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ARTICLE

Role for MRI in Secondary Screening for Placenta Accreta

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Abstract

Aims/Background Rates of both placenta praevia and placenta accreta spectrum (PAS) are rising. There is significant morbidity associated with PAS and antenatal detection reduces morbidity at delivery. In the UK there is a move to centralise care of these cases in dedicated units. Incidental diagnosis is more common, in the absence of a regular screening program. In non-specialist hospitals, there is a need to consider adjunct confirmatory diagnostics prior to referral to specialist centres. This is important to ensure capacity management in specialist centres. Ultrasound (US) and Magnetic Resonance Imaging (MRI) have both been used to diagnose PAS with high levels of accuracy with experienced operators. The role of MRI as an adjunct with US has not been clearly defined but is often requested.

Methods A retrospective analysis of all cases referred for MRI as a secondary modality after US to evaluate possible PAS. A total of 41 cases had MRI performed over 13 years with a trend of increasing demand over time.

Results The series identified eleven cases of PAS. MRI demonstrated a high level of accuracy, similar to published literature (sensitivity 81.8%, Specificity 86.6%) and correctly reclassified 2 cases as PAS, which were considered normal on US. There were 2 cases of PAS which were missed by both US and MRI.

Conclusion This series demonstrates increasing demand in our trust for MRI over the period of the study. The addition of MRI as a second test improved accuracy compared to ultrasound alone. MRI has a role in secondary screening for PAS in non-specialist units.

Key words: placenta accreta; postpartum hemorrhage; Magnetic Resonance Imaging; color doppler ultrasonography

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Introduction

The incidences of both placenta praevia and placenta accreta spectrum (PAS) are increasing. Whilst a prevalence of approximately 1 in 4000 was reported in the 1970s, recent data from the USA gives a prevalence of 1 in 272 (Jauniaux et al, 2019). Current consensus on the pathophysiology is that damage to the endometrium leads to a failure in decidualisation (American College of Obstetricians and Gynecologists and Society for Maternal-Fetal Medicine, 2018). This results in an area of myometrium with deficient decidua. The absence of a true decidual layer allows invasion directly into the myometrium and in some cases beyond myometrium, uterine serosa and into adjacent pelvic structures. Whilst in theory anything resulting in endometrial scarring can predispose someone to PAS, caesarean

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Table 1. FIGO consensus guidelines for classification of PAS.

Grade	Clinical findings	Previous terminology
1	Superficial invasion into myometrium	Accreta
2	Invasion through myometrium to serosa but not beyond serosa	Increta
3	A: Invasion into uterine serosa B: Invasion beyond uterine serosa and involving bladder C: Invasion into other pelvic structures (broad ligament, pelvic sidewall)	Percreta

FIGO, the International federation of Gynaecology and Obstetrics; PAS, placenta accreta spectrum.

section (CS) is responsible for most cases and explains the increasing prevalence, which mirrors rising CS rates.

There are a variety of classification systems for describing PAS. The International federation of Gynaecology and Obstetrics (FIGO) proposed a new system in 2019 (Jauniaux et al, 2019), which grades cases 1–3, with grade 3 further subdivided into grades a–c (Table 1). The classification broadly mirrors the older terminology of describing placenta accreta as adherent but superficially invasive into myometrium, placenta Increta exhibiting deep invasion into myometrium but not beyond uterine serosa and then percreta or grade 3 invading beyond serosa and potentially into adjacent pelvic organs. Grades 3 (a–c) then describe the level of adjacent invasion. Grade 3a is limited to uterine serosa and *3c* extends into pelvic structures other than the bladder, such as broad ligament or pelvic sidewall.

The concern over rising rates of PAS relates to the levels of morbidity and even mortality associated with the diagnosis. A recent retrospective analysis of 219 cases in France and 154 cases in the UK demonstrated high levels of morbidity (McCall et al, 2023). In the UK over half, 58% of cases, were associated with severe haemorrhage of over 3 L, hysterectomy was performed in 43% of cases, 68% required admission to an intensive care unit, 64% received blood transfusion of over 6 units of red blood cells and there was 1 death due to massive haemorrhage after attempted manual removal of placenta. It is noteworthy that in both countries only approximately 50% of PAS was suspected prior to delivery. Antenatal detection of PAS is associated with better outcomes even though antenatal diagnosis usually reflects a more severe stage of disease (Erfani et al, 2019).

The two modalities utilised for antenatal detection of PAS are ultrasound (US) and Magnetic Resonance Imaging (MRI). Several metanalysis have been published in recent years, which show comparable sensitivity and specificity, which are high for both. A 2014 metanalysis of MRI found a sensitivity of 94.4% and specificity of 84.0% (D'Antonio et al, 2014). A separate metanalysis published in 2022 comparing US and MRI found very similar rates of detection when comparing US and MRI (Hong et al, 2022). It found a sensitivity of 90% with a specificity of 83% for US and sensitivity of 89% with a specificity of 87% for MRI. There was not a statistically significant difference between the two modalities. A potential drawback of some of these larger studies is they use older data, and it has been argued that as detection is improving, they underestimate the value of imaging by skilled opera-

Table 2. Protocol of agreed risks for PAS.

Risk factors for PAS
• Low lying placenta with previous CS • Uterine surgery with placenta suspected to overly area of scarring • Previous PAS

CS, caesarean section.

Table 3. MRI scanner (General Electric, Boston, MA, USA) protocol.

MRI scanner details
Magnet: • GE Signa Artist • 1.5 Tesla • Software Version RVR 30.0 (General Electric, Boston, MA, USA) • Sequences utilise Air Recon Deep Learning (AI reconstruction algorithm) Coils: • Anteriorly - 30ch large air coil • Posteriorly - 40ch integrated spine coil Sequences: (1) 3 plane localiser (2) Coronal T2 SS FSE, (Single shot fast spin echo) (3) Coronal T2 SS FSE Fat Sat (4) Sagittal T2 SS FSE (5) Sagittal T2 SS FSE Fat Sat (6) Axial T2 SS FSE (7) Axial T2 SS FSE Fat Sat (8) Axial T1 FSPGR (9) Axial T1 FSPGR Fat Sat

Sagittal and Coronal sequences are 40 cm field of view. Axial sequences are 38 cm field of view. MRI, Magnetic Resonance Imaging; AI, artificial intelligence; FSE, Fast Spin Echo; FSPGR, Fast Spoiled Gradient Recalled Echo.

tors today (D'Antonio et al, 2014). It has been suggested that MRI has additional benefits in defining the depth and extent of invasion in Grade 3 PAS and may have benefits over US in cases of PAS with a posterior placenta (Srisajjakul et al, 2021). The purpose of this study was to assess if the use of MRI in addition to ultrasound improved the accuracy of screening.

Methods

This was a retrospective analysis covering a period of 13 years from 2008 to 2021. All cases, which were referred for MRI to screen for PAS were included. Data was obtained from electronic and paper maternity records at Epsom and St. Helier NHS Trust. Epsom and St. Helier is a public funded National Health Service (NHS) hospital trust, comprising two hospital sites in Greater London with an annual delivery rate across the sites of approximately 4500. The local policy

states that anyone with risk factors for PAS (Table 2) is referred to a fetal medicine specialist for additional placental assessment with ultrasound. If at the time of the ultrasound assessment the placenta is suspected to have implanted over an area of scarring, then MRI (Table 3) is requested as a second test to exclude or confirm suspected PAS. A database of MRI referrals is maintained for audit purposes and this project involved reviewing the records of these cases. The inclusion criteria for this study were all cases that had MRI imaging to investigate suspected PAS. An exclusion criterion was cases for whom an eventual diagnosis of PAS was unknown. The decision to categorise cases as PAS or not was a clinical diagnosis. Histological confirmation was only available for cases involving excisional treatment, which was most commonly hysterectomy. For all cases, a clinical diagnosis based on records could be determined. All data used in this study was collected retrospectively, fully anonymised and there was no impact on patient care. The study met the criteria for a departmental audit of our standard care. The ethics and informed consent for this article were exempted by the Epsom and St. Helier ethics committee.

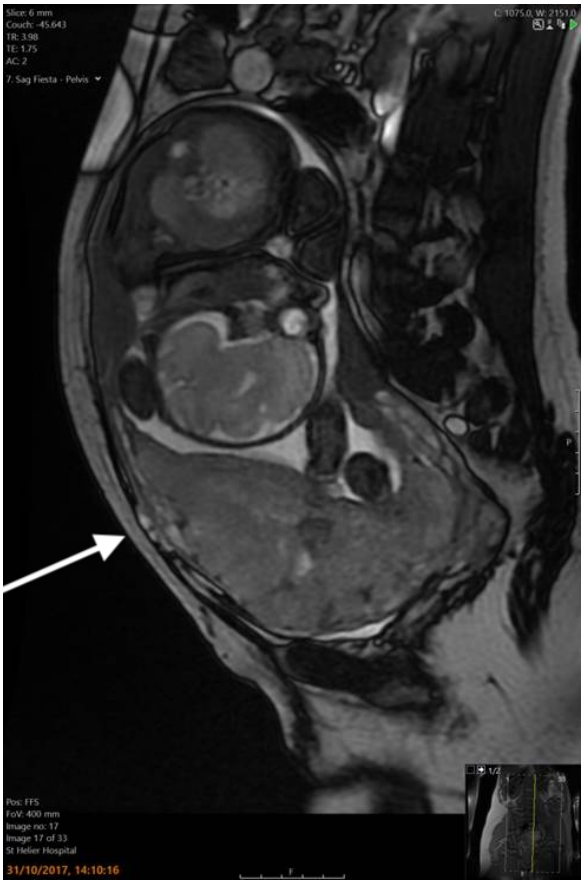

Fig. 1. Sagittal Fiesta image showing a 2.7 cm long craniocaudal length bulge with focal cystic change extending to the uterine serosal surface. 2.7 cm long craniocaudal length bulge with focal cystic change extending to the uterine serosal surface as indicated by arrow.

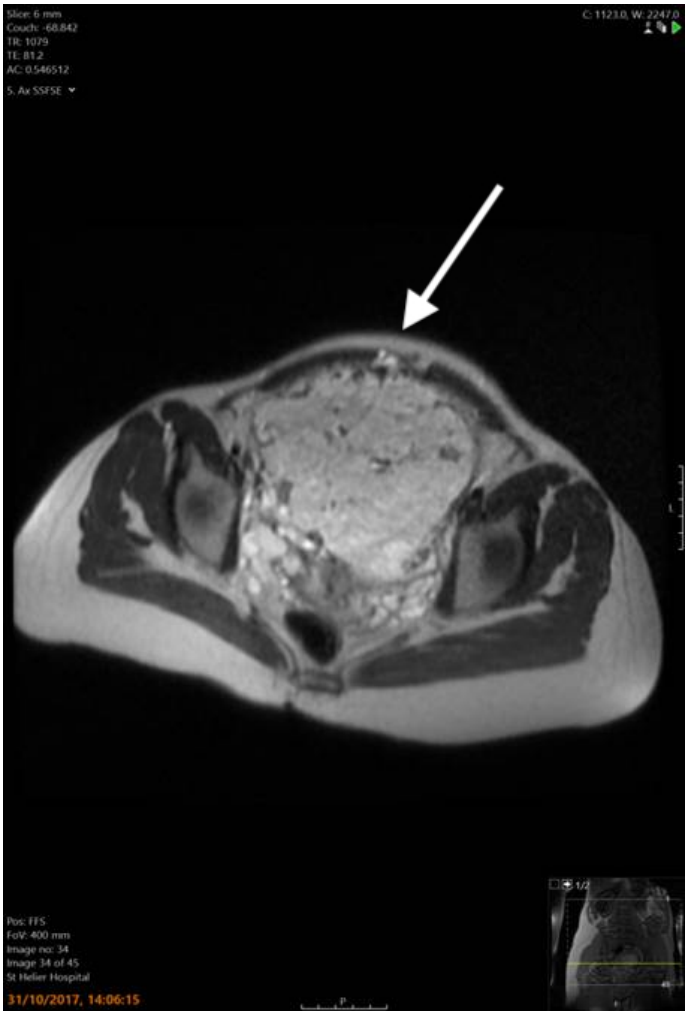

Fig. 2. Axial T2 image demonstrating the same abnormality in axial plane with cystic foci abutting the posterior aspect of the anterior abdominal wall. The arrow in the figure indicates the site of lesion.

Results

There were a total of 41 cases referred for MRI over a period of thirteen years. There was a trend of increasing numbers recently, with 28 MRIs performed in the last 5 years. Figs. 1,2 demonstrate an example of suspected placenta percreta seen on MRI.

There were 11 confirmed cases of PAS, 10 cases of placenta praevia with no PAS and 20 cases with normal placentation. Table 4 summarises the demographic characteristics of the cases. All but one of the 41 cases had some form of previous uterine surgery, the details of this are summarised in Table 5.

We have referred to cases as confirmed PAS based on the clinical findings at time of delivery. Whilst histology is perhaps preferable to objectively define the level of abnormal invasion, it is by its nature only available in this series for cases treated with hysterectomy or localised resection.

Histology was available for 6 cases (Table 6). Five cases were treated with hysterectomy and one with some localised myometrial excision. There were confirmed

Table 4. Demographic characteristics of cases according to classification of placenta.

Placenta type	Normal	Placenta praevia no PAS	PAS	All cases
Age				
Mean	40.8	40.2	42.8	41.2
Median	40.5	40	41	41
Range	33–48	31–47	38–56	31–56
Ethnicity				
White	16	7	7	30
Asian	0	2	2	4
Black	3	0	2	5
Mixed	1	1	0	2
Parity				
Nulliparous	6	0	0	6
Multiparous	14	10	11	35

Table 5. History of previous uterine surgery according to classification of placenta.

Type of previous uterine surgery	Normal	Placenta praevia	PAS	Total
1 previous CS	6	7	5	18
1 previous CS + 1 myomectomy	2	0	1	3
2 previous CS	2	3	3	8
3 previous CS	1	0	1	2
4 previous CS	1	0	0	1
Surgical treatment of Ashermann's	1	0	1	2
Myomectomy	4	0	0	4
Uterine septum removal	2	0	0	2
None – previous adherent placenta	1	0	0	1
Total	20	10	11	41

histological features of PAS in 4/6 of these specimens with the other 2 being inconclusive. One of the inconclusive specimens concerned a case of clinical percreta with invasion at the level of the cervix—this was treated with subtotal hysterectomy with the invasive area of cervical placenta left *in situ*. The other case treated with myometrial excision was inconclusive as no significant amount of myometrial tissue was available for analysis. The placenta had been removed manually in fragments at caesarean with some particularly adherent sections cut away from the uterus and the defects then oversewn.

Of the cases with confirmed PAS, 10/11 of these involved an anterior placenta praevia. The single remaining case of PAS occurred in a patient, who had a previous surgical treatment of Ashermann's syndrome but a high lateral placenta. The diagnostic accuracy of US and MRI is summarised in Table 7.

Of the two cases not detected on MRI, one was a case of superficial accreta with a high placenta treated with manual removal of placenta at caesarean. The other case was an anterior placenta praevia, which eventually required treatment with peripartum hysterectomy—there was histological confirmation of placenta increta

Table 6. Histology results for cases with tissue samples.

Clinical diagnosis	Histology specimen	Histological diagnosis
Placenta increta	Subtotal hysterectomy	Placenta accreta
Placenta accreta	Subtotal hysterectomy	Placenta accreta
Placenta accreta	Subtotal hysterectomy	Placenta increta
Placenta increta	Subtotal hysterectomy	Placenta increta
Placenta percreta	Subtotal hysterectomy	Inconclusive
Placenta accreta	Myometrial resection	Inconclusive

Table 7. Diagnostic accuracy of MRI and US.

MRI result	Confirmed PAS	No PAS
Positive	9	4
Negative	2	26
	Sensitivity 81.8%	Specificity 86.6%
US result	Confirmed PAS	No PAS
Positive	7	5
Negative	4	25
	Sensitivity 63.6%	Specificity 83.4%

US, ultrasound.

following hysterectomy for this case. There was a correlation in this regard with US as both cases were also classified as normal on US. The 2 additional cases missed by US were both anterior placenta praevia which were found to have features of PAS on MRI.

Most cases in this series were eventually delivered by caesarean section and this is summarised below in Table 8. Morbidity was higher in both cases of placenta praevia and PAS with the highest average blood loss seen in cases of confirmed PAS, Table 9. There were 5 cases of peripartum hysterectomy and one case of ureteric injury requiring treatment with nephrostomy and subsequent reimplantation surgery. All of these occurred in cases of confirmed PAS.

Discussion

For non-specialist centres PAS remains a rare presentation, with this series demonstrating an incidence of one proven case every 1.2 years.

Incidental diagnosis is more common, in the absence of a regular screening program (Coutinho et al, 2021). In non-specialist hospitals, there is a need to consider adjunct confirmatory diagnostics prior to referral to specialist centres. This is important to ensure capacity management in specialist centres (Adu-Bredu et al, 2023). Almost all cases in this series were associated with anterior placenta praevia and all cases had previous uterine surgery. The morbidity and risk associated with these cases is significant and accurate antenatal detection is the most reliable way to improve outcomes. In the last 5 years, we have been screening roughly 5–6 cases a year where there is a suspicion of PAS. The sensitivity and specificity of MRI in

Table 8. Mode of delivery for cases according to classification of placenta.

Mode of delivery	Normal	Placenta praevia	PAS	Count
Elective (planned) caesarean section	12	8	9	29
Emergency (unplanned) caesarean section	3	0	2	5
Spontaneous vaginal delivery	2	0	0	2
Ventouse	2	0	0	2
Unknown	1	2	0	3
Total	20	10	11	41

Table 9. Average blood loss at delivery by classification of placenta.

	Normal placentation	Placenta praevia no accreta	PAS
Average blood loss	680 mL (100–1400)	1050 mL (300–2700)	3000 mL (1100–9000)

this series are similar to that in published metanalysis (Hong et al, 2022). In our study the accuracy of US was inferior, and this perhaps reflects operator familiarity in a non-specialist unit. Of the two cases incorrectly diagnosed as normal at MRI both were also missed on US. However, there were two cases of proven PAS detected on MRI which had been classified as normal by US, which gave opportunity to better plan delivery.

For non-specialist centres, the rising prevalence of PAS will be reflected in more cases being detected at screening. Increased awareness of the condition and the potential to improve outcomes by earlier detection will result in an increased need for diagnostic imaging. This need will remain even if suspected cases are then referred on to specialist centres for delivery (Adu-Bredu et al, 2023). It is in this setting that MRI is a useful adjunct to ultrasound in the detection and confirmation of PAS. Antenatal detection with ultrasound requires suitably trained operators and due to the low volume of cases, many clinicians will wish to correlate their scan findings with a second modality.

Conclusion

In our study MRI improved local screening prior to referral, allowing suspected cases to be excluded and therefore reducing unnecessary referrals. The number of scans performed does not represent a significant commitment of resources but provides the opportunity for a clinician with an interest in this area to maintain and develop skills. It therefore becomes feasible to develop a pathway for investigation of suspected cases and antenatal planning of delivery. There is a wide variety in the use of MRI nationally to screen for PAS but this data suggests that it is a useful adjunct to screening with ultrasound.

Key Points

- Rates of PAS are increasing, and these cases are associated with significant morbidity and mortality.
- Antenatal detection of PAS has the potential to improve outcomes.
- Demand for imaging to investigate suspected PAS is increasing in our unit.
- MRI as an adjunct to US was more accurate than US alone in our unit.

Availability of Data and Materials

All data included in this study are available from the corresponding author upon reasonable request.

Author Contributions

RG, KB designed the research study. EG, TD, SL and JG performed the research. EG and RG drafted the manuscript. All authors contributed to revising the manuscript critically for important content. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The ethics approval and informed consent for this article were exempted by the Epsom and St. Helier ethics committee. The study was conducted in accordance with the principles of the Declaration of Helsinki.

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Conflict of Interest

The authors declare no conflict of interest.

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