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ORIGINAL ARTICLE

Maternal and neonatal outcomes among scheduled versus unscheduled deliveries in women with prenatally diagnosed, pathologically proven placenta accreta

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ABSTRACT

Objective: To evaluate maternal and neonatal outcomes among scheduled versus unscheduled deliveries in cases of prenatally diagnosed, pathologically proven placenta accreta.

Study design: Retrospective cohort of placenta accreta cases delivered in five University of California hospitals.

Results: Of 151 cases of histopathologically proven placenta accreta, 82% were prenatally diagnosed. Sixty-seven percent of women underwent scheduled deliveries and 33% were unscheduled. There were no differences in demographics between groups except a higher rate of antepartum bleeding in the unscheduled delivery group (81 versus 53%; $p = .003$). Scheduled deliveries were associated with a later gestational age at delivery (34.6 versus 32.6 weeks; $p = .001$), lower blood loss (2.0 versus 2.5 l; $p = .04$), higher birth weight (2488 versus 2010 g; $p < .001$), shorter postpartum length of stay (4 versus 5 d; $p = .03$) and neonatal length of stay (12 versus 20 d; $p = .005$).

Conclusion: Despite a prenatal diagnosis of placenta accreta, 1/3 of these cases require unscheduled delivery, portending poorer maternal and neonatal outcomes.

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Placenta accrete; preterm delivery; invasive placentation; morbidly adherent placenta

Introduction

Contemporary studies report the incidence of placenta accreta to be 1 in 533 pregnancies [1]. There is a significant increase in the incidence in women with multiple prior cesarean deliveries, particularly in the setting of a placenta previa [1,2]. The rates of placenta accreta in women with a placenta previa range from 3% in those undergoing their first cesarean delivery to over 60% for those undergoing their fourth or fifth cesarean deliveries [3]. Hysterectomy and the surgical management of placenta accreta are associated with maternal morbidities including peripartum hemorrhage with the need for massive blood transfusion and genitourinary tract injuries. The diagnosis of placenta accreta is also associated with an increased risk of maternal mortality with studies reporting a rate of up to 7% [4].

Prenatal diagnosis improves the outcomes with placenta accreta. Warshak et al. demonstrated that preoperative diagnosis was associated with lower hemorrhagic and transfusion related morbidities and fewer unscheduled urgent deliveries [5]. Planned deliveries allow for a multidisciplinary approach to delivery with coordination among subspecialties including anesthesia, maternal-fetal medicine, gynecologic oncology, urology, transfusion medicine and surgical and neonatal intensive care services. Unscheduled deliveries may be associated with poorer outcomes even in the setting of a prior prenatal diagnosis. The ideal gestational age for delivery in women with invasive placentation to optimize both maternal and neonatal outcomes and avoid the need for unscheduled urgent delivery is not known. Robinson et al. using decision tree analysis, suggests that scheduled delivery at 34-week yields the highest quality-adjusted life years for women with prenatally diagnosed placenta accreta [6].

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Our study aims to assess outcomes for women with a prenatal diagnosis of placenta accreta from a geographically diverse cohort representing deliveries within the University of California Fetal Consortium (UCfC), a collaborative of five academic medical centers within the state of California. Our objective was to evaluate the effect of scheduled versus unscheduled deliveries on maternal and neonatal outcomes in cases of prenatally diagnosed, pathology-proven placenta accreta.

Materials and methods

We performed a retrospective cohort study of all cases of pathology-proven placenta accreta from 2009 to 2014 delivered at the five tertiary level, academic hospitals comprising the UCfC. This includes the Universities of California at Davis, Irvine, Los Angeles, San Diego, and San Francisco. The placenta accreta cases were collected from the review of delivery records, International Classification of Disease codes, and pathology records. Cases were only included if invasive placentation (placenta accreta, increta, or percreta) was confirmed by histopathology. A confirmed diagnosis of placenta accreta required pathological demonstration of placental villi directly within the underlying myometrium, with the absence of the intervening decidua basalis. Our academic centers have similar practices for diagnosis of placenta accreta in at-risk women, primarily by ultrasound with MRI used as an adjunct. Delivery is generally planned at 34–35 weeks *via* cesarean hysterectomy with the placenta left *in situ* during the procedure in most centers.

Demographic characteristics and maternal and neonatal outcomes were collected by chart review at each of the individual sites. Demographic characteristics including age, ethnicity, body mass index (kg/m^2), gravidity, parity, number of cesarean deliveries and uterine surgery (dilation and curettage (D&C) and myomectomy). BMI was calculated based on first prenatal visit weight. Estimated blood loss (EBL) was estimated intraoperatively by the operating surgeons. Blood loss, units of blood products transfused (packed red blood cells (PRBC) and fresh frozen plasma (FFP)), operative time, and surgical complications were obtained from a review of operative reports. Neonatal outcomes including gestational age at delivery, corticosteroid administration, birth weight, Apgar score, diagnosis of respiratory distress syndrome (RDS) and surfactant use was obtained from a review of the neonatal chart. The demographic variables and the outcomes of women with prenatal diagnosis and those delivered as scheduled or unscheduled deliveries were assessed. Student's *t*-test, chi-square analyses, and the Mann–Whitney U test were used where appropriate. A p value of $<.05$ was considered significant. IBM SPSS version 22.0 (Armonk, NY) was used for all statistical analyses. The study was approved by the Institutional Review Boards at each site, under the auspices of the Reliance Registry. Subject consent was waived given the retrospective nature of the study.

Results

Over the 6-year study period, 155 cases of placenta accreta were identified from the five UCfC institutions. All of these cases were confirmed to have histopathologic evidence of placenta accreta. Four cases were excluded from analysis due to delivery prior to 23 weeks, which left 151 cases for evaluation. Of the confirmed cases, 82% (124/151) were diagnosed by prenatal imaging and these 124 cases comprised the cohort of interest.

The baseline demographic variables for the prenatal diagnosis group including maternal age, ethnicity, BMI, and participation in prenatal care are shown in Table 1. 95.2 percent (118) of the cohort had a history of at least one prior cesarean delivery and 93.5% (116) had a placenta previa. The mean gestational age at the time of prenatal diagnosis was 25.7 ± 6.3 weeks. Diagnosis of accreta was achieved by ultrasound only in 47.6% (50), MRI only 1.6% (2) and both 50.8% (60). The percentages of accreta, increta, and percreta by pathological examination after delivery were 34.7, 34.7, 30.6%, respectively.

The overall rate of unscheduled delivery in the prenatal diagnosis cohort was 33% (41/124). There were no statistically significant differences in demographic characteristics between those with scheduled or unscheduled deliveries (Table 1). Specifically, there were no differences in maternal age, BMI, number of prior cesarean deliveries, the percentage with a previa, or the level of placenta invasion (accreta, increta, or previa) (Table 1). Hospital admission for antepartum bleeding at some point during pregnancy occurred in 53% (44/83) of the women undergoing scheduled procedures and in 80.5% (33/41) of women with unscheduled delivery ($p = .003$). The number of antepartum bleeding episodes was also significantly lower among women with scheduled deliveries when compared to women with unscheduled deliveries (1 (interquartile range: 0–2) versus 2 (interquartile range: 1–2.5); $p = .004$).

The intra- and postoperative outcomes are shown in Table 2. The median gestational age of delivery for the prenatal diagnosis cohort was 34.3 weeks

Table 1. Demographic and baseline data of the prenatal diagnosis cohort and by scheduled and unscheduled deliveries.

	Prenatal diagnosis $N = 124$	Scheduled delivery $n = 83$	Unscheduled delivery $n = 41$	p value
Maternal age (years)	33.6 ± 5.3	33.1 ± 5.1	34.7 ± 5.4	.11
Ethnicity				
Hispanic	59 (47.1%)			
Caucasian	38 (30.6%)			
Asian	8 (6.5%)			
Black	7 (5.6%)			
Multiracial	3 (2.4%)			
Body mass index (kg/m^2)	31.1 ± 6.2	31.6 ± 6.5	30.3 ± 5.8	.34
Participation in prenatal care	122 (98.4%)	81 (97.6%)	41 (100%)	.32
Any prior cesarean delivery	118 (95.2%)	80 (96.4%)	38 (92.7%)	.37
No. of prior cesarean deliveries	2 (2.3)	2 (2.3)	2 (1.3)	.16
Any prior D&C	44 (35.5%)	26 (32.1%)	18 (46.2%)	.16
No. of prior D&Cs	0 (0.1)	0 (0.1)	0 (0.1)	.14
Any prior myomectomy	4 (3.2%)	1 (1.2%)	3 (7.3%)	.07
Placenta previa present	116 (93.5%)	77 (92.8%)	39 (95%)	.62
Prenatal diagnosis of accreta				.87
Ultrasound only	59 (47.6%)	40 (48.2%)	19 (46.3%)	
MRI only	2 (1.6%)	1 (1.2%)	1 (2.4%)	
Both	63 (50.8%)	42 (50.6%)	21 (51.2%)	
Gestational age at diagnosis of accreta (weeks)	25.7 ± 6.3	26.4 ± 6.6	24.3 ± 5.5	.08
Type of accreta				
Accreta	43 (34.7%)	28 (33.7%)	15 (36.6%)	.95
Increta	43 (34.7%)	29 (34.9%)	14 (34.1%)	
Percreta	38 (30.6%)	26 (31.3%)	12 (29.3)	

Data are mean ± standard deviation, no. (%), or median (25th, 75th quartiles).
D&C: dilation and curettage.

Table 2. Intraoperative and postoperative outcomes in the prenatal diagnosis cohort and by scheduled and unscheduled deliveries.

	Prenatal diagnosis $N = 124$	Scheduled delivery $n = 83$	Unscheduled delivery $n = 41$	p value
Gestational age at delivery	34.3 (33.5, 35.5)	34.6 (34.1, 35.9)	32.6 (31.0, 34.4)	<.001
Estimated blood loss (l)	2.2 (1.5, 3.9)	2.0 (1.5, 3.5)	2.5 (2.0, 5.5)	.04
Operative time (min)	209 (155, 282)	205 (152, 290)	225 (171, 262)	.84
Any intraoperative transfusion	87 (70.2%)	23 (27.7%)	16 (39%)	.20
Intraoperative PRBCs (units)	2 (0.6)	2 (0.5)	3 (0.9)	.03
Intraoperative FFP (units)	0 (0.4)	0 (0.2)	1 (0.5)	.02
Urinary tract or bowel injury	27 (21.8%)	18 (21.7%)	9 (22.0%)	.97
Maternal ICU admission	58 (46.8%)	39 (47.0%)	19 (46.3%)	.94
Any postoperative transfusion	39 (31.5%)	82 (98.8%)	41 (100%)	1.0
Postpartum length of stay (d)	5 (4.6)	4 (4.6)	5 (4.6)	.03

Data are median (25th, 75th quartiles) or no. (%).
PRBC: packed red blood cells; FFP: fresh frozen plasma; ICU: intensive care unit.

(interquartile range: 33.5–35.5 weeks). The median EBL was 2.2 l (interquartile range: 1.5–3.9). Overall, 70.2% (87/124) received an intraoperative transfusion and 31.5% (39/124) received a postoperative transfusion. Fifty-eight (46.8%) out of the 124 women were admitted to intensive care unit (ICU). The median postpartum length of stay was 5 d (interquartile range: 4–6 d). Comparing outcomes among women with scheduled and unscheduled deliveries, there was a significantly higher gestational age at delivery (34.6 weeks (interquartile range: 34.1–35.9 weeks) versus 32.6 weeks (interquartile range: 31.0–34.4 weeks), $p = .001$) and lower blood loss 2.0 l (interquartile range: 1.5–3.5 l) versus, 2.5 l (interquartile range: 2.0–5.5 l), $p = .04$). There was a lower number of units of PRBCs (2 units (interquartile range: 0–5 units) versus 3 units (interquartile range: 0–9 units), $p = .03$) and FFP (0 units (interquartile range: 0–2 units) versus 1 unit (interquartile range 0–5.5 units), $p = .02$) in the women undergoing scheduled deliveries although the overall percentage of women requiring intraoperative transfusions did not differ. There were no differences in operative time, urinary tract/bowel injury or maternal ICU admission. However, the women with scheduled deliveries had a shorter median postpartum length of stay (LOS)F (4 d (interquartile range: 4–6 d) versus 5 d (interquartile range: 4–6 d), $p = .03$).

Neonatal outcomes are shown in Table 3. For the entire prenatal diagnosis cohort, 72.6% (90/124) of the mothers received antenatal corticosteroids before delivery. The mean birth weight was 2332 ± 558 g and 63% (78/124) were <2500 g at delivery. Forty-six (37.4%) had RDS and 14.8% required surfactant. The median length of stay was 13 d (interquartile range: 6–22 d). Comparing neonatal outcomes between those with scheduled versus unscheduled procedures, there

Table 3. Neonatal outcomes of the prenatal diagnosis and by scheduled and unscheduled deliveries.

	Prenatal diagnosis $N = 124$	Scheduled delivery $n = 83$	Unscheduled delivery $n = 41$	p value
Antenatal corticosteroids	90 (72.6%)	55 (66.3%)	35 (85.4)	.03
Birth weight (g)	2333 ± 558	2488 ± 499	2010 ± 539	<.001
Birth weight <2500 g	78 (63%)	47 (56.6%)	31 (77.5%)	.02
1-min Apgar score <7	7 (4.8)	7 (5.8)	7 (4.8)	.41
5-min Apgar score <7	9 (8.9)	9 (8.9)	8 (7.9)	.33
Respiratory distress syndrome	46 (37.4%)	26 (31.7%)	20 (48.8%)	.07
Surfactant administration	18 (14.8%)	8 (9.9%)	10 (24.4%)	.03
Neonatal length of stay (d)	13 (6.22)	12 (6.18)	20 (8.30)	.005

Data are no. (%), mean ± standard deviation, or median (25th, 75th quartiles).

was a lower rate of corticosteroid administration (66.3 versus 85.4%, $p = .03$), higher mean birth weight (2488 ± 499 g versus 2010 ± 539 g, $p < .001$) and lower percentage of infants with birth weight <2500 g (56.6 versus 77.5%, $p = .02$). There were no differences in Apgar scores at 1 and 5 min or the frequency of RDS. Despite no differences in the frequencies (incidences) of RDS, there was lower surfactant administration (9.9 versus 24.4%, $p = .03$) in the infants born to mothers with scheduled deliveries. The length of neonatal stay was also shorter in infants born to mothers with scheduled deliveries (12 d (interquartile range: 6–18 d) versus 20 d (interquartile range: 8–30 d) ($p = .005$)).

Discussion

In our cohort of histopathologically confirmed placenta accreta cases, 82% were diagnosed prenatally and of these, 67% had controlled scheduled deliveries and 33% had unscheduled deliveries. The rates of maternal operative complications and transfusion were significantly affected by whether or not deliveries occurred in an unscheduled manner. Scheduled procedures were associated with later gestational age at delivery and lower hemorrhagic and transfusion related morbidities. For the neonate, there was a lower need for surfactant and a shorter length of stay for scheduled deliveries.

Prenatal diagnosis of placenta accreta allows for management in tertiary care centers such as those represented in the UCfC. Given the need for extensive surgical and anesthesia expertise, the availability of an experienced blood bank, and the benefit of the support of an intensive care team, many organizations have advocated that women with suspected placenta accreta should be delivered at specialty centers. The Committee Opinion on behalf of the American College of Obstetrics and Gynecology (ACOG) specifically on placenta accreta endorses that delivery occurs in a tertiary care center with specialized teams [7,8]. This team often includes obstetricians, perinatologists, gynecologic oncologists, anesthesiologists, critical care intensivists, radiologists and urologists. Criteria have been published that would qualify an institution as an "Accreta Center of Excellence" and it is likely that these types of designations in the future will improve both care coordination and maternal outcomes [8,9].

This study demonstrates a significant improvement in the success of prenatal diagnosis over prior studies, with prior studies suggesting that only 27–53% [10–12] of accreta cases are suspected prenatally. However, even with a prenatal diagnosis, one-third of the deliveries were still performed in an unscheduled manner. These unscheduled deliveries occurred at earlier gestational ages and had higher maternal and neonatal morbidities. Similarly, a study by Bailit et al. showed an earlier gestational age of delivery in prenatally suspected cases of placenta accreta that were delivered in an unscheduled manner [11]. This outcome is not completely avoidable, as 80% of women who were delivered in unscheduled manner had antepartum bleeding.

The ideal delivery timing for women with suspected placenta accreta is controversial. There are no randomized studies to guide these decisions. A 2012 decision analysis suggested that delivery at 34 weeks may provide the most optimal outcome in prenatally diagnosed cases of placenta accreta [6]. A more recent ACOG publication on recommendations for late preterm and early term delivery suggests delivery at 34 0/7 to 35 6/7 weeks for cases with suspected placenta accreta [9]. In our study, in the cases with prenatal diagnosis, scheduled deliveries occurred at the median gestational age of 34.1 weeks (interquartile range: 33.4–35.5 weeks). Additional data from other referral centers will only further help to identify the optimal gestational age for delivery, balancing both maternal and neonatal outcomes.

The strength of our study is the evaluation of a large cohort of contemporary cases of placenta accreta that reflect current practices in diagnosis and management. The limitations include the retrospective nature of the study and the potential bias and improvement in the outcomes when only including deliveries at tertiary referral centers. Inconsistency in the gestational

ages at diagnosis may reflect variance in community-based referrals to our university-based centers.

Despite advances in prenatal diagnosis, placenta accreta remains a condition with high maternal and neonatal morbidity, particularly when delivery occurs in an unscheduled and potentially urgent manner. Further characterization of the risk factors associated with unscheduled delivery, creating centers of excellence for the care of placenta accreta cases, and defining the optimal gestational age for delivery, will likely decrease the need for such unscheduled deliveries as well as decrease maternal and neonatal morbidities.

Disclosure statement

The authors report no conflicts of interest.

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