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ORIGINAL ARTICLE

Assessing the multidisciplinary team approaches to placenta accreta spectrum across five institutions within the University of California fetal Consortium (UCfC)

Victoria M. Fratto[a], Charlotte L. Conturie[a], Jerasimos Ballas[a], Kate E. Pettit[a], Megan L. Stephenson[b], Yen N. Truong[c], Dana Henry[d], Yalda Afshar[e], Aisling Murphy[e], Lena Kim[d], Nancy Field[c], Deborah A. Wing[b], Mary E. Norton[d], and Gladys A. Ramos[a] for the University of California fetal Consortium

[a]Department of Obstetrics, Gynecology, and Reproductive Sciences, University of California San Diego, San Diego, CA, USA; [b]Department of Obstetrics and Gynecology, University of California Irvine, Irvine, CA, USA; [c]Department of Obstetrics and Gynecology, University of California, Davis, Sacramento, CA, USA; [d]Department of Obstetrics, Gynecology, and Reproductive Sciences, University of California, San Francisco, San Francisco, CA, USA; [e]Department of Obstetrics and Gynecology, University of California, Los Angeles, Los Angeles, CA, USA

ABSTRACT

Purpose: To describe the multidisciplinary approaches to placenta accreta spectrum (PAS) across five tertiary care centers that comprise the University of California fetal Consortium (UCfC) and to identify potential best practices.

Materials and methods: Retrospective review of all cases of pathologically confirmed invasive placenta delivered from 2009 to 2014 at UCfC. Differences in intraoperative management and outcomes based on prenatal suspicion were compared. Interventions assessed included ureteral stent use, intravascular balloon use, anesthetic type, gynecologic oncology (Gyn Onc) involvement, and cell saver use. Intervention variation by institution was also assessed. Analyses were adjusted for final pathologic diagnosis. Chi-square, Fisher's exact, Student's *t*-test, and Mann–Whitney's *U*-test were used as appropriate. Binary logistic regression and multivariable linear regression were used to adjust for confounders.

Results: One hundred and fifty-one cases of pathologically confirmed invasive placenta were identified, of which 82% (123) were suspected prenatally. There was no correlation between the degree of invasion on prenatal imaging and use of each intervention. Ureteral stents were placed in 33% (41) of cases and did not reduce GU injury. Intravascular balloons were placed in 29% (36) of cases and were associated with shorter OR time (161 versus 236 min, $p < .01$) and lower estimated blood loss (EBL) (1800 versus 2500 ml, $p < .01$). General endotracheal anesthesia (GETA) was used in 70% (86). EBL did not differ between GETA and regional anesthesia. Gyn Onc was involved in 58% (71) of cases and EBL adjusted for final pathology was reduced with their involvement (2200 versus 2250 ml, $p = .02$) while OR time and intraoperative complications did not differ. Cell saver was used in 20% (24) and was associated with longer OR time (296 versus 200 min, $p < .01$). Use of cell saver was not associated with a difference in EBL or number of units of packed red cells transfused. All analyses were adjusted for pathologic severity of invasion.

Conclusions: Intravascular interventions such as uterine artery balloons and the inclusion of Gynecologic Oncologists as part of a multidisciplinary approach to treating PAS reduce EBL. Additionally, the placement of intravascular balloons may reduce OR time. No significant differences were seen in outcomes when comparing the use of ureteral stents, general anesthesia, or institutions. A team of experienced operators with a standard approach may be more significant than specific practices.

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Intravascular balloons; multidisciplinary approach; placenta accreta spectrum; placenta increta; placenta percreta

Introduction

The rate of placenta accreta spectrum (PAS) disorders is increasing, mirroring the rise of cesarean deliveries [1]. In a recent cohort, PAS complicated approximately one in 533 deliveries [1]. Prenatal diagnosis improves maternal outcomes by allowing planned delivery

CONTACT Victoria M. Fratto Victoria.fratto@gmail.com Naval Medical Center San Diego, 34800 Bob Wilson Drive, San Diego, CA, USA

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Table 1. Demographic characteristics of the cohort ($n = 123$).

Maternal age, years, mean, SD	33.6, 5.3
Race/ethnicity[a] (n= 115)	
White	31% (38)
Hispanic	48% (59)
Black	6% (7)
Asian	7% (8)
Other	2% (3)
Parity, median, IQR	3, 2–4
Number of prior sections, median, IQR	2, 2–3
BMI, median, IQR[a] (n= 111)	33.1, 26.1–35.1
Gestational age at diagnosis, median, IQR[a] (n= 122)	25.1, 20.4–30.5
Gestational age at delivery, median, IQR	34.3, 33.4–35.4
Preoperative diagnosis, % (n)	
Accreta	76% (93)
Increta	16% (20)
Percreta	8% (10)
Final pathological diagnosis	
Accreta	34% (42)
Increta	35% (43)
Percreta	31% (38)
number of cases contributed by institution, % (n)	
Institution # 1	10% (12)
Institution # 2	12% (15)
Institution # 3	17% (21)
Institution # 4	29% (36)
Institution # 5	32% (39)

IQR: interquartile range.
[a]Data not available for all cases.

before complications occur, under the guidance of a multidisciplinary team [2,3]. The Society for Maternal-Fetal Medicine (SMFM) and the International Federation of Gynecology and Obstetrics (FIGO), among others, advocate for a multidisciplinary team approach and the creation of centers of excellence for PAS [4,5]. Currently, optimal management of PAS disorders is debated; standard management in the USA has been planned late preterm cesarean delivery followed by hysterectomy with the placenta *in situ* [1]. Specific operative practices used in the definitive treatment of PAS disorders have also been debated, and clear improvements in outcomes with the use of many common intraoperative practices have not been proven [5]. The five institutions in the University of California fetal Consortium (UCfC) have instituted multidisciplinary approaches to PAS with planned en bloc hysterectomy in nearly all cases. Presurgical and surgical adjunctive procedures, however, vary by institution. We hypothesize that compilation of data across the consortium will facilitate identification of best practices with regard to presurgical and surgical adjunctive interventions.

Materials and methods

This is a retrospective chart review of pathologically confirmed cases of PAS from 2009 to 2014 at the five academic tertiary care centers in the UCfC. The UCfC is a consortium composed of five academic obstetric hospitals in the University of California system: UC San Diego, UC Irvine, UC Los Angeles, UC Davis, and UC San Francisco. The specifics of data collection for this cohort have been previously described, and an analysis has previously been published comparing outcomes among scheduled versus unscheduled deliveries [6]. In summary, data were collected retrospectively by trained investigators on all pathologically confirmed cases of PAS at the five University of California sites listed above. Institutional review board approval was obtained at all sites. All cases of invasive placentation (accreta, increta, and percreta) were included in the definition of PAS.

Intraoperative management was assessed for prenatally suspected cases. The following interventions were assessed with regard to their effect on the outcomes listed: ureteral stent placement and genitourinary (GU) tract injury; intravascular balloon use with both estimated blood loss (EBL), and operating room (OR) time; anesthetic type and EBL; gynecologic oncologist (Gyn Onc) involvement and EBL, OR time, and intraoperative complications; and cell saver use and EBL, OR time, and number of packed red blood cells transfused. All analyses were adjusted for final pathologic diagnosis. Chi-square, Fisher's exact, Student's *t*-test, and Mann–Whitney's *U*-test were used as appropriate. Binary logistic regression and multivariable linear regression were used to adjust for confounders. A p value of $<.05$ was considered significant. IBM SPSS version 24.0 (Armonk, NY) was used for all statistical analyses.

Results

One hundred and fifty-one pathologically confirmed PAS cases were identified. Of these, 123 (82%) were suspected on prenatal imaging and are included in this analysis. Demographic characteristics of the cohort are described in Table 1. The median number of prior cesarean deliveries was 2. The median gestational age at diagnosis was 25 weeks, and the median gestational age at delivery was 34 weeks and two days. Suspected preoperative diagnosis was accreta in 76% of cases, increta in 16% of cases, and percreta in 8% of cases, while final pathologic diagnosis was accreta in 34% of cases, increta in 35% of cases, and percreta in 31% of cases. The five institutions contributed to the database as shown, with the smallest institution contributing 10% of the total and the largest institution contributing 32% of the total.

Table 2. Interventions and related outcomes in prenatally diagnosed invasive placenta.

Intervention Outcome(s) of interest	Without intervention	With intervention	Adjusted *p* value
Ureteral stent placement	67% (82)	33% (41)	.12
Genitourinary tract injury, % (*n*)	16% (13)	22% (9)	
Intravascular balloon placement	71% (87)	29% (36)	
EBL in liters, median, IQR	2.5, 1.6–5.0	1.8, 1.3–2.5	<.01
Operating room time in minutes, median, IQR	236, 181–298	161, 150–200	<.01
General anesthesia[a]	30% (36)	70% (86)	.1
EBL in ml, median, IQR	2, 1.5–2.5	2.5, 1.6–5.0	
Gyn oncology involvement	42% (52)	58% (71)	
Obesity, % (*n*)[a]	51% (22/43)	59% (40/68)	.4
Number of prior cesarean deliveries, median, IQR	2, 1	2, 1	.5
EBL in liters, median, IQR	2.2, 2.5	2.25, 2	.02
Operating room time in minutes, median, IQR	264, 96	183, 90	.16
Intraoperative complications, % (*n*)	21% (11)	34% (24)	.4
Cell saver use	80% (99)	20% (24)	
EBL in liters, median, IQR	2.0, 1.5–3.4	3.45, 2.2–4.5	.19
Operating room time in minutes, median, IQR	200, 152–258	296, 243–396	<.01

EBL: estimated blood loss; IQR: interquartile range.
[a]Data not available for all cases.

Each institution uses a multidisciplinary team approach, with four out of five institutions using a designated checklist, to coordinate care for prenatally diagnosed PAS cases (see Supplementary Table 3 for a compilation of elements of these checklists). Common elements include the development of a preoperative and operative plan utilizing a multidisciplinary team approach. Our institutional preoperative checklist additionally includes the development of an emergency plan, advance directive, and the involvement of social work.

Ureteral stents were used in 33% of cases, and the rate of GU tract injury did not differ between those with and without ureteral stents ($p = .12$) (Table 2). Intraoperative practices varied by institution and surgeon preference. Two out of five institutions did not use ureteral stents. Three institutions used them according to surgeon preference.

Intravascular balloons were placed in 29% (36) of cases, and their use was associated with lower EBL (1.8 versus 2.5 liters, $p < .01$) and shorter OR time (161 versus 236 min, $p < .01$). Note that 19% (7/36) of these cases were intra-aortic balloons, and the remainder were iliac balloons. Balloons were inflated in 61% of cases (22/36) and were inflated prior to uterine artery transection in 90% of cases (20/22). Balloons were inflated in all intra-aortic cases. Excluding cases with aortic balloons, there was a significantly lower EBL in cases where iliac balloons were inflated compared to cases where they were either not inflated or not placed (median EBL 1.5 versus 2.3 l, $p = .04$). Excluding cases with iliac balloons, there was a significantly lower EBL with the use of aortic balloons compared to cases without aortic balloons (median EBL 2 versus 2.5 l, $p < .01$). There were no balloon related complications in this cohort. One institution did not use intravascular balloons. Four institutions used them according to surgeon preference. One institution used largely intra-aortic balloons (institution three) as part of a pilot study [7].

Gyn Onc surgeons were involved in 58% of cases ($n = 71$). There was a lower EBL when adjusting for final pathology with Gyn Onc involvement (2.2 versus 2.25 l, $p = .02$). There was no difference in OR time or intraoperative complications. Four institutions have a mix of maternal fetal medicine (MFM), obstetrician (OB), and Gyn Onc surgeons on the PAS teams. Institution four relied on MFM and OB surgeons, calling Gyn Onc only if needed intraoperatively.

General anesthesia use varied according to team preference, and may be used from the start of the case or after delivery of the infant. Cell saver was used in 20% of cases ($n = 24$). OR time was longer in cases where cell saver was used (296 versus 200 min, $p < .01$). EBL and number of packed cells transfused were not different ($p = .19$ and $p = .2$, respectively). Cell saver was used according to team preference. There was no correlation between the degree of invasion on prenatal imaging and the use of each intervention (data not shown).

Discussion

Placenta accreta spectrum disorders are increasingly common and have the potential to cause significant morbidity for women and their neonates [1,8]. The literature supports improved outcomes when PAS is suspected prenatally and when a multidisciplinary team approach is used [2–4,6,9]. Currently, two available checklists have been published in association with the American College of Obstetricians & Gynecologists (ACOG) [10], and the Society for Maternal Fetal

Medicine (SMFM) [11]. Several similar checklists have been proposed by individual institutions [12–14], and are in use at UCfC institutions.

Our study demonstrates that, consistent with prior reports, multidisciplinary team management varies across institutions. Currently, there is no standard bundle of intraoperative interventions for PAS, as a variety of management strategies have been described in the literature without clear evidence or consensus on best practices [5,7,15–17]. A multidisciplinary team approach with a group of experienced operators was standard in all centers, and we believe this factor enabled women to experience similar outcomes regardless of the interventions used.

Ureteral stents were not placed by all surgical teams, and were not associated with a statistically significant difference in the rate of GU tract injury. While one systematic review has previously concluded that ureteral stent placement was associated with a significant reduction in ureteral injury, other series have not shown a difference in outcomes [16,18,19]. Ureteral stents have been described as a beneficial intervention that may allow the surgical team to visualize and avoid the ureters, especially in highly invasive cases where significant disease may distort anatomy and significant bleeding may rapidly obscure the surgical field. We hypothesize that variability in disease severity and operating team practice, as well as small sample sizes in ours and other studies, makes it difficult to draw conclusions about the true impact of ureteral stent placement on urinary tract injury.

The placement of intravascular balloons was associated with reduced EBL of approximately 700 ml and a significant decrease in OR time. The reduction in EBL was still present when comparing cases in which iliac balloons were inflated (excluding aortic balloon cases) and cases in which aortic balloons were inflated (excluding iliac balloons). These findings are comparable to other published studies on intravascular balloons for PAS. In fact, two studies involving the largest cohort in which prophylactic iliac artery balloons were placed in cases of suspected PAS noted a reduction in EBL of about 500–700 ml and a reduction in transfusion of PRBCs when balloons were placed, but a significant increase in EBL and transfusion in cases where balloons were inflated [15,20]. In both studies, this was attributed to the heterogeneous nature in which balloons were inflated due to surgeon discretion, as well as the physiologic development of collateral blood flow due to the occlusion of the internal iliac. More recent studies of intravascular aortic occlusion in cases of trauma and uncontrollable truncal bleeding in general surgery have shown significant advancement and improvement in outcomes [21,22]. Devices such as the resuscitative endovascular balloon occlusion of the aorta (REBOA) have the potential for use in cases of suspected PAS by offering a similar placement method, ease of deployment and the ability to reduce collateral formation by temporarily occluding flow to the entire abdominal vascular tree and allowing surgeons to control bleeding. Additionally, our cohort did not include intravascular embolization, which is an intervention that has become increasingly adopted for treating PAS with varying reported outcomes [23–25]. Our analysis also demonstrates reduced OR time, a finding that is not widely reported in the literature.

Concerns surrounding the use of intravascular balloons include additional maternal risk with placement and deployment of the balloons, additional time and cost with preoperative placement and the availability of interventional radiology services across institutions. With embolization, there is an additional concern for migration and metastasis of the various occlusive materials utilized causing thrombotic events outside of the pelvis. While there were no reported complications related to balloon placements in our cohort, there is a potential for selection bias stemming from the availability, experience, and comfort of interventional radiology placing intravascular balloons across institutions.

Involvement of a gynecologic oncologist resulted in a statistically significant lower EBL in our study. While much has been written about the importance of and improved outcomes with a multidisciplinary team, the recommended makeup of the surgical team has been determined by expert opinion and local practice [2,4,26]. One retrospective study reported lower blood loss and reduced transfusion requirement in cases where a gynecologic oncologist was present at the start of the case [27]. While our study supports this conclusion, we agree with the experts that the most important aspects of the surgical team are surgical expertise and standardized procedures rather than a specific specialty or intervention [5].

Cell saver use varied widely among sites, from 5% to 73% of cases, and was associated with longer OR time without difference in EBL or red cell transfusion. The published literature regarding cell saver use is limited by small sample size, prior concerns about fetal cellular debris and amniotic fluid being introduced into the maternal bloodstream, and limited prospective studies [26]. Observational data suggest that cell saver can be safely and effectively used in obstetric hemorrhage [28], and may even be cost effective for cases where significant hemorrhage is anticipated [29].

While we agree with theoretical benefit to this technology, we were unable to demonstrate it in our study, likely due to small sample size and heterogeneous use.

The major limitation of this study is its retrospective nature. The use of specific interventions was not prospectively standardized. While a prospective randomized controlled trial would be optimal, our pragmatic analysis of available data within an academic consortium provides a unique opportunity to analyze and compare practices for managing PAS across five distinct tertiary care centers. To date, the majority of descriptive PAS studies have been from single institutions.

The collection of data across a five-institution consortium without imposition of a standardized protocol supports generalizability of both our methodology and our findings to other centers. We look forward to continued prospective collection and reporting of the variety of intraoperative interventions currently in use. As PAS disorders become more common, the need for further study regarding best management practices becomes more urgent, and the feasibility of such studies increases. We anticipate that future data will allow more rigorous assessment of operative interventions and their associated outcomes.

Disclosure statement

No potential conflicts of interest were reported by the authors.

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