The effect of placental location in cases of placenta accreta spectrum

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BACKGROUND: Placenta accreta spectrum affects approximately 3 in 1000 pregnancies. There is a paucity of data evaluating the effect of placental location on diagnosis, risk factors, and resultant outcomes in cases of placenta accreta spectrum.

OBJECTIVE: We analyzed placenta accreta spectrum cases to assess whether risk factors or maternal outcomes varied based on placental location.

MATERIALS AND METHODS: We performed a retrospective chart review of pathology-confirmed cases of placenta accreta spectrum from patients delivering at 2 large urban hospitals in the same healthcare system from 2007 to 2017. Placental location was defined by ultrasound images and confirmed by pathology reports. Location was categorized as anterior, posterior, or anterior/posterior for those with placental location at both sites. Fisher exact tests and analysis of variance were used to examine associations with measures of diagnosis, risk factors, and maternal outcomes.

RESULTS: A total of 86 pathology-confirmed placenta accreta spectrum cases were reviewed. The distribution of placental location on ultrasound was as follows: 19% posterior, 59% anterior, and 22% anterior/posterior. We found that prior cesarean delivery was lower with posterior placenta accreta spectrum (63% vs 94% vs 84% in the anterior and anterior/posterior groups respectively; ($P = .007$); however, in vitro fertilization rates were significantly higher (38% vs 2% vs 5% in the anterior and anterior/posterior groups respectively; $P = .001$). There was also lower incidence of percreta with posterior placenta accreta spectrum compared to the anterior and anterior/posterior groups (19% vs 47% vs 58% respectively; $P = .055$). Posterior cases were less likely to have placenta accreta spectrum suspected prenatally (50%) compared to anterior (80%) and anterior/posterior (89%) cases ($P = .019$). Despite late diagnosis, ureteral injury was the only surgical complication that was more common in patients with posterior placenta accreta spectrum (13% vs 0% vs 5% for anterior and anterior/posterior groups respectively; $P = .037$).

CONCLUSION: Placenta accreta spectrum with posterior placental location is associated with delayed diagnosis, surgical complications, assisted reproductive technology, and lower numbers of prior cesarean deliveries relative to anterior location. These differences in outcomes and risk factors based on placental location may allow for heightened clinical awareness, and improved diagnosis and management.

Key words: accreta, IVF, placenta accreta spectrum, placental location, posterior placenta accreta

Placenta accreta spectrum (PAS) affects approximately 3 in 1000 pregnancies, with even conservative estimates demonstrating a 5-fold increase in incidence over the past 3 decades.[1] PAS occurs when there is damage to the boundary between the endometrium and myometrium allowing placental trophoblast to grow into, or in some cases through, the uterine wall.[2] It has been implicated in substantial perinatal maternal morbidity due to an increased risk of intrapartum and postpartum hemorrhage, frequently requiring massive transfusion of blood products. Hysterectomies are often necessary, contributing to an increased risk of surgical complications and lengthier hospital stays.[3] PAS may also cause a significant emotional toll on women, particularly those who had plans for future childbearing.

A finding of placenta previa together with a history of cesarean delivery has long been an indication for counseling patients on their risk of PAS in a current pregnancy, as the risk for placenta accreta in the presence of placenta previa increases with each subsequent cesarean delivery.[4] Aside from cesarean deliveries and placenta previa, other risk factors have been identified for PAS, including past uterine surgeries, in vitro fertilization (IVF), multiparity, maternal age, and even female sex of the infant.[5,6]

Although placental location has been explored in the context of placenta previa, with anterior placenta previa being more often associated with greater blood loss and increased risk of placental invasion and hysterectomy, there are scant clinical data on posterior placental location and PAS.[7–11] To date, no studies have examined whether the distribution of risk factors and outcomes for PAS vary based on placental location. As such, PAS cases with posterior location remain diagnostic and therapeutic challenges, with a paucity of data regarding risk factors and relation to anterior PAS.

Given the lack of examination of the role of placental location in cases of PAS, the purpose of this study was to assess how risk factors, diagnosis, and outcomes might vary for PAS cases with posterior location compared to those with anterior or anterior/posterior location.

Materials and Methods

Study context

Cases were identified from Abbott Northwestern and United Hospitals in the Twin Cities, part of the Allina Health system. Minnesota Perinatal Physicians (MPP) provides care for high-risk pregnancies at both hospital campuses that serve as regional perinatal health care centers, pulling in patient referrals from

Cite this article as: Morgan EA, Sidebottom A, Vacquier M, et al. The effect of placental location in cases of placenta accreta spectrum. Am J Obstet Gynecol 2019;221:357.e1-5.

0002-9378/$36.00

https://doi.org/10.1016/j.ajog.2019.07.028

AJOG at a Glance

Why was the study conducted?

This study was conducted to identify risk factors and diagnostic dilemmas and outcomes in women with histologically proven placenta accreta with posterior placenta location.

Key findings

PAS with posterior placental location is associated with delayed diagnosis, surgical complications, assisted reproductive technology, and lower prevalence of prior cesarean deliveries.

What does this add to what is known?

This study contributes a timely review of how placental location affects identification, management, and outcomes of PAS, and how PAS patients with posterior placentae may differ from the more commonly described patients with anterior placentae.

across the state. Prior to referral to MPP, patients may have received prenatal care at an Allina Health–owned clinic or may have been referred from a clinic outside the Allina Health system.

Selection criteria

To identify all cases of PAS, data were extracted from the electronic health record. Case patients were included in the extract if they had a delivery at 1 of the 2 hospitals from January 1, 2007, to December 31, 2017; had a hysterectomy performed at the delivery; had a pathology-confirmed diagnosis of PAS (gross pathology and histology); and placental location was clearly defined on ultrasound report. Twin pregnancies were included in this study.

Data collection and measures

Data for this study come from Allina Health's electronic health records, with some data collected via data extraction and other data collected via chart reviews. Chart reviews were conducted by perinatologists and the MPP clinic manager (RN). The use of these data was approved by the Allina Institutional Review Board. Placental location was defined by ultrasound images. Location was categorized as anterior, posterior, or anterior/posterior for those that involved both sites on imaging. Diagnosis-related measures included whether PAS was suspected prenatally from ultrasound (yes/no), delivery type (scheduled vs spontaneous/emergent), gestational age at delivery, and severity of invasion (defined from the pathology report based on the highest level of invasion noted). Risk factors included number of prior cesarean deliveries, number of prior uterine surgeries, placenta previa during the study pregnancy (defined as complete or marginal <2 cm from cervical os), and IVF. Maternal outcomes collected included operating room time, estimated blood loss, intraoperative transfusion of blood products, and intensive care unit admission. Surgical complications included organ injury and complications related to interventional radiologic procedures, and transfusion complications. Postoperative complications included hemorrhage, fever, infection, inability to extubate postoperatively, acute kidney injury need for re-exploration, multiorgan failure, and mortality.

Statistical analysis

Fisher exact tests were used for categorical measures and analysis of variance was used for continuous variables to examine associations of placental location with measures of diagnosis, risk factors, and maternal outcomes. Odds ratios (ORs) were calculated for selected measures showing association in the cross-tabulations. All ORs were calculated out of the subset of 67 PAS cases with either an anterior or posterior location, using anterior as the reference category. All analyses were conducted using Stata 15.1 (StataCorp, College Station, TX).

Results

There were 76,048 deliveries with consent to use medical records for research from 2007 to 2017 at the 2 hospitals. Of those women, 137 had a hysterectomy performed at the time of delivery. After reviewing pathology reports, 95 case patients were confirmed to have a diagnosis of PAS. Nine patients were excluded from the current analysis because they were missing documentation of placenta location on the ultrasound. This resulted in a final sample of 86 histology-confirmed PAS cases, which were reviewed. The distribution of placental location on ultrasound was as follows: 19% posterior, 59% anterior, and 22% anterior/posterior.

We found that prior cesarean delivery was lower with posterior location (63% vs 94% in the anterior group; $P = .007$), with an OR of 0.10 for prior cesarean delivery for the posterior group relative to the anterior group (confidence interval [CI], 0.02, 0.57; $P = .001$). However, when history of any prior cesarean delivery or uterine surgery was combined, there was no difference between the groups. There was also a trend toward a decreased incidence of percreta with posterior location than within the anterior and anterior/posterior groups (19% vs 47% vs 58% respectively; $P = .055$); the OR was 0.26 for percreta among posterior versus anterior location (CI, 0.06, 1.08; $P = .045$), for the 67 cases with either anterior or posterior location. The IVF rates were significantly higher (38% vs 2% vs 5% in the posterior group relative to the anterior and anterior/posterior group; $P = .001$), with an OR of IVF history of 30.0 for posterior location relative to anterior (CI, 2.28, 395.36; $P < .0001$). However, the limited number of cases in each category make the estimations imprecise (Table 1). Posterior cases were more likely to have PAS identified at the time of delivery (ie, no PAS

TABLE 1
Examination of diagnosis and risk factors by ultrasound placental location in placenta accreta spectrum cases

Diagnosis related measures	Posterior (n = 16)	Anterior (n = 51)	Posterior & Anterior (n = 19)	*P* value
PAS suspected prenatally, n (%)				
Yes	8 (50)	41 (80)	17 (89)	.019
No	8 (50)	10 (20)	2 (11)	
Delivery type, n (%)				
Scheduled	10 (63)	33 (65)	12 (63)	1.000
Spontaneous/Emergent	6 (38)	18 (35)	7 (37)	
Gestational age at delivery (mean ± SD)	34.8 (2.18)	33.4 (3.93)	33.6 (2.08)	.344
Severity of invasion, n (%)				
Accreta/Increta	13 (81)	27 (53)	8 (42)	.055
Percreta	3 (19)	24 (47)	11 (58)	
Risk factors				
Prior cesarean delivery or prior uterine surgeries, n (%)	14 (88)	49 (96)	18 (95)	.365
Prior cesarean delivery, n (%)	10 (63)	48 (94)	16 (84)	.007
Number of prior cesarean delivery, median (IQR)	2 (2)	2 (2)	2 (2)	.175
Prior uterine surgeries, n (%)	6 (38)	22 (43)	12 (63)	.233
Number of prior uterine surgeries, median (IQR)	0 (1)	0 (1)	1 (2)	.323
Placenta previa in this pregnancy, n (%)	11 (69)	43 (84)	17 (89)	.277
IVF this pregnancy, n (%)	6 (38)	1 (2)	1 (5)	.001

IQR, interquartile range; *IVF,* in vitro fertilization; *PAS,* placenta accreta spectrum.
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suspected on their prenatal ultrasound) (50%) compared to anterior (20%) and anterior/posterior (11%) cases (P = .019); the OR was 4.10 for diagnosis at time of delivery for posterior vs anterior (CI, 1.16, 14.51; P = .018). Despite late identification of possible PAS, ureteral injury was the only surgical complication increased in patients with posterior location (13% vs 0% vs 5% for anterior and anterior/posterior groups respectively; P = .037 (Table 2).

Comment

Although there has been a proliferation in the literature devoted to PAS,[12,13] these studies remain limited to relatively small case series because of the rarity of the disease process. In our study, we aimed to examine a large cohort of patients to further describe how contributory risk factors, diagnosis-related measures, and resultant outcomes differ based on placenta location.

We found that PAS with posterior placenta location is associated with delayed identification of PAS, surgical complications, assisted reproductive technology, and lower prevalence of prior cesarean deliveries. These differences in outcomes and risk factors based on placental location may allow for heightened clinical awareness and improved management.

Placental location in PAS and outcomes

Past studies have demonstrated that anterior location of the placenta in conjunction with placenta previa increases the risk of postpartum hemorrhage, massive transfusions, and hysterectomy.[7–11] Anterior placenta previa has also been associated with a lower gestational age of initial onset of bleeding than posterior placenta previa. Importantly, the increased hemorrhage risk is present even when controlling for the presence of placenta accreta.[11,14] Despite often later diagnosis, and although maternal outcomes are better with earlier diagnosis, posterior placenta previa still was associated with better maternal and surgical outcomes.[9] Our study provided some insight into this trend, as we found that PAS cases with posterior placenta location less often presented as an increta or percreta, both of which are associated with higher morbidity.[15,16]

Posterior placenta accreta spectrum and assisted reproductive technology

Our data shows differences in risk factors between PAS patients with posterior and

TABLE 2
Examination of outcomes by ultrasound placental location in placenta accreta spectrum (PAS) cases

Outcomes	Posterior (n = 16)	Anterior (n = 51)	Posterior and anterior (n = 19)	*P* value
Operating time, min (mean ± SD)	218.6 (83.19)	279.3 (126.42)	288.3 (100.05)	.155
Operating time (min), median (IQR)	217 (85)	281 (168)	276 (87)	
Bleeding (EBL), mL (mean ± SD)	3524.2 (2648.5)	4347.0 (3769.7)	2971.1 (1727.9)	.262
Bleeding (EBL), mL, median (IQR)	3000 (2800)	3000 (4000)	2800 (2700)	
Transfusion of blood products during delivery, n (%)	10 (63)	42 (82)	14 (74)	.223
Cell Saver transfusion during delivery, n (%)	5 (31)	20 (41)	7 (37)	.864
ICU admission, n (%)	8 (50)	25 (49)	9 (47)	1.000
Surgical complications, n (%)				
Cystotomy	2 (13)	16 (35)	5 (26)	.325
Vascular injury	1 (6)	0 (0)	0 (0)	.186
Neurologic injury	0 (0)	0 (0)	1 (5)	.407
Bladder injury	0 (0)	10 (20)	4 (21)	.126
Ureteral injury	2 (13)	0 (0)	1 (5)	.037
Intestinal injury	—	—	—	—
Wound complications requiring antibiotics or opening the wound	0 (0)	6 (12)	2 (11)	.506
Postoperative complications, n (%)				
Postoperative hemorrhage	0 (0)	4 (8)	0 (0)	.474
Ileus/SBO	3 (19)	9 (18)	4 (21)	.928
Inability to extubate postoperatively	2 (13)	13 (26)	7 (37)	.260
Fever	1 (6)	7 (14)	1 (5)	.620
Infection	1 (6)	8 (16)	2 (11)	.744
Thromboembolic	1 (6)	2 (4)	2 (11)	.465
AKI	0 (0)	2 (4)	0 (0)	1.000
Re-exploration	0 (0)	6 (12)	0 (0)	.146
Multiorgan failure	0 (0)	2 (4)	0 (0)	1.000
Mortality	-	-	-	-

AKI, acute kidney injury; *EBL*, estimated blood loss; *ICU*, intensive care unit; *IQR*, interquartile range; *SBO*, small bowel obstruction; *SD*, standard deviation.
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those with anterior placenta location, most notably the use of assisted reproductive technology (ART). Our finding linking IVF with placenta accreta is not unique. In 2011, Esh-Broder et al demonstrated a 13-fold increased risk of placenta accreta spectrum in patients undergoing IVF vs those with spontaneous conception.[17] Mechanisms may include disruption of the endometrium, different patient characteristics such as age, parity, or other unknown factors, or some combination thereof. These likely differ from patients without a history of ART. A small French cohort illustrated this when they showed an increased number of IVF cases in women with placenta accrete without prior cesarean delivery.[18] Our study, adding to this prior exploration of ART, adds novel information by showing that IVF use may be associated with posterior location in PAS cases and accreta vs increta or percreta, which may be useful for patient counseling and prognosis.

Limitations

We were limited by the retrospective nature of this study. The quality of our measures may be affected by the quality

of documentation available over the 10-year study period, as well as changes in documentation possible over the tenure of the project, such as implementation of an electronic medical record. Furthermore, because our study focuses only on cases of histologically confirmed PAS, our study does not answer questions about the risk of PAS in the general obstetric population.

Future directions

In the future, we look forward to data that prospectively follow a cohort of patients with placenta previa to help further define risks for improved patient counseling. Unfortunately, in our institutions, as in many other tertiary care facilities, patients often have ultrasound diagnosis made at a location different from their delivering hospital. This loss to follow-up makes prospective studies difficult in a standard hospital system, and may be better conducted within a large health maintenance organization or other similarly structured organization. However, we do hope to partner with other accreta "centers of excellence" to combine numbers for a larger study cohort. ■

References

1. Belfort MA, Shamshirsaz AA, Fox KA. The diagnosis and management of morbidly adherent placenta. Semin Perinatol 2018;42:49–58.

2. Jauniaux E, Collins S, Burton GJ. Placenta accreta spectrum: Pathophysiology and evidence-based anatomy for prenatal ultrasound imaging. Am J Obstet Gynecol 2018;218:75–87.

3. American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine with assistance of Cahill AG, Beigi R, Heine RP, Silver RM, Wax JR. Placenta accreta spectrum. Am J Obstet Gynecol 2018;219:B2–16.

4. Silver RM, Landon MB, Rouse DJ, et al. Maternal morbidity associated with multiple repeat cesarean deliveries. Obstet Gynecol 2006;107:1226–32.

5. Silver RM. Abnormal placentation: placenta previa, vasa previa, and placenta accreta. Obstet Gynecol 2015;126:654.

6. Fitzpatrick KE, Sellers S, Spark P, Kurinczuk JJ, Brocklehurst P, Knight M. Incidence and risk factors for placenta accreta/increta/percreta in the UK: A national case-control study. PLoS One 2012;7:e52893.

7. Sekiguchi A, Nakai A, Kawabata I, Hayashi M, Takeshita T. Type and location of placenta previa affect preterm delivery risk related to antepartum hemorrhage. Int J Med Sci 2013;10:1683–8.

8. Lee HJ, Lee YJ, Ahn EH, et al. Risk factors for massive postpartum bleeding in pregnancies in which incomplete placenta previa are located on the posterior uterine wall. Obstet Gynecol Sci 2017;60:520–6.

9. Jang DG, We JS, Shin JU, et al. Maternal outcomes according to placental position in placental previa. Int J Med Sci 2011;8:439–44.

10. Matsubara S, Baba Y, Takahashi H. Placenta previa and hemorrhage: The placental location may be an important determinant of the bleeding amount. J Matern Fetal Neonatal Med 2018;31:1390–1.

11. Young BC, Nadel A, Kaimal A. Does previa location matter? Surgical morbidity associated with location of a placenta previa. J Perinatol 2014;34:264–7.

12. Placenta accreta. Available at: https://www.ncbi.nlm.nih.gov/pubmed/?term=placenta+accreta. Accessed March 1, 2019.

13. Morbidly adherent placenta. Available at: https://www.ncbi.nlm.nih.gov/pubmed/?term=morbidly+adherent+placenta. Accessed March 1, 2019.

14. Baba. Anterior placentation as a risk factor for massive hemorrhage during cesarean section in patients with placenta previa. J Obstet Gynaecol Res 2014;40:1243–8.

15. Marcellin L, Delorme P, Bonnet MP, et al. Placenta percreta is associated with more frequent severe maternal morbidity than placenta accreta. Am J Obstet Gynecol 2018;219:193.

16. Brookfield KF, Goodnough LT, Lyell DJ, Butwick AJ. Perioperative and transfusion outcomes in women undergoing cesarean hysterectomy for abnormal placentation. Transfusion (Paris) 2014;54:1530–6.

17. Esh-Broder. Placenta accreta is associated with IVF pregnancies: A retrospective chart review. BJOG 2011;118:1084–9.

18. Tourette C, Bretelle F, Cravello L, et al. [Comparative study of patients with placenta accreta with or without a history of cesarean section]. J Gynecol Obstet Biol Reprod (Paris) 2014;43:322–7.

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Received March 12, 2019; revised June 22, 2019; accepted July 16, 2019.

The authors report no conflict of interest.

This study was funded partially by the Abbott Northwestern Foundation.

Presented as a poster at the Society for Maternal-Fetal Medicine 39th Annual Pregnancy Meeting, Las Vegas, NV, Feb. 13–16, 2019.

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