Original Article

Incidence, risk factors, and maternal outcomes of major degree placenta previa

A 10-year retrospective analysis

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ABSTRACT

الأهداف: تحديد معدل الحدوث وعوامل الخطورة ونتائج مضاعفات ووفيات الأمهات في حالات المشيمة المنزاحة من الدرجة المتقدمة±الملتصقة في مستشفى أبها للولادة والأطفال خلال الأعوام العشرة الأخيرة؛ وشملت مضاعفات الأمهات (المراضة النزفية-الولادة المبكرة-الإصابات الحشوية- استئصال الرحم الطارئ - والإقامة في المستشفى بعد الجراحة)، وتلخيص ومقارنة نتائجنا بنتائج الدراسات السعودية السابقة حول المشيمة المنزاحة والملتصقة.

المنهجية: أجريت دراسة مرجعية تم فيها جمع و تحليل حالات المشيمة المنزاحة من الدرجة المتقدمة والمشيمة الملتصقة التي عولجت في مستشفى الولادة والأطفال بأبها خلال السنوات العشرة الماضية (يناير 2012 إلى ديسمبر 2021) بمنطقة عسير بالمملكة العربية السعودية. أيضًا، قمنا بمقارنة نتائجنا بملخص نتائج مرضى المشيمة المنزاحة من الدرجة المتقدمة والملتصقة في 6 دراسات سعودية.

النتائج: كان إجمالي عدد الولادات 54،341 ولادة وبلغ عدد حالات المشيمة المنزاحة من الدرجات المتقدمة والصغرى 376 بنسبة حدوث اجمالية (0.69%) – منها 299 حالة من الدرجة المتقدمة أوالملتصقة. اشتملت عوامل الخطورة على الآتي: تأخر العمر للحمل والولادة، والولادات المتكررة والولادات القيصرية السابقة. تم تشخيص المشيمة الملتصقة باستخدام التصوير بالرنين المغناطيسي في 91 بنسبة 30.5%. شملت المضاعفات أن 68.5% (العدد=205) من المريضات ولدن مبكراً قبل إكمال 37 أسبوعًا. خضعت 29 مريضة لعملية استئصال الرحم القيصرية الطارئة بنسبة (9.7%). سجلنا معدل وفيات للأمهات 0.3% (العدد=1). وبصفة عامة كانت نتائج هذه الدراسة متقاربة في المقارنة مع نتائج الدراسات السعودية السابقة المشابهة لحالات المشيمة المنزاحة والملتصقة.

الخلاصة: ترتبط حالات المشيمة المنزاحة من الدرجة المتقدمة والملتصقة بارتفاع نسبة حدوث مضاعفات الأمهات مع حالات وفيات نادرة. خلال الثلاثين عامًا الأخيرة لم تتغير خصائص الحمل والولادة للمريضات بما في ذلك تأخر العمر في الحمل والولادة وكذلك الولادات المتكررة والذي يعد سلوكاً عاماً في المملكة. هناك زيادة كبيرة في معدل الولادات القيصرية المتكررة كسبب رئيسي لحدوث حالات المشيمة المنزاحة من الدرجة المتقدمة أو الملتصقة.

Objectives: To determine the incidence, risk factors, and maternal outcomes of "major degree" placenta previa (PP)/placenta accreta spectrum (PAS) in Abha Maternity and Children's Hospital, Abha, Saudi Arabia. Secondly, to compare our findings to those of previous studies on PP/PAS in Saudi Arabia.

Methods: This is a retrospective study that included 299 patients diagnosed with major degree PP/PAS and admitted to Abha Maternity and Children's Hospital, Abha, Saudi Arabia, within 10 years (January 2012-December 2021). Also, we compared our results to the outcomes of PP/PAS patients in 6 previous Saudi studies.

Results: The total number of deliveries was 54,341; PP minor and major degrees were diagnosed in 376 (0.69%) patients. Of them, 299 patients had PP major degree (79.5%). The pattern of main risk factors for major PP/PAS included: elder age, high parity, and previous cesarean deliveries. Nearly 30.5% had evidence of PAS on antenatal MRI (n=91). Approximately 68.5% (n=205) of patients were delivered <37 weeks. Of 299 patients, 29 (9.7%)patients had emergency cesarean hysterectomy. The maternal mortality rate was 0.3% (n=1). Generally, in many aspects, our results are comparable to similar Saudi studies on PP/PAS.

Conclusion: Major degree of PP/PAS is associated with high maternal morbidity but rare mortality. Over 30 years, our patients' obstetric characteristics did not change, including both elder age and high parity. A substantial increase in the rate of cesarean deliveries is a leading cause of major PP/PAS.

Keywords: placenta previa, risk factors, outcomes

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Placenta previa (PP) and placenta accreta spectrum (PAS) are linked to higher rates of maternal and newborn morbidity and mortality, according to the most recent Green-top guidelines of the Royal College of Obstetricians and Gynecologists.[1] The rates of PP and PAS have sharply grown over the last 3 decades. A number of risk factors, such as rising cesarean delivery rates, rising maternal age, grand multiparity, and usage of assisted reproductive technology, will cause them to continue to rise, adding to the strain on maternity facilities. When these disorders are only discovered at birth, the highest rates of complications for both the mother and the infant are seen.[2-4] The presence of PP substantially increases the patient's risk for PAS.[5,6] Therefore, the American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine (SMFM) recommend that the PP/PAS patients should receive level III (subspecialty) or higher care. Level III includes continuously available medical staff with appropriate training and experience in managing complex maternal and obstetric complications, including PAS.[7,8] Unfortunately, recent studies showed that the existing protocol for PP/PAS missed almost one-fifth of cases. Both major and minor PP are risk factors for the abnormally invasive placenta and should be treated as severe.[9] A systematic study and meta-analysis identified no evidence from routine ultrasound units on the ultrasound screening of PAS during the normal mid-trimester ultrasound test.[10]

Past reports by Abduljabbar et al[11] studied the number of publications on PP in Saudi Arabia. Data were collected for 18 years from January 2000 to May 2018 (only 19 publication was selected out of 40). The inclusion criteria were all studies published in the Institute for Scientific Information journals, carried out in or published in Saudi Arabia. "Placenta previa is a significant cause of maternal morbidity and mortality in Saudi Arabia," they concluded. Every hospital must have a defined protocol and a dedicated team to manage all PP cases.

So a 10-year retrospective study was carried out in Abha Maternity and Children's Hospital (AMCH), Aseer region, Saudi Arabia, which included 299 consecutive patients with "major degree" PP/PAS. We aimed to determine the incidence, pattern of risk factors, and maternal outcomes of our patients with "major degree" PP/PAS, including maternal mortality and morbidity (as preterm birth-hemorrhagic morbidity-visceral injuries-emergency hysterectomy and postoperative hospital stay). Also, to compare our findings to the previous studies on PP/PAS in Saudi Arabia which were carried out throughout the last 3 decades.

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Methods. A retrospective cohort was built from 299 patients diagnosed with major degree PP and admitted to AMCH during 10 years (January 2012-December 2021), in Abha, Aseer region, Saudi Arabia. Files with incomplete data were excluded.

The Research Ethics Committee at King Khalid University, Abha, Saudi Arabia, approved the study (ECM# 2023-607).

Major degree PP was diagnosed when the placenta reaches the internal os of the uterine cervix, partially or completely covers it after 24 weeks gestation, and confirmed after 32 weeks, corresponding to ultrasonographic types III and IV. When the placenta was posterior or the trans-abdominal ultrasonography (TAUS) was unclear due to patient concerns, trans-vaginal ultrasonography (TVUS) was infrequently used to improve the accuracy of placental localization (5 obese patients with recurrent bleeding refused TVUS and magnetic resonance imaging (MRI) was ordered to confirm PP diagnosis). However, the improved TVUS images outweigh the theoretical disadvantages of provoking bleeding.[12] Delivery timing was decided according to the antenatal presentation (bleeding, preterm labor, and presence of PAS). For uncomplicated major degree PP patients, delivery was considered between 37-38 weeks of gestation. All patients were delivered by emergency or planned C-section; because if the PP reached the internal os or covered it after 35 weeks, this indicated for C-section as the delivery route.[1]

Ultrasound scanning (USS) is the first-line imaging technique for PAS diagnosis.[13] However, patients with "equivocal" ultrasonographic evidence of PAS were subjected to MRI as a complementary diagnostic modality to USS.[14] This is recommended as non-expert ultrasound evaluation of PP could lead to missing the diagnosis of PAS in up to 50% of patients.[4,10] Furthermore, new evidence suggests a better performance of MRI in diagnosis and management of PAS in high risk patients, particularly with equivocal USS evidence of PAS to accurately assess depth of invasion or extra-uterine extension.[15-17]

Intra-operatively, if pharmacological measures fail to control hemorrhage, intrauterine balloon tamponade, and surgical hemostatic techniques were initiated

(such as b-lynch compression suture, bilateral uterine, and internal iliac artery ligation). In the event that conservative medical and surgical interventions proved ineffective, a rescue emergency hysterectomy was carried out. A histopathological examination was carried out to confirm the PAS diagnosis in hysterectomy specimens. However, PAS diagnosis could not be confirmed among patients who experienced heavy intra-operative bleeding with difficult placental separation but were non-hysterectomized. Intr-aoperative blood loss was assessed by visual estimation.

Socio-demographic, obstetric data, risk factors, placental location, presence of PAS, intra/post-operative data, and maternal outcomes were extracted from the medical records of the enrolled patients and recorded in a predesigned excel sheet. The outcomes were: incidence of PP, risk factors, and maternal morbidity and mortality. Maternal morbidity included: hemorrhagic morbidity (hemoglobin levels and blood products transfusion), preterm birth, emergency cesarean hysterectomies, visceral injuries, and length of hospital stay.

Statistical analysis. The Statistical Package for the Social Sciences, version 19.0 (IBM Corp., Armonk, NY, USA) was used to analyze the extracted data. The mean, range, standard deviation (SD), and frequency distribution (numbers and percentages) were suitably used in the descriptive analysis.

Results. Table 1 presents the magnitude of PP among our patients. Over the last 10 years, the total number of deliveries was 54,341. Placenta previa minor and major degrees were diagnosed in 376 (0.69%) patients, PP minor degrees in 77 (20.5%) patients, while 299 (79.5%) patients had PP major degrees. Of 54,341 total deliveries, 21,708 (39.9%) were delivered by C-sections. All the 299 patients with major degree PP were delivered by C-sections, which equals 1.4% of all cesarean deliveries. A total of 29 emergency cesarean hysterectomies were carried out. Only one maternal death was recorded, with a maternal mortality rate of nearly 0.3%.

Maternal admission characteristics are depicted in Table 2. The pattern of risk factors for PP and PAS were completely manifested among our patients; 59.5% were aged between 31-40 years, and 8% were older than 41. The majority were grand multipara, with 24.1% having ≥5 deliveries. Approximately 61.5% of patients had a previous cesarean delivery, and 28.1% had ≥3 repeated C-sections. Previous uterine surgery (dilatation and curettage and dilatation and evacuation) was experienced by 18.4% of patients. Interestingly, 38.5% (n=115) of patients had no previous C-sections, and one-fifth (n=61) did not bleed until admission.

Table 1 - Magnitude of placenta previa and placenta accreta spectrum in the current study.

Variables	n (%)
Total number of deliveries	54,341 (-)
Total number of C-sections	21,708 (-)
General precentage of C-sections	21,708 (39.9)
Total number of PP patients	376 (0.69)
Minor degree PP	77 (20.5)
Major degree PP	299 (79.5)
Major degree PP/number of all deliveries	299 (0.5)
Numbers of C-sections for major degree PP	299 (1.4)
Emergency hysterectomy/major PP patients	29 (9.7)
Maternal mortality/major PP patients	1 (0.3)

Values are presented as numbers and precentages (%). PP: placenta previa

Table 2 - Maternal admission characteristics (n=299).

Variables	n (%)	Mean±SD	Range (min-max)
Age (years)			
≤20	4 (1.3)		
21-30	93 (31.1)	33.3±5.7	17-47
31-40	178 (59.5)		
≥41	24 (8.0)		
Gravidity			
1-4	140 (46.8)	5.1±2.7	1-13
≥5	159 (53.2)		
Parity			
Nullipara	22 (7.4)		
1-4	205 (68.6)	3.3±2.2	0-12
Grand multipara (≥5)	72 (24.1)		
Abortions			
No abortion	170 (56.9)		
1-2	104 (34.8)	0.8±1.1	0-6
Recurrent (≥3)	25 (8.4)		
Previous C-sections			
No	115 (38.5)		
1	47 (15.7)		
2	53 (17.7)		
3	38 (12.7)	1.6±1.5	0-6
4	32 (10.7)		
5	11 (3.7)		
6	3 (1.0)		
Previous uterine surgery			
No uterine surgery	241 (80.6)		
Dilatation and curettage	43 (14.4)		
Dilatation and evacuation	12 (4.0)		
Suction evacuation	2 (0.7)		
Myomectomy	1 (0.3)		
Clinical presentation			
No bleeding	61 (20.4)		
Bleeding	238 (79.6)		

Values are presented as numbers and precentages (%). Min: minimum, max: maximum, SD: standard deviation

Regarding the placental-fetal admission characteristics, are seen in Table 3. Nearly 60% (n=180) of patients had posterior major PP, and antenatal MRI confirmed PAS in ~30.5% (n=91) of them. The majority of patients had natural pregnancy (97.3%), single fetus (99%), cephalic presentation (76.9%), and one-third (32.8%) of them were pregnant at 32 weeks or less on initial diagnosis. Seven (2.3%) patients had IUFD on or shortly after admission. On termination, the mean gestational age was 34.6±5.5 weeks, with only one-third being ≥37 weeks gestation (n=94 [31.9%]) and 14.6% (n=43) were ≤32 weeks.

Table 4 presents the hemorrhagic morbidity among our major PP patients. Hemoglobin <9 gm/dl was seen preoperatively in 27 (9%) patients but only in 13 (4.4%) post-operative patients. Regarding transfusion with blood products, 87.3% (n=261) of them received packed red blood cells (RBCs), with 11.4% (34 patients) receiving ≥4 units, while 113 (37.8%) patients received fresh frozen plasma, and with 24 (14.4%) patients received ≥4 units.

Table 3 - Placental and fetal admission characteristics (n=299).

Variables	n (%)	Mean±SD	Range (min-max)
Placental location			
Posterior	180 (60.2)		
Anterior	119 (39.8)		
Placenta accreta spectrum (by MRI)			
No PAS	208 (69.6)		
Yes	91 (30.5)		
Current IVF pregnancy			
No	291 (97.3)		
Yes	8 (2.7)		
Number of fetuses			
Single	296 (99.0)		
Twins	3 (1.0)		
Fetal status			
Living/normal	282 (94.3)		
IUFD	7 (2.3)		
IUGR	6 (2.0)		
Malformed	4 (1.4)		
Fetal presentation			
Cephalic	230 (76.9)		
Breech	53 (17.7)		
Transverse/complex	16 (5.4)		
Gestational age on admission (weeks)			
24-32	98 (32.8)		
33-36	167 (55.9)	31.7±3.3	25-37
≥37	34 (11.4)		
Gestational age on termination (weeks)			
24-32	43 (14.6)		
33-36	162 (53.6)	34.6±5.5	27-39
≥37	94 (31.9)		

Values are presented as numbers and precentages (%). SD: standard deviation, min: minimum, max: maximum, MRI: magnetic resonance imaging, IVF: in vitro fertilization, PAS: placenta accreta spectrum, IUFD: intra uterine fetal death, IUGR: intra uterine growth restriction

Table 4 - Hemorrhagic morbidity.

Variables	n (%)	Mean±SD	Range (min-max)
Pre-operative (admission) hemoglobin (gm/dl)			
<9 gm/dl	27 (9.0)	10.9±1.5	6.5-14.3
≥9 gm/dl	272 (91.0)		
*Post-operative hemoglobin (gm/dl)**			
<9	13 (4.4)	10.3±1.4	6.1-13.5
≥9	285 (95.6)		
Packed RBCS transfusion (units)			
No	38 (12.7)	1.9±1.7	0-13
1-3	227 (75.9)		
4-6	23 (7.7)		
≥7	11 (3.7)		
Fresh frozen plasma transfusion (units)			
No	186 (62.2)	1.1±2.1	0-21
1-3	89 (29.7)		
4-6	22 (7.4)		
≥7	2 (7.0)		

Values are presented as numbers and precentages (%). *N=298 (one maternal death). SD: standard deviation, min: minimum, max: maximum, RBCS: red blood cells

Major peri-operative data are summarized in Table 5. Nearly one-third (n=103) of major PP patients underwent "emergency" C-sections, mostly due to severe antepartum bleeding. Intra-operative excessive bleeding was visually reported in 87.3% of PP patients, with 115 (38.5%) of them having moderate (>2000 cc) and severe bleeding (>3000 cc), which necessitated further hemostatic interventions and even emergency hysterectomy. Of 299 C-sections, 29 patients had an emergency cesarean hysterectomy due to PAS or uncontrollable intra-operative bleeding, representing 9.7% (n=29) of major degree PP patients. Histopathological diagnosis of PAS was confirmed in approximately one-half of hysterectomy specimens. Urinary bladder injuries were the most common visceral injuries reported in 17 (5.9%) patients, either as isolated bladder injuries in 5 patients or 12 patients during emergency hysterectomy. Approximately one-fourth of patients (n=67) had hospital stay for ≥4 days (3.67±2.04 days).

Lastly, Table 6 presented a full summary and comparison of our results to the outcomes of PP/PAS patients in 6 Saudi studies, which included approximately 187,000 deliveries, and were carried out throughout the last 3 decades.

Discussion. The current study is one of the largest retrospective Saudi studies on major degree PP with

Table 5 - Major peri-operative data.

Variables	n (%)
Timing of C-sections	
Planned	196 (65.6)
Emergency	103 (34.4)
Intra operative bleeding ± hysterectomy	
Normal blood loss (~1000 cc)	39 (13.0)
Mild bleeding (>1000-2000 cc; only medical treatment)	145 (48.5)
Moderate bleeding (>2000-3000 cc; medical treatment±balloon tamponade/b-lynch±vessel ligation)	86 (28.8)
Heavy bleeding (>3000 cc) + hysterectomy (failed all conservative treatment)	29 (9.7)
Intra operative visceral Injury ± hysterectomy	
No hysterectomy or visceral injury	264 (88.3)
Bladder injury (isolated)	5 (1.7)
Intestinal injury	1 (0.3)
Emergency hysterectomy	17 (5.7)
Emergency hysterectomy + bladder injury	10 (3.3)
Emergency hysterectomy + bladder injury + ureteric injury	2 (0.7)
Post operative hospital stay (days), mean±SD*	3.67±2.04
≤3	231 (77.6)
4-6	48 (16.2)
≥7	19 (6.1)

Values are presented as numbers and precentages (%). *N=298 (one maternal death). SD: standard deviation

or without PAS, including 299 Saudi patients. The total incidence of PP was 0.69% (376 patients out of 54,341); PP minor degree in 77 (20.5%) patients, while 299 (79.5%) patients had PP major degree. Since a simple comparison with regional or international studies is quite difficult due to the major differences in maternal risk factors and study methodologies, the logical approach was to keep our comparison primarily with other Saudi studies (summarized in Table 6). Generally, the incidence of PP among other Saudi studies ranged from 0.41-1.6%.[18-23] In a previous report from AMCH, Saudi Arabia, by Bahar et al[21] the total incidence of PP was 0.73% which is comparable to our study (0.69%). An earlier study from AMCH by Zaki et al[23] reported an incidence of PP patients delivered by C-sections (meaning major degree) to be 0.48%, which is marginally less than our study (0.55%). A recent extensive meta-analysis study revealed that regional variance affects the rate of PP globally, with rates of PP being greater in Asian countries (1.22%) and lower in Europe (0.36%), North America (0.29%), and Sub-Saharan Africa (0.27%).[24]

The well known risk factors for PP/PAS were typically present among our patients, including elder age, grand multiparity parity, and repeated cesarean deliveries (Table 2). These features are identical to the findings of previous studies from AMCH.[21,23] Moreover, the recent Saudi studies (Table 6) fully agreed with our findings which represent national trends.[18-23] According to the most recent recommendations, the incidence of PP/PAS is increasing as a result of changing trends in risk factors, particularly increasing maternal age, high parity, and multiple prior C-sections.[1,7] Among our PP patients, previous/repeated cesarean deliveries are leading risk factors, where 61.5% (n=184) of patients had a previous cesarean delivery and 28.1% (n=84) had ≥3 repeated C-sections. Again, this is a major feature of similar Saudi studies presented in Table 6. The percentage of patients with PP and a previous cesarean delivery is up to 75-96% among PP/PAS patients.[18-23] In AMCH, over the last 2 decades (2000-2021), the percentage of PP patients with one previous C-section had increased from approximately 57% (in a previous study by Bahar et al[21]) to ~61% in the current study. It is recommended that every pregnant woman with a previous cesarean delivery should have a placental localization during a mid-pregnancy routine fetal anomaly scan.[1,7]

The risk of PP/PAS is verified to proportionally increase with the number of past C-sections in a previous systematic review.[25] A large multi-centric US cohort study concluded that for women presenting with PP and prior cesarean delivery, the risk of PAS for 1st cesarean delivery was 3%, 11% for 2nd, 40% for 3rd, 61% for 4th, and 67% for 5th or more cesarean deliveries.[6] Furthermore, apparent placental 'migration' is less likely to occur in women with a previous cesarean delivery.[26] In the current study the overall percentage of cesarean deliveries was 39.9%, which is higher than

Table 6 - Incidence, risk factors, and maternal outcomes of the placenta previa/accreta spectrum in the current study and in previous Saudi studies.

Variables	Current study	Mansour et al[18]	Radwan et al[20]	Abduljabbar et al[19]	Kassem et al[22]	Bahar et al[21]	Zaki et al[23]
Population city	Abha	Al-Madinah Al-Munawarah	Jeddah	Jeddah	Taif	Abha	Abha
Total deliveries	54,341	31,296	6000	55,862	29,053	42,487	23,070
C-sections	21,708 (39.9)	-----	-----	11,412 (20.3)	-----	9620 (22.6)	-----
Total PP	376 (0.69)	200 (0.64)	96 (1.6)	230 (0.41)	122 (0.42)	306 (0.73)	110 (0.48)
Major degree PP	299/376 (79.5)	-----	-----	110/230 (47.8)	80/122 (65.5)	173/306 (56.5)	110 (100)
Minor degree PP	77/376 (20.5)	-----	-----	120/230 (52.2)	42/122 (34.5)	133/306 (43.5)	-----
PAS per PP	91/299 (30.5)	82/200 (41.0)	11/96 (11.5)	-----	25/122 (20.5)	45/173 (26.0)	12/110 (11.0)
PAS per all deliveries	91 (0.16)	82 (0.26)	11 (0.18)	-----	25 (0.09)	45 (0.11)	12 (0.05)
No PAS	208/299 (69.6)	118/200 (59.0)	85/96 (88.5)	-----	97/122 (79.5)	128/173 (74.0)	98/110 (89.0)
No APH (asymptomatic)	61/299 (20.4)	-----	-----	39/230 (17.0)	-----	26/173 (15.0)	-----
Age, mean±SD or median (range)	33.3±5.7 (17-47)	34.3±6.0	32.3±5.1	>35 Y: 79 (34.0)	32.9±5.06	31 (16-48)	34±5.4
parity, mean±SD or median (range)	3.3±2.2 (0-12)	---	3.0±1.5	-----	3.7±2.52 (0-10)	4 (0-15)	4.8±3.0
Grand multipara (≥5-6)	72/299 (24.1)	42/200 (21.0)	-----	35/230 (15.3)	-----	-----	-----
Previous C-sections in PP or PAS	PP: 184/299 (61.5)	PP: 147/200 (73.5)	PP: 73/96 (75.4)	PP: 105/230 (45.7)	PP: 70/122 (57.4) PAS: 24/25 (96.0)	PP: 100/173 (57.8)	PP: 27/98 (27.5) PAS: 9/12 (75.0)
C-sections (≥3)	84/299 (28.1)	67/200 (33.5)	-----	24/230 (10.5)	30/122 (24.5)	35/173 (20.2)	5/110 (4.5)
No C-sections	115/299 (38.5)	53/200 (26.5)	23/96 (25.6)	125/230 (54.3)	52/122 (42.6)	73/173 (42.2)	74/110 (67.3)
Previous uterine surgery	58/299 (19.4)	21/200 (10.5)	-----	47 (20.4)	-----	-----	-----
Cesarean hysterectomy with PP or PAS	PP: 29/299 (9.7)	PP: 9/200 (4.5) PAS: 9/82 (11.0)	PP: 13/96 (13.5) PAS: 7/11 (63.6)	PP: 22/230 (9.6)	PP: 24/122 (19.7) PAS: 21/25 (84.0)	PP: 38/173 (22.0)	PP: 2/98 (2.0) PAS: 6/12 (50.0)
Emergency cesarean Sec.	103/299 (34.4)	184/200 (92.0)	-----	130/230 (56.5)	56/122 (45.9)	112/173 (64.7)	-----
Planned cesarean Sec.	196/299 (65.6)	16/200 (8.0)	-----	100/230 (43.5)	66/122 (54.1)	61/173 (35.3)	-----
Urologic injuries (bladder/ureteric)	19/299 (6.3)	10/200 (5.0)	4/96 (4.1)	---	12/122 (9.8)	10/173 (5.8)	-----
Blood transfusion (RBCs)	PP: 261/299 (87.5)	PP: 134/200 (67.0)	-----	PP: 26/230 (11.3)	PP: 70/122 (57.3)	Intra: 35 (20.2) Post: 93 (53.8)	PP: 18/98 (18.3) PAS: 11/12 (91.5)
Pre-term delivery (<37 weeks)	205/299 (68.5)	-----	-----	110/230 (50.0)	82/122 (67.2)	98/173 (56.6)	---
Maternal mortality by PP	1/299 (0.3)	No mortality	No mortality	-----	No mortality	No mortality	1/110 (0.9)
Postoperative hospital stay, mean±SD	3.67±2.04 ≥4 D: 67 (22.4)	-----	-----	-----	4.9±1.83 >5 D: 22 (18.0)	≥14 D: 98 (56.6)	-----

Values are presented as numbers and precentages (%). Some percentages are calculated against the total number of patients with PP or against total number of patients with PAS. PP: placenta previa, PAS: placenta accreta spectrum, APH: antepartum haemorrhage, SD: standard deviation, Sec.: section, RBCs: red blood cells, D: days, Y: years

many previous Saudi studies.[19,21] However, the World Health Organization (WHO) is not recommending a particular rate of C-sections in hospitals. Depending on the type of population served by a hospital, the demand for C-sections can vary significantly between facilities.[27] On the other hand, 38.5% (n=115) of our patients with major PP had no previous C-sections. This feature is seen in similar Saudi studies, which reported incidences ranging from 26-67%.[18-23] However, other risk factors for PP such as older age, grand multiparity, and previous uterine surgery were present.

Nearly one-fifth (20.4%) of our patients with major degree PP (n=61) were asymptomatic (non-bleeders) until diagnosis during routine late second or third-trimester ultrasonography. A previous study in AMCH by Bahar et al[21] reported that 15% of PP patients were

asymptomatic until ultrasonographic diagnosis. In other Saudi studies, Abduljabbar et al[19] found 17% of PP were discovered incidentally. On admission, out of 299 patients with major degree PP, 180 (60.2%) patients had posteriorly located placentae. Recently, in a study by Jansen et al[28] the placentae were more frequently located on the posterior side (62.0%) than on the anterior side (38.0%). There were contradictions for Koai et al[29] which showed that anterior PP is more common than a posterior position with significantly higher maternal hemorrhagic morbidity and preterm delivery.

Among our major PP patients, the mean gestational age of delivery was 34.6±5.5 weeks, with 68.5% (n=205) of PP patients delivered prematurely (PTB), before completing 37 weeks of pregnancy. Similarly, other Saudi studies reported that the risk of PTB <37 weeks associated with PP ranged from ~56-67%.[19,21,22] An up-to-date systematic review and meta-analysis by Jansen et al,[28] on the risk of PTB in women with PP, concluded that "the pooled proportions were 46% regarding PTB of <37 weeks, 17% for PTB of <34 weeks, 10% for PTB of <32 weeks, and 2% for PTB of <28 weeks regarding among these women, resulting in significant perinatal morbidity and mortality".

The need for our PP patients for transfusion with blood products directly reflects the hemorrhagic morbidity; up to 87.3% (n=261) of them received packed RBCs, while 113 (37.8%) patients received fresh frozen plasma. This morbidity is constantly reported in other Saudi studies (**Table 6**). Mansour et al,[18] reported transfusion with blood products in 67%, Kassem et al[22] reported 57.3%, and Bahar et al[21] reported 53.8%. Among patients with PP and PAS, up to 91.5% required blood transfusion.[23] Global estimates place the risk of severe bleeding and the requirement for blood transfusions roughly 12 times higher in PP C-sections than in cesarean deliveries for other causes.[30] These women who undergo a C-section for PP have an increased risk of blood loss exceeding 1000 milliliters.[31] Only 13% (n=39) of our PP/PAS patients had blood loss up to 1000 ml, while 87.3% (n=260) had variable degrees of excessive bleeding (mild, moderate, and heavy). Despite aggressive medical treatment and hemostatic interventions, 115 (38.5%) of them had moderate (>2000 cc) and severe bleeding (>3000 cc). Other Saudi studies are in general agreement with us; Kassem et al[22] observed that the median estimated blood loss from PP/PAS was ≥2,000 mL in 72% with emergency hysterectomy in 24/122 (19.7%) of patients. Abduljabbar et al[19] reported that 11.3% of PP/PAS cases had a hypovolemic shock with massive blood transfusion, and 6.5% had an emergency hysterectomy.

Notably, in AMCH, the general incidence of PAS among our patients has steadily risen over the last 3 decades. The reported incidence by Zaki et al[23] was 0.05%, by Bahar et al[21] was 0.11%, and in the current study, it is 0.17%. Mostly, this is in parallel to the rise in rates of cesarean deliveries. The general incidence of PAS in other PP Saudi studies ranged from 0.09-0.26%.[18,20,22] Nevertheless, a simple comparison between incidences of PAS is of limited value due to different diagnostic criteria (based on TAS or MRI) and the absence of standard histopathological confirmation. The reported prevalence of PAS ranged from 1 in 300 to 1 in 2000 pregnancies in large-scale studies carried out across the globe.[2-4]

Our peri-operative data showed that more than one-third (n=103 [34.4%]) of our major PP/PSA patients had emergency cesarean delivery due to uncontrollable antepartum bleeding. Other Saudi studies recorded comparable or higher findings; the percentage of emergency C-sections ranged from 45-92%.[18-23] Internationally, in the Netherlands, a previous 10-year retrospective study of singleton pregnancies complicated by PP proved that 93 (43%) had an emergency cesarean delivery.[32] Another recent study from Turkey by Oğlak et al[33] reported that 97 (46.6%) patients with PP required emergency cesarean delivery. Intra-operative visceral injuries commonly reported were the urological injuries in 17 (5.9%) patients. This parallels a 10-year retrospective analysis of PP patients admitted to AMCH who reported 10 urological injuries among 173 (5.8%) major PP patients.[21] Furthermore, the previous Saudi studies reported the incidence of urological injuries from 4-9.8%.[18,20,22]

In the current study, out of 299 C-sections for major PP, 29 (9.7%) patients had emergency cesarean hysterectomy due to associated PAS and uncontrollable intra-operative bleeding. In other Saudi studies documented incidences of emergency cesarean hysterectomy for PP ranged from 4.5-22% and as high as 50-84% among PP with PAS.[18-23] In patients with suspected PAS and significant blood loss, a cesarean hysterectomy is anticipated; trials of placental separation could carry a risk of hysterectomy in up to 100 percent of cases.[34] Currently, the majority of US SMFM members and the consensus of the Federation International of Obstetrics and Gynecology expert panel proceed with hysterectomy in cases of high suspicion for PAS during cesarean delivery.[35,36]

Finally, only one maternal death was recorded among our patients, and the calculated maternal mortality rate

per major PP/PAS patients is 0.3% (n=1). Maternal PAS mortality in the 1990s was estimated to be as high as 7% of cases.[37] However, more recent large studies have reported markedly lower maternal death rates due to planning delivery in multi-disciplinary standard obstetric care hospitals.[1,7] Fortunately, many of the latest Saudi studies reported no maternal mortality in PP/PAS patients indicating appropriate obstetric care.[18-22] Nevertheless, our recording of one maternal death is explained by the poor general condition of a few patients on arrival at AMCH. In reality, maternal mortality is still uncommon but greater than among postpartum controls who are matched.[38]

Study limitations. The relatively small sample size and missing/incomplete histopathological confirmation of PAS in the majority of patients. However, the results have outlined the current magnitude of the PP/PAS among this population and this would help to adopt policies to modify the risk factors.

In conclusion, a major degree of PP/PAS is associated with high maternal morbidity and rare mortality. Over 30 years, our patients' obstetric characteristics did not change, including elder age and high parity. There is a substantial increase in the rate of cesarean deliveries as a leading cause of PP/PAS.

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