Ultrasound Obstet Gynecol 2018
Published online in Wiley Online Library (wileyonlinelibrary.com). **DOI:** 10.1002/uog.20104

Screening for morbidly adherent placenta in early pregnancy

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KEYWORDS: first trimester; morbidly adherent placenta; placenta accreta; prenatal diagnosis; ultrasound screening

ABSTRACT

Objective *To estimate the diagnostic accuracy of a two-stage strategy for early prediction of morbidly adherent placenta (MAP). In the first stage, at 11–13 weeks' gestation, women with low-lying placenta and history of uterine surgery are classified as being at high risk for MAP and, in the second stage, at 12–16 weeks, these high-risk pregnancies are assessed at a specialist MAP clinic.*

Methods *This was a prospective study in women having an ultrasound scan at 11–13 weeks' gestation as a part of routine pregnancy care. Women with low-lying placenta and a history of uterine surgery were followed up at a specialist MAP clinic at 12–16 weeks' gestation, 20–24 weeks and 28–34 weeks. At each visit to the MAP clinic, an ultrasound scan was carried out and the following features suggestive of MAP were recorded: non-visible Cesarean section scar; bladder wall interruption; thin retroplacental myometrium; presence of intraplacental lacunar spaces; presence of retroplacental arterial-trophoblastic blood flow; and irregular placental vascularization demonstrated by three-dimensional power Doppler.*

Results *Screening at 11–13 weeks was carried out in 22 604 singleton pregnancies, 1298 (6%) of which were considered to be at high risk of MAP because they had previous uterine surgery and low-lying placenta. At the MAP clinic at 12–16 weeks, the diagnosis of MAP was suspected in 14 cases and this was confirmed at delivery in 13. In the rest of the population, there were no cases of MAP.*

Conclusion *Accurate prediction of MAP can be achieved by ultrasound examination at 12–16 weeks' gestation.* *Copyright © 2018 ISUOG. Published by John Wiley & Sons Ltd.*

INTRODUCTION

Morbidly adherent placenta (MAP) is a histopathological term, which includes three categories according to the depth of placental villous invasion into the uterine wall: first, placenta accreta in which the placental villi are directly attached to the myometrium without interposing decidua; second, placenta increta in which the villi penetrate the myometrium up to the uterine serosa; and, third, placenta percreta in which the villi penetrate through the serosa and invade surrounding tissues and organs such as the bladder[1–3]. In clinical practice, the term placenta accreta is often used for the three types of MAP. Placenta accreta is associated with high maternal mortality of up to 10% and morbidity of about 75%, including uterine rupture before viability, massive hemorrhage, multiorgan failure and need for hysterectomy[4,5]. Placenta accreta is now the most common reason for Cesarean hysterectomy[6,7]. The two main risk factors for MAP are placenta previa and history of Cesarean delivery[8–11], and the risk increases with the number of Cesarean sections from 3% for one, to 11% for two, 40% for three and > 60% for four or more[10].

The prognosis of MAP can be improved with prenatal diagnosis, which has been shown to reduce morbidity by 50%[5]; however, only half of MAP cases are diagnosed prenatally[12]. Ultrasound features suggestive of MAP include non-visible Cesarean section scar, bladder wall interruption, thin retroplacental myometrium, presence of intraplacental lacunar spaces, presence of retroplacental arterial-trophoblastic blood flow, and irregular placental vascularization demonstrated by three-dimensional (3D) power Doppler[13–28]. Most of the reported studies evaluating the role of ultrasound markers in the prediction of MAP were carried out during the second and/or third trimesters of pregnancy[16,17,19,21–28]. There is only one prospective first-trimester study that evaluated 105 high-risk pregnancies at 11–13 weeks' gestation, in which the one case of MAP was correctly predicted[29].

This is a prospective screening study at 11–13 weeks' gestation to, first, identify pregnancies at high risk of MAP on the basis of history of uterine surgery and low-lying placenta and, second, follow up the high-risk pregnancies at a specialist MAP clinic at 12–16 weeks. The objectives are to determine the performance of such a screening

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Accepted: 12 August 2018

strategy in the prediction of MAP and to evaluate the first-trimester ultrasonographic markers of MAP.

METHODS

This was a prospective study of women with a singleton pregnancy attending for a routine hospital visit at 11–13 weeks' gestation at King's College Hospital, London, UK, between August 2013 and August 2016. During this visit, we recorded maternal demographic characteristics and medical and obstetric history, and carried out an ultrasound examination for measurement of fetal crown–rump length (CRL) and nuchal translucency thickness, diagnosis of major fetal defects, and placental localization. The ultrasound scan was performed transabdominally unless there were technical problems impairing visualization, in which case transvaginal sonography was also carried out. Gestational age was determined from CRL[30].

Patients fulfilling the following two criteria were referred to a specialist MAP clinic for further assessment: first, history of uterine surgery, including Cesarean section or myomectomy that involved opening of the uterine cavity; and, second, low-lying placenta, defined as the edge reaching to within 2 cm from the internal cervical os in the case of anterior placenta and reaching or covering the internal cervical os in the case of posterior placenta.

In the MAP clinic, both transabdominal and transvaginal ultrasound examinations at 12–16, 20–24 and 28–34 weeks' gestation were performed by one of three operators who had received training in the diagnosis of MAP, including ultrasound scanning under the direct supervision of an expert and review of pictures and videos from affected cases. At each visit, we recorded the presence or absence of the following features: non-visible Cesarean section scar; bladder wall interruption; thin retroplacental myometrium; intraplacental lacunar spaces; retroplacental arterial-trophoblastic blood flow; and irregular placental vascularization on 3D power Doppler (Figure 1). The diagnosis of MAP was made in the presence of at least three of the above features.

Pregnancy outcome, including diagnosis of MAP, was obtained from the hospital records in all patients undergoing first-trimester screening. In all cases of MAP diagnosed at delivery, the diagnosis was confirmed by histopathological examination[31].

The study constituted routine clinical practice in our hospital and did not require research ethics approval; the patients gave verbal consent for their data to be used for publication.

RESULTS

First-trimester screening was carried out in 22 604 singleton pregnancies with a live fetus and CRL of 45–84 mm (Figure 2). We excluded 1130 (5%) cases because there was miscarriage, pregnancy termination or no follow-up. In the study population of 21 474 pregnancies, 2961 (13.8%) had previous uterine surgery, 17 778 (82.8%) had low-lying placenta and 1298 (6%) were considered to be at high risk for MAP because of both previous uterine surgery and low-lying placenta.

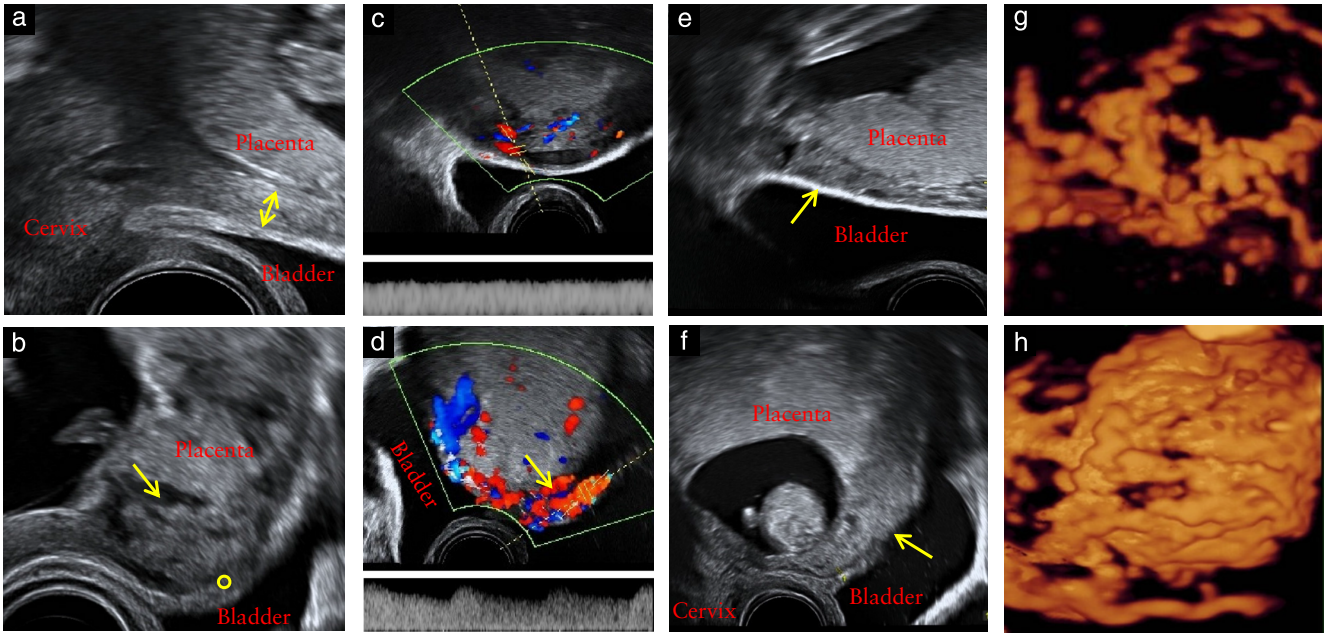

Figure 1 Ultrasound images at 11–13 weeks' gestation illustrating normal placentation (a,c,e,g) and morbidly adherent placenta (b,d,f,h). (a) Normal appearance of placenta and thickness of myometrium (arrow). (b) Intraplacental lacunar spaces (arrow) and retroplacental myometrial thickness < 1 mm (circle). (c) Normal retroplacental vascularization and venous blood flow. (d) Increased retroplacental vascularization (arrow) and abnormal arterial-trophoblastic blood flow. (e) Normal uterine serosa–bladder wall interface (arrow). (f) Interruption of bladder wall (arrow). (g) Normal placental vascularization on three-dimensional (3D) power Doppler. (h) Irregular placental vascularization on 3D power Doppler.

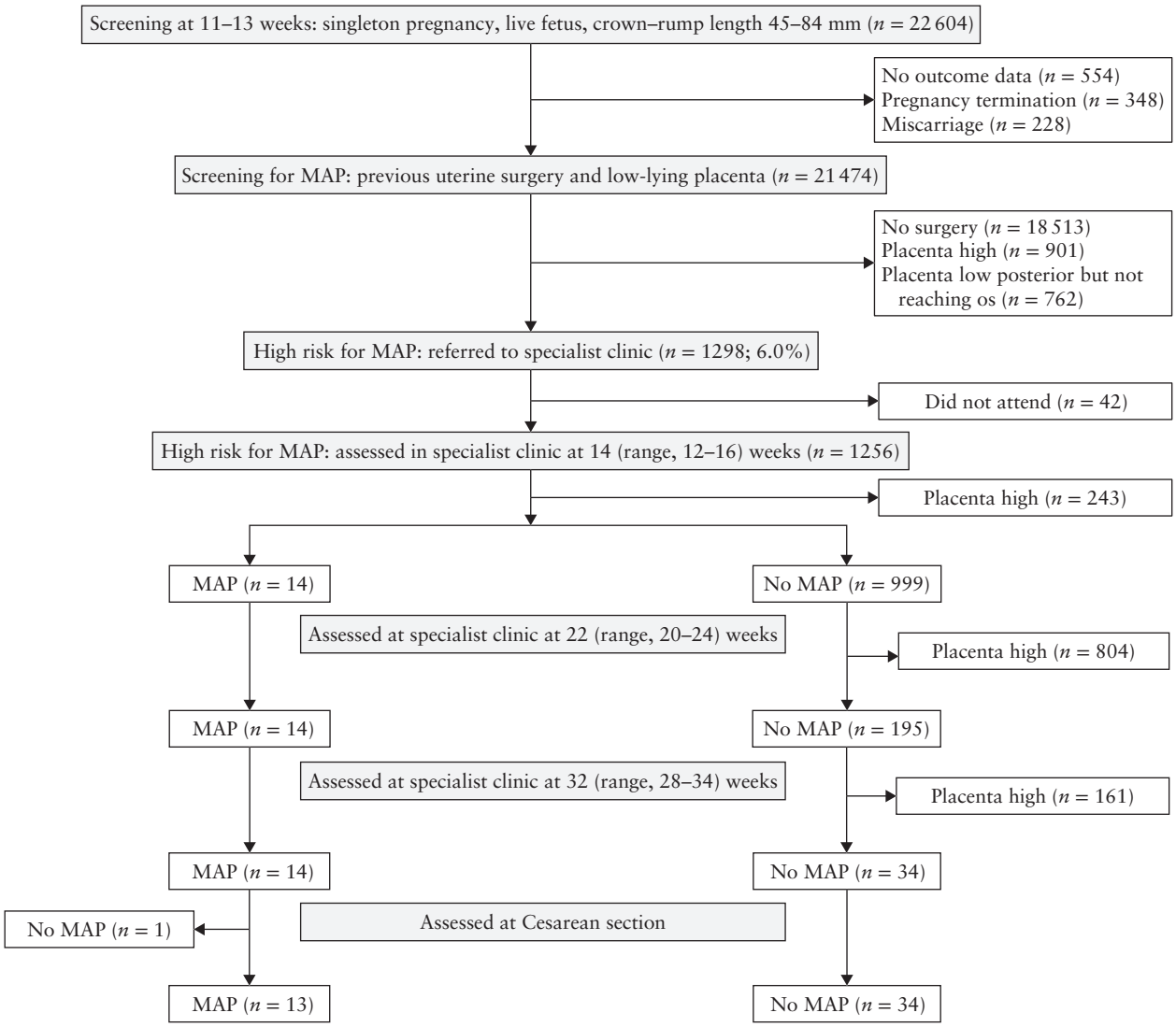

Figure 2 Two-stage screening for and follow-up of morbidly adherent placenta (MAP).

These high-risk pregnancies were referred to the MAP clinic at 14 (range, 12–16) weeks' gestation. Of the 1256 patients who attended the MAP clinic, we suspected MAP in 14, low-lying placenta without MAP in 999 and high placenta in 243.

In the 14 cases of suspected MAP, the suspicion was confirmed at subsequent visits at 20–24 and 28–34 weeks' gestation but, at the time of Cesarean section and subsequent histopathological examination, the diagnosis of MAP was made in only 13 of the cases. In the 13 cases of MAP, eight had hysterectomy and five had partial myometrial resection. In nine cases, elective delivery was carried out at 35–38 (mean, 37) weeks' gestation but, in four, there was emergency Cesarean section at 29–34 (mean, 32) weeks because of severe abdominal pain, heavy bleeding or suspicion of uterine rupture. The median blood loss at surgery was 4.0 (range, 1.5–22.0) L. In the case in which the diagnosis was not confirmed, there was difficult removal of the placenta at the time of Cesarean section and hemorrhage of 900 mL; 6 h later, hysterectomy was performed because of continuing hemorrhage that did not respond to conservative management, but pathological examination demonstrated absence of MAP. In the rest of the study population of 21 474 pregnancies, there were no cases of MAP.

In the 999 cases of low-lying placenta without MAP diagnosed at 12–16 weeks' gestation, the placenta was found to be high in 804 (80.5%) at 20–24 weeks and in 161 (16.1%) at 28–34 weeks, so that, at delivery, there was placenta previa in only 34 (3.4%) cases.

Table 1 shows the incidence of each ultrasound marker of MAP in the group with MAP and in the group with low-lying placenta without MAP at the assessment at 12–16 weeks' gestation. In all 13 cases of MAP, there were intraplacental lacunar spaces, retroplacental arterial-trophoblastic blood flow and irregular placental vascularization on 3D power Doppler. In 12 cases, the myometrial thickness was < 1 mm and the Cesarean section scar was non-visible, and in five there was bladder wall interruption. In the MAP group, there were four ultrasound markers in two cases, five markers in six cases and six markers in five cases. In the non-MAP group, there

Table 1 Ultrasound markers of morbidly adherent placenta (MAP) at 12–16 weeks' gestation in pregnancies with MAP and in those with low-lying placenta without MAP

		Low placenta, no MAP	
Ultrasound marker of MAP	*MAP (n = 13)*	*Previa (n = 35)*	*No previa (n = 965)*
Intraplacental lacunar spaces	13 (100)	8 (22.9)	31 (3.2)
Myometrium < 1 mm	12 (92.3)	1 (2.9)	2 (0.20)
Retroplacental arterial-trophoblastic blood flow	13 (100)	3 (8.6)	20 (2.1)
Irregular placental vascularization on 3D power Doppler*	13/13 (100)	4/28 (14.3)	13/686 (1.9)
Non-visible Cesarean section scar	12 (92.3)	5 (14.3)	39 (4.0)
Bladder wall interruption	5 (38.5)	0 (0)	0 (0)
Number of markers			
≥ 1	13 (100)	12 (34.3)	96 (9.9)
1	0	6	87
2	0	5	9
3	0	0	0
4	2	1	0
5	6	0	0
6	5	0	0

Data are given as *n* (%), *n/N* (%) or *n*. *Examination was not possible in cases of posterior placenta not covering internal os. 3D, three-dimensional.

were 35 cases of placenta previa confirmed at Cesarean section and 965 cases without placenta previa. In the placenta previa group, there was one ultrasound marker in six cases, two markers in five cases and four markers in one case; the most commonly seen markers were intraplacental lacunar spaces, irregular placental vascularization on 3D power Doppler and non-visible Cesarean section scar. The case with four markers was falsely thought to have MAP. In the group without placenta previa, there was one ultrasound marker in 87 cases and two markers in nine cases; the most commonly seen markers were intraplacental lacunar spaces and non-visible Cesarean section scar.

DISCUSSION

Principal findings of the study

The findings of this study demonstrate the diagnostic accuracy of a two-stage strategy for early prediction of MAP. The first stage of routine screening at 11–13 weeks' gestation identifies a group of women at high risk for MAP because they have low-lying placenta and a history of uterine surgery, and this group constitutes about 6% of the total. In the second stage, the high-risk group was examined at a specialist MAP clinic at 12–16 weeks' gestation, at which detailed ultrasound examination was carried out in search of six specific markers of MAP.

At least one marker was found in all cases of MAP, in one-third of cases of placenta previa and in about 10% of cases without placenta previa. The most common markers, found in both the cases with and those without MAP, were intraplacental lacunar spaces and non-visible Cesarean section scar. At least four markers were found in all 13 cases of MAP and in one of the 1000 cases without MAP, giving a false-positive rate of 0.1%.

The overall incidence of MAP in the study population was one in 1651, but in the subgroup with previous uterine surgery and low placenta at 12–16 weeks' gestation, it was 1%, rising to 6% in those with a persistently low-lying placenta at 20–24 weeks, and 27% at 28–34 weeks.

Strengths and limitations

The strengths of this study are, first, prospective screening for MAP in a large population of pregnant women attending for a routine ultrasound examination at 11–13 weeks' gestation, second, use of a specific protocol and appropriately trained doctors to assess women identified at the routine visit as being at high risk of MAP, and, third, collection of pregnancy outcome for the whole screened population, allowing estimation of the performance of population screening for MAP by the proposed two-stage strategy.

A limitation of the study is that the number of patients with MAP was inevitably small, preventing accurate assessment of the performance of screening.

Comparison with previous studies

The ultrasound markers of MAP examined in our study were reported in previous studies which were conducted in the second and/or third trimesters of pregnancy[16,17,19,21–28]. A meta-analysis of 23 studies reported that, in the overall performance of ultrasound for the antenatal detection of MAP, sensitivity and specificity were 91% and 97%, respectively; the best predictor was abnormal vasculature on color Doppler ultrasound and the poorest was presence of placental lacunae[32]. A retrospective study reported that the classical signs of MAP are already present at 11–14 weeks' gestation[33]. A prospective study examined 105 women with previous Cesarean section by transvaginal ultrasound

at 11–13 weeks' gestation and reported that, in one of six with evidence that the trophoblast overlapped the scar, there was subsequent diagnosis of MAP[29].

Our study was prospective and involved screening for MAP in the whole population through a two-stage strategy aiming to identify all cases of MAP in women with previous uterine surgery and low-lying placenta.

Clinical implications of the study

The finding that a screening strategy arising from the 11–13-week routine hospital visit can lead to the early accurate diagnosis of MAP provides further support for the proposed inverted pyramid of pregnancy care[34]. In this proposal, detailed assessment at 11–13 weeks aims to stratify pregnancies on the basis of patient-specific risk for a wide range of pregnancy complications into the appropriate optimum management pathway.

The finding that, among women with previous uterine surgery and low-lying placenta, the incidence of MAP increases with advancing gestational age because of decreasing incidence of low placenta, from 1% at 14 weeks to 6% at 22 weeks and 27% at 30 weeks, could raise the argument that it would be preferable to screen for this condition at 32 rather than at 12 weeks. However, early diagnosis provides the option of surgical termination of pregnancy. Such a procedure can be carried out by ultrasound-guided suction curettage, with minimal risk of maternal death and a high chance of preservation of the uterus and future fertility; recent publications provide support for the hypothesis that Cesarean scar pregnancy is a precursor of MAP, both sharing the same histopathology[35–38]. In contrast, termination beyond 16 weeks, which is considered in severe cases with a high risk of maternal morbidity or mortality due to placental penetration of maternal bladder or uterine parametria, usually requires hysterotomy, hysterectomy or uterine artery embolization[39–45]. Early diagnosis is also important for patients who choose to continue with the pregnancy, because they could be referred for the management of pregnancy and delivery in a hospital with expertise in this condition. This is particularly important in cases that develop symptoms of uterine rupture during the second trimester and before fetal viability, because these patients have a high risk of maternal mortality or severe morbidity[46].

In our series, all women with early diagnosis of MAP chose to continue with the pregnancy. They received extensive counseling concerning the potential complications during pregnancy and delivery, as well as their options of elective hysterectomy or attempts at preserving the uterus, and they were managed by a multidisciplinary team of specialists at a tertiary referral hospital.

ACKNOWLEDGMENT

This study was supported by a grant from The Fetal Medicine Foundation (Charity No: 1037116).

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