45)	0.687
Neonatal respiratory support	85 (45.21)	10 (45.45)	0.983

Values are presented as mean ± standard deviation or n (%). ICU: intensive care unit; MRI: magnetic resonance imaging; NICU: neonatal intensive care unit.

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Additional Predictive Findings

Maternal age, gravidity, parity, BMI, smoking and previous cesarean deliveries were not significant predictor of delivery category in univariate analysis. Planned vs. emergency delivery was significantly associated with gestational age at delivery, preoperative hematocrit, and intraoperative blood loss, NICU stay, and neonatal respiratory distress (the direction of the ORs varied depending on coding of the outcomes).

After adjusting for the presence of maternal diabetes, hypertension, parity and gestational age, emergency delivery was still associated with increased risks of neonatal respiratory distress syndrome (adjusted odds ratio 2.7; 95% confidence interval 1.4-5.2) and perinatal death (adjusted odds ratio 3.8; 95% confidence interval 1.1-8.6) in the supplied adjusted analysis. These results confirmed the negative effect of emergency presentation on the neonate.

DISCUSSION

This is an eight-year retrospective cohort study which presented the clinical features and outcomes of 210 women with PAS managed from a tertiary teaching-hospital group. The main results were: Emergency delivery was found to be significantly associated with early delivery, high intraoperative blood loss, low birth weight, low Apgar scores, longer hospital stays in NICU, higher requirement for respiratory support during admission, neurological morbidity and a significantly higher perinatal mortality rate. Advanced placental invasion was significantly related to the presence of primary hysterectomy, and anterior placentation was related to an earlier diagnosis, complete involvement, and bladder invasion.

The average number of previous cesareans was around two, highlighting the importance of uterine scarring in PAS. A previously made uterine incision that is not performed correctly allows abnormal trophoblastic attachment and invasion to occur. Central placentation with its high rate is another factor that adds to the widely described association of placenta previa, previous cesarean section, and PAS (1-3). Therefore, targeted screening is especially crucial when a woman with previous uterine surgery has been diagnosed with a low-lying placenta or placenta previa.

The majority of the women received both grayscale and colour Doppler ultrasound, and the mean gestational age at diagnosis was around 26 weeks. Antenatal detection provides an opportunity for referral, multi-disciplinary planning, preparation of blood products and conscious selection of a uterine incision that avoids the placenta. Structured evaluation of ultrasound and standardized terminology will facilitate and aid communication between imaging and surgical teams (4,5). It is reasonable that only one woman received MRI, as ultrasound was used to obtain sufficient anatomical information for most cases.

One-third of the cohort needed emergency intervention. The amount of blood loss was much higher and the cases were delivered almost 4 weeks earlier than the cases that were scheduled for delivery. These results are consistent with the systematic reviews showing that planned delivery is generally associated with less transfusion burden, shorter hospital stay and less severe morbidity, as well as maternal preparation (7,8). No significant differences were found in the number of transfusion units or maternal ICU admission in the current study, which could be due to the speed of blood products, standard emergency response or variations in the severity of the disease and its management. However, when clinically possible, the increased blood loss and remarkable differences at delivery between the mother and baby strongly support planned management.

Emergency delivery had specific consequences to the newborns. Average birth weight was over 700 g lighter, Apgar scores were lower, NICU stay was about three times longer and the number of respiratory-support requirements doubled. There was also a significant increase in intracranial haemorrhage and hypoxic-ischemic encephalopathy. There were 20% perinatal mortalities in emergency cases and 1.4% in planned cases. These differences are likely due to a combination of factors, including prematurity, acute hemorrhage, fetal compromise, and insufficient time to complete antenatal corticosteroid therapy and prepare the infant. The same is reflected in previous cohort studies, which reported higher rates of NICU admission and poor neonatal outcomes in PAS pregnancies (9).

What was observed in the surgical comparison was that more advanced disease was strongly associated with the use of a primary hysterectomy. Hysterectomy group had a 60% incidence of placenta percreta with >90% of cases being complete. In comparison, accreta and focal disease was more common in women who were chosen for a uterus-preserving procedure. This pattern is clinically sensible as the depth and topography of the invasion affects the possibility of uterine preservation. In referral centres, placenta percreta has been linked to significantly higher severe morbidity rates in mothers than superficial accreta (12).

Hysterectomy group: classical and vertical incisions were more common, and high transverse incisions were more common in the uterus-preserving group. The choice of incision is important as it should be away from the placenta to reduce placental disruption and bleeding. The lack of differences in blood loss and transfusion requirement between surgical-strategy groups should not be read as a measure of equivalence of the procedures as surgical strategy decisions were based on disease extent, anatomy, fertility and intra-operative findings. Further, 23 women in the first group of women who had their uterus saved needed conversion to hysterectomy at the time of surgery and three women needed hysterectomy delayed. Conservative management is therefore a careful selection and readiness to escalate (6).

Anterior placentation predominated and was related to earlier diagnosis, complete invasion and bladder involvement. This corresponds to the PAS predilection to occur over an anterior lower-segment cesarean scar. Involvement of the bladder was more common in anterior than posterior placentation, affecting over one-quarter of the anterior cases, but very uncommon in posterior cases. In contrast, the diagnosis of posterior PAS was delayed and more likely to be focal, reflecting the recognized difficulties of the diagnosis of posterior disease (10). The increased use of MRI in the posterior group (with only one case) is consistent with the likely role of MRI in difficult posterior anatomy.

It also revealed that there was a great variation in choice of uterine incision depending on placental location. In the case of posterior placentas, low transverse incisions were frequently used, while high transverse and classical incisions were used more often in case of anterior placentas. This finding emphasizes the value of preoperative placental mapping. If the disease is extensive anterior, the bleeding and the fetal compromise may be minimized by avoiding transplacental entry.

One woman died, and about one-third of women were admitted to the maternal ICU. The present results demonstrate that, in spite of advances in imaging and operative planning, PAS is still a life-threatening condition. Specialized centers indicate that structured MDM can achieve a reduction in composite maternal morbidity (13,14). Institutions with a responsibility for managing PAS should therefore have pathways planned with senior obstetric surgeons, anesthesiologists, and blood-bank services, with critical care, neonatology, and urology, as well as interventional radiology, if available, and other surgical specialties, depending on the anticipated invasion.

The modified results confirmed the emergency delivery as an independent marker of neonatal respiratory distress and of perinatal death. It is important to note, however, that the results of the predictive models must be interpreted with care, because the assignment of the binary outcome by retrospective coding, the number of events, and the direction of the odds ratio can all affect the results. Unadjusted differences in gestational age, respiratory morbidity, and mortality are of a strong nature, and consistent with the broader literature.

There are a number of strengths to this study. It involved a large tertiary referral cohort of PAS, was 8-year long and assessed several clinically relevant domains. The analyses compared timing of delivery, primary surgical strategy, and placental location and included detailed neonatal outcomes. The four tables of summary give a detailed picture of the main findings.

There are a number of caveats to note. The current design was retrospective, which relied on the quality and quantity of the available records. This could have been a referral bias, leading to an overrepresentation of advanced cases. Analysis was conducted within one group of teaching hospitals with limited generalizability. The surgical groups were not necessarily equivalent to the final uterine status, since some uterus-preserving surgeries were changed to hysterectomy. The data for respiratory distress were provided as a binary mean and the approximate percentage for each group, rather than exact numbers. Postoperative infection, thromboembolism, readmission, psychological outcomes, subsequent fertility and infant neurodevelopment data were not available in detail. Therefore, the study does not measure long-term maternal and neonatal outcomes and should not be reported as a long-term follow-up study.

CONCLUSION

In this 8-year cohort, there was a high level of operative, maternal, and neonatal morbidity associated with placenta accreta spectrum. Emergency delivery was the single most important clinical predictor of poor neonatal outcome, and was associated with lower birth weight, poorer Apgar scores, higher perinatal mortality, longer NICU stay, respiratory morbidity, and neurological morbidity.

Primary hysterectomy was significantly associated with placenta percreta and complete involvement and anterior placentation was significantly associated with more extensive invasion and bladder involvement. Identification of high-risk women, expert imaging of the fetus, planned delivery before bleeding, meticulous choice of uterine incision, prompt availability of blood products and coordinated multidisciplinary care are critical to help improve outcomes. Future prospective studies should confirm the predictive factors for emergency delivery, and measure long-term maternal reproductive, urinary, psychological, and QOL outcomes alongside infant growth and neurodevelopment.

DECLARATIONS

Ethics approval and consent to participate: Ethical approval was received from the ethics committee of the relevant institutional review committee (IRC) of Saidu Group of Teaching Hospitals, Swat and consent to participate was obtained. Before submitting, include approval numbers and consent-waiver statement.

Consent for publication: Data and materials availability: The de-identified dataset can be shared with the corresponding author upon approval by the institution and confidentiality requirements.
Competing interests: The authors declare that they have no competing interests.
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Availability of data and materials: The de-identified dataset may be made available by the corresponding author subject to institutional approval and applicable confidentiality requirements.

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