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ORIGINAL ARTICLE

Maternal morbidity in placenta accreta spectrum following introduction of a multi-disciplinary service compared to standard care: an Irish perspective

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Abstract

Aim The purpose of this study is to compare maternal outcomes in patients with placenta accreta spectrum (PAS) when managed as part of a multi-disciplinary team (MDT) compared to standard care.

Methods Patients in the standard care group were retrospectively identified from pathology records, with patients in the MDT group prospectively collected on an electronic database. Data on maternal demographics, delivery, estimated blood loss (EBL), transfusion requirements, and morbidity were recorded.

Results Sixty patients were diagnosed with PAS between 2006 and 2019, of whom 32 were part of the standard care group and 28 in the MDT group. Compared to standard care, MDT care was associated with an increase in antenatal diagnosis from 56.3 to 92.9% ($p < 0.0001$), a significant reduction in EBL (4150 mL (800–19500) vs 1975 (495–8500), $p < 0.0001$), and transfusion requirements (median 7 (0–30) units of RCC vs 1 (0-13), $p < 0.0001$).

Conclusion PAS is associated with significant maternal morbidity and warrants management in an MDT setting with specialist input, which is associated with improved outcomes.

Keywords Blood loss · Multi-disciplinary team care;Morbidity · Placenta accreta spectrum

Abbreviations

PAS	Placenta accreta spectrum
MDT	Multidisciplinary team
EBL	Estimated blood loss

Key message Maternal outcomes are significantly improved in placenta accreta spectrum when managed by a multidisciplinary team in a specialist center. Antenatal diagnosis, elective pre-term delivery, and a standardized surgical approach contribute to improved maternal outcomes.

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Introduction

Placenta accreta spectrum (PAS) is defined as abnormal trophoblast invasion into the myometrium of the uterine wall [1]. PAS is thought to occur as a consequence of a localized uterine injury, which can result in locally defective decidualization and abnormal placental adherence in a subsequent pregnancy [2]. The spectrum includes placenta accreta (attachment of the placenta to the myometrium with no intervening decidua), placenta increta (invasion of the trophoblast extends into the myometrium), and placenta percreta (invasion has progressed beyond the myometrium, serosa, and invades surrounding structures) [3].

PAS is associated with severe maternal morbidity and mortality [4], with maternal mortality estimated to be as high as 7% [5]. Maternal morbidity is largely related to major obstetric hemorrhage, with over 80% of patients requiring a blood transfusion [6]. Obstetric hemorrhage accounts 27.1% of all maternal deaths worldwide [7, 8] and PAS is becoming an increasingly common contributing factor [5].

A number of predisposing risk factors for PAS have been identified, the most common and significant being a previous caesarean section (CS) [9]. However, any previous injury to the endometrial-myometrial interface increases the risk of placental adherence, and patients with a previous myomectomy, surgical termination, manual removal of placenta, and infertility treatments are also at higher risk of developing PAS [10]. Given the worldwide trend of an increasing caesarean section rate, it is no surprise there has been a dramatic increase in the incidence of PAS from 0.8 per 1000 deliveries in the 1980s to 3 per 1000 deliveries in the past decade, although more recent data from the USA using the National Inpatient Sample suggest an even higher incidence of 1 in 272. However, given the broad diagnostic criteria used for diagnosis of PAS, an exact incidence is difficult to determine with various figures reported in literature. Nevertheless, all studies agree that the incidence of PAS is increasing and that increase has accelerated in recent years [11–13].

A systematic review and meta-analysis performed by our group demonstrated significant improvements in maternal outcomes including reduced blood loss and peri-operative complications when PAS is managed via a multidisciplinary team (MDT) [14]. Given the increasing frequency of PAS and the increasing evidence that MDT care improves maternal outcomes, all cases of PAS should be managed in a centralized unit with expertise in this high-risk complex condition, a recommendation supported by the Royal College of Obstetricians and Gynecologists [15].

In keeping with global trends, our unit has seen a significant increase in the number of cases of PAS in parallel with our units rising CS rate. It is estimated that the placental complications of repeated CSs will lag behind the rising CS by 6 years [16]; hence, our unit can expect to see a significant rise in the near future. Hence, the importance of an established and organised MDT is essential to ensure patient outcomes continue to improve. The aim of this study is to compare maternal outcomes from our tertiary unit in PAS before and after the implementation of an MDT service for management of PAS cases.

Methods

This is a retrospective cohort study including all patients diagnosed with PAS at a tertiary referral center between 2006 and 2019. Patients were included if there was a suspicion of placenta accreta on antenatal imaging, either ultrasound or magnetic resonance imaging (MRI), or if there was no natural separation of the placenta from the endometrium following delivery of the baby. In 2017, an MDT approach for the management of PAS was introduced in our unit. Prior to 2017, patients were identified from pathology records and data was reviewed retrospectively. Since the introduction of the MDT, all patients with a diagnosis PAS are collected on a comprehensive electronic database and hence patient data has been collected prospectively as part of the MDT group. Data was collected on patient demographics, obstetric history, and antepartum and intrapartum management and a database was compiled. The main measurable outcomes were the rate of antenatal diagnosis, EBL and blood transfusion requirements, and maternal morbidity. For quantitative analysis, only morbidities rating Clavien-Dindo grade 3B and above were included [17]. Bladder injury with intentional cystotomy was not included as a morbidity.

Ethical approval was granted by the National Maternity Hospital Ethics committee (August 2017).

Multi-disciplinary team

The PAS MDT was started in June 2017. The MDT involves a monthly meeting where all patients with a suspicion of PAS are discussed, with input from maternal-fetal medicine specialists, gynae-oncology, anesthetics, interventional radiology, radiology, and theatre staff. The meeting allows for a team discussion on optimization of antenatal care and risk factors, raising awareness of high-risk patients attending the hospital, deciding on a suitable delivery time and allowing for surgical planning. Elective delivery is planned between 34 and 36 and is determined on a case by case basis. In selected cases, an elective delivery may be planned prior to 34 weeks where the individual circumstances make an emergency delivery prior to this gestation high.

A standardized surgical approach is followed for each patient undergoing caesarean hysterectomy, which we have previously described in detail [18]. Assistance from urology and interventional radiology is determined on a case by case basis at the MDT meeting. A lead surgeon, who is a gynae-oncologist, is allocated to each patient to coordinate her care and provide a single point of contact. A gynae-oncologist is present for every case.

Standard care

Prior to introduction of the MDT, patients were managed with varied input from specialists. There was no standardised approach to antenatal and intrapartum care and patients were managed by individual treating clinicians. Consultations with other specialties such as urology or interventional radiology may have been formal or informal. The presence of a gynae-oncologist was at on an ad hoc basis with a “call-as-needed” approach. Hence, patient care in the standard care group was inconsistent, with varying degrees of multidisciplinary input, which was largely related to suspected severity of PAS antenatally and intra-operative findings.

Table 1 Patient demographics

	Pre-MDT (n = 32)	MDT (n = 28)	P value
Maternal age at delivery (y)	37.5 (28–44)	38 (29–44)	0.876
BMI	24 (19–32)	24.5 (21.5–40)	0.589
Parity	2 (0–5)	2 (0–11)	0.672
Number of previous CS	2 (0–5)	1.5 (0–4)	0.772
History of risk factors % (n)			
Caesarean section	87.5 (28)	85.7 (24)	0.780
ERPC	15.6 (5)	21.4 (6)	0.402
MROP	6.3 (2)	7.1 (2)	0.157
Placenta previa	3.1 (1)	28.6 (8)	0.041
IVF	0	31.1 (9)	0.001
TOP	3.1 (1)	3.6 (1)	0.414
Diagnosed antenatally % (n)	56.3 (18)	92.9 (26)	0.001+
Gestational age at delivery (weeks)	37 (25–41)	35 (27–40)	0.003*
Birth weight (g)	3315 (810–4200)	2720 (1720–3750)	0.280*

*Mann-Whitney

+ Pearson Chi-square

Statistical analyses

Data were analyzed using SPSS software, version 24 (IBM Inc.). Continuous variables are presented as mean ± SD or median and range, as appropriate. Categorical variables are presented as number (%). Continuous parameters were compared by Student's t test and categorical variables by chi-square test or Fisher exact test, as appropriate. The Mann-Whitney test was used to compare medians between groups for non-parametric data. p value < 0.05 was considered statistically significant. For the meta-analysis, analyses were performed using RevMan software (Review Manager, version 5.3; The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark). Cochran's Q test was used to calculate the I^2 statistic in order to objectively measure heterogeneity for each of the outcome measures; an I^2 value greater than 50% was taken to denote significant heterogeneity between studies. A fixed-effects model was performed for each variable, or where there was appreciable heterogeneity ($I^2 > 50\%$) a random-effects model was used for meta-analysis. For continuous variables, the weighted mean differences (MD) are presented with 95% confidence intervals (CI). For categorical variables, Mantel–Haenszel odds ratios (ORs) were calculated and described with 95% CI. Corresponding funnel plots of log standard error as a function of effect size were used to examine the effect of publication bias visually.

Table 2 Maternal morbidity outcomes

	Pre-MDT (n = 32)	MDT group (n = 28)	P value
Hysterectomy performed % (n)	87.5 (28)	67.9 (19)	0.000+
Estimated Blood Loss (L)	4150 (800–19500)	1975 (495–8500)	0.000*
Blood transfusion:			
Any blood transfusion % (n)	87.5 (28)	53.6 (15)	0.000+
Number of RCC units	7 (0–30)	1 (0–13)	0.000*
Length of stay (mean ± SD)	11.6 ± 7.66	15.94 ± 13.17	0.125*
Clavien-Dindo grade 3 morbidities: % (n)			
Reintervention (early and delayed)	12.5 (4)	3.5 (1)	0.080+
Intensive care admission	9.3 (3)	7.1 (2)	0.965+
Ureteric injury	3.1 (1)	3.5 (1)	0.711+

All figures in median (range) unless otherwise stated

*Mann-Whitney

+ Pearson chi-square

Table 3 Multidisciplinary team outcomes elective vs emergency delivery

	Elective delivery (n = 21)	Emergency delivery (n = 7)	P value
Diagnosed antenatally % (n)	95.2 (20)	85.7 (6)	0.821+
Gestational age in weeks at delivery	35 (27-39)	34 (28–39)	0.122*
Hysterectomy performed % (n)	66.7 (14)	71.4 (5)	0.071+
EBL (mL)	1540 (500–8000)	3000 (495–8500)	0.028*
Received blood transfusion % (n)	47.6 (10)	71.4 (5)	0.055+
Units transfused	1 (0–8)	4 (0–13)	0.055*
Clavien-Dindo grade 3 morbidities: % (n)	14.2 (3)	14.2 (1)	0.463+

All figures in median (range) unless otherwise stated

*Mann-Whitney

+ Pearson chi-square

Results

Sixty patients were included in this study, 32 in the standard care group, and 28 in the MDT group. Maternal demographics are reported in Table 1 and there was no significant difference between the two groups.

There was no difference in the number of previous CS between the standard care and MDT group; however, significantly more patients underwent fertility treatments in the MDT group compared to the standard care group (0 vs 9 patients, $p = 0.001$, Table 1). The depth of placental invasion was similar between the groups with no difference in the number of women with placenta accreta, increta, or percreta.

In the standard care group, data was collected from retrospective chart review, with patients identified from histopathology records; hence, all patients had a confirmation of PAS. In the MDT group, 23 patients had a confirmed diagnosis of placenta accreta on histopathology. Two patients had a diagnosis of placenta accreta occulta [19]. Both patients had no ultrasound features suggestive of PAS, had a vaginal delivery, and manual removal of placenta with an EBL of 2750 mL and 4000 mL. Three patients had no findings of PAS on histopathology but are included here as they were considered high risk for placenta accreta and were discussed antenatally as part of MDT care; all three patients had a placenta previa in the presence of a uterine scar; however, US features suggested low likelihood of PAS. At CS, the placentas delivered spontaneously and histopathology confirmed placenta previa with no features of accreta.

The antenatal diagnosis rate increased from 56.3% ($n = 18$) in the standard care group to 92.9% ($N = 26$) in the MDT group ($p = 0.001$) (Table 1). The gestational age at delivery was significantly earlier in the MDT group compared to the standard care group (35 (27–40) vs 37 (25–41), $p = 0.003$).

The median EBL decreased significantly when comparing the standard care and MDT groups (4150 mL (800–19500) vs 1975 (495–8500), $p < 0.0001$) (Table 2). Transfusion requirements also decreased significantly with 87.5% ($n = 28$) of patients receiving a transfusion in the standard care group compared to 53.6% ($n = 15$) in the MDT group ($p < 0.001$), with a significant reduction in the median number of RCC transfused (7 (0–30) vs 1 (0–13), $p < 0.001$). There was no difference in the rate of Clavien-Dindo morbidities between the two groups (Table 2).

In the standard care group, 4 patients had the placenta left in situ with a plan to await spontaneous resolution. Of these, 3 patients subsequently had an emergency hysterectomy for secondary haemorrhage, 2 within the first 10 days, and one patient on day 44. No patient in the MDT group had the placenta left in situ and this is not part of the MDT protocol.

There was no maternal death in the standard care or the MDT group.

Sub-group analysis

For the MDT group, we performed a sub-group analysis comparing patients who were delivered electively compared to those who underwent emergency delivery. Elective delivery was defined as delivery on the scheduled date as decided at the MDT meeting. Twenty-one patients (75%) in the MDT group were delivered electively (Table 3). There was a significant difference in EBL between the groups with a reduction from 3000 mL (495–8500) in the emergency group compared to 1540 mL (500–8000) in the elective group ($p = 0.028$).

In keeping with global trends, our unit has seen an increase in the incidence of PAS, with an average of 0–2 cases per year from 2000 to 2010, rising to 3–10 cases per year since 2010. In parallel, the CS rate in our unit has increased steadily every year from 8.8% in 1994 to 27% in 2018.

Meta-analysis

We previously performed a meta-analysis of 6 studies [20–25], comparing maternal morbidity and mortality

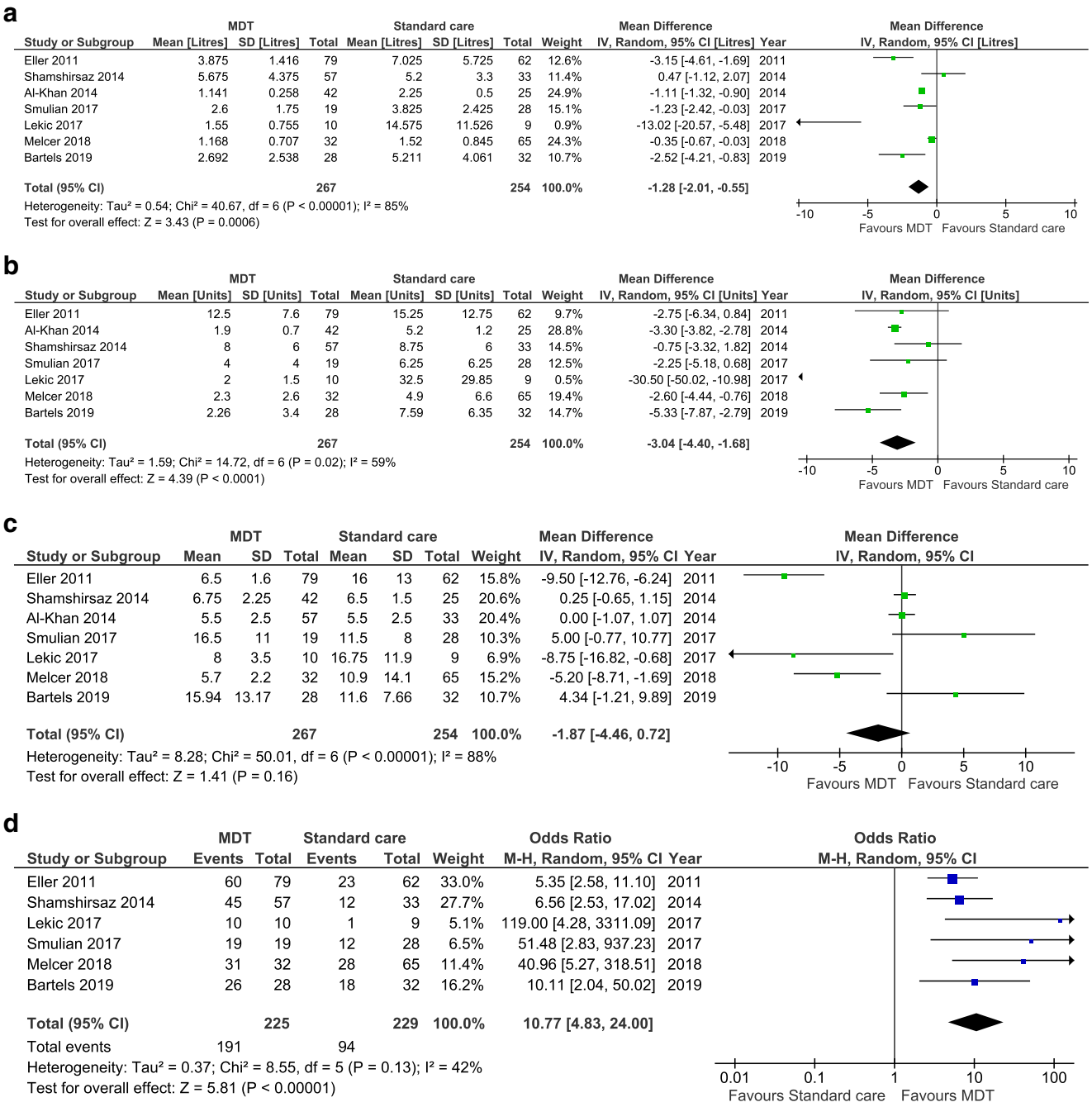

Fig. 1 Forest plots of meta-analysis results for effects of multidisciplinary team versus standard care. a Estimated blood loss. b Red cell units transfused. c Length of stay. **d** Antenatal diagnosis

comparing standard care to MDT care in PAS. We repeated the meta-analysis for EBL, number of RCCs transfused, length of stay (LOS), and antenatal diagnosis adding in our data to the previously included 6 studies. EBL was significantly reduced in women treated in a MDT setting, with a reduction in blood loss of over a litre compared to the standard care group (mean difference − 1.27 L, 95% CI − 2.00–− 0.54, p = 0.0006, Fig. 1a). Patients managed in a MDT care setting had lower transfusion requirements than those in a standard care setting, amongst the seven studies at meta-analysis (mean difference − 3.03 units, 95% CI − 4.39–− 1.67, $p = < 0.0001$, Fig. 1b). For LOS, MDT input demonstrated no significant difference in LOS than standard care (mean difference − 1.92 days, 95% CI − 4.52–0.68, $p = 0.15$, Fig. 1c). However, substantial heterogeneity was noted in the reporting of LOS (I^2 = 88%) with mean values ranging from 5.5 to 16.5 days amongst the two groups in all studies. Antenatal diagnosis was significantly higher in the MDT group compared to the standard care

group (OR for being diagnosed antenatally in the multidisciplinary team setting 10.77, 95% CI 4.83–24.00, $p < 0.00001$, Fig. 1d)

Discussion

This study highlights the significant improvement in maternal outcomes in PAS when managed as part of a MDT. Patients managed as part of an MDT had less blood and consequently received less blood transfusions. A number of components likely contributed to this. The significant increase in antenatal diagnosis in the MDT allows for the necessary protocols to be implemented and a pre-term elective delivery to be planned. Poor maternal outcomes are associated when PAS is undiagnosed antenatally. The opportunity to refer these patients to a specialist center and plan an elective pre-term delivery are missed when the diagnosis is only made at the time of delivery. Furthermore, when the diagnosis is only made intra-operatively, blood loss may already be significant, intraoperative resources required are not prepared, and the necessary surgical expertise may not be available.

A planned pre-term elective delivery is an essential part of improving maternal outcomes. Elective delivery allows for the necessary pre-operative preparation to be implemented and a controlled surgical approach where blood loss has not already begun prior to the first incision. Our elective delivery rate of 75% compares favourably with other large studies of PAS MDT care [26]. We have shown the increased EBL associated with an emergency delivery which is in keeping with previous studies [27].

Furthermore, a standardized surgical approach with bladder dissection and avoiding placenta disruption, which is associated with increased maternal morbidity [28], are important factors in reducing intra-operative blood loss. The presence of a gynae-oncologist at the start of the procedure has previously been shown to reduce maternal morbidity [18] and this approach has been implemented for all cases in the MDT group.

A key component of the MDT is the repeated discussion of patients following a diagnosis of PAS. All patients are discussed on at least two occasions, once antenatally and again following delivery for discussion of intraoperative findings and pathology. The majority of patients are discussed at least 2–3 times during the antenatal period as updated imaging becomes available and any change in clinical condition is highlighted. Repeated discussion allows for invaluable learning in particular where patients have been diagnosed in the first and second trimester, to allow for review of imaging and see placental invasion progression as gestation advances. The postnatal review provides an opportunity for comparison of ultrasound and MRI imaging with intra-operative and pathology findings. Any intra-and post-operative complications are also discussed. The MDT also allows for discussion of patients at high risk of placenta accreta, such as those with a previous diagnosis of PAS who underwent fertility sparing surgery and are now in a subsequent pregnancy. Furthermore, the MDT highlights high-risk patients to all hospital staff and puts appropriate plans in place in case an out-of-hours emergency delivery is required.

The main strength of this study is the high number of cases prospectively collected as part of the MDT group with a high rate of histopathological confirmation of PAS. This study is a single-centre study and hence is limited by the high risk of bias due to individual clinician decisions regarding patient treatment. Furthermore, there was an insufficient sample size to differentiate between rare morbidities in the two groups, such as ureteric injury.

In conclusion, it is clear that maternal outcomes are significantly improved when managed in a specialised centre as part of a MDT. It remains unclear which component offers the greatest advantage; however, antenatal diagnosis, a planned elective delivery, and avoidance of placental disruption are certainly key components to improving outcomes. All such high-risk cases warrant MDT care in a tertiary centre.

Compliance with ethical standards

The authors declare that they have no conflict of interest. All authors who contributed to the manuscript are named authors.

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