DOI: https://doi.org/10.53350/pjmhs2115113050

SYSTEMIC REVIEW

Sonographic Association of Placenta Accreta Spectrum in patients of Placenta Previa - A Systematic Review

MAIDA SAADAT[1], MUHAMMAD NAWAZ ANJUM[2], FAIZA FAROOQ[3], REHAN ASLAM GILL[4], ABEER YASIN[5], RABIA TARIQ[6]
[1]*MBBS; Post Graduate Trainee (DMRD)*
[2]*HOD, Radiology Research Section, Faculty of Allied Health Sciences, The University of Lahore*
[3]*Associate Professor and HOD Radiology, UOL Teaching Hospital, The University Of Lahore*
[4]*Consultant Radiologist, DHQ Teaching Hospital Sargodha,* [5]*Senior Registrar, Lahore General Hospital, Lahore*
[6]*Consultant Radiologist, DHQ Hospital, Jehlum*
Correspondence to Dr. Maoda Saadat

ABSTRACT

Aim: To determine the diagnostic accuracy and epidemiology of placenta accreta spectrum (PAS) in patients of placenta previa.
Methods: PubMed, Google Scholar, ClinicalTrials.gov and MEDLINE were searched between January1992 and December 2020.
Studies on placenta previa complicated by PAS diagnosed in a defined obstetric population. This research was carried out using standard methods and protocols and keeping in view Newcastle-Ottawa scale for observation and assessment of case study along with the difference approved by consensus. The overall diagnostic accuracy of ultrasonographic findings is the main outcome of this study, whereas the prevalence of placenta accreta in patients of placenta previa and its incidence among different countries all over the world is also described.
Results: In this review study, about 300 articles were evaluated. More over about 15 prospective and 14 retrospective case studies incorporated for assessment having complication with placenta previa and PAS. According to the meta-analysis, a significant ($p<0.001$) heterogeneity was found between case research that evaluate PAS prevalence and incidence in the placenta previa cohort. The median prevalence in case of placenta previa along with PAS came out to be 0.113% (IQR 0.048–0.17).Whereas incidence in females having placenta previa along with complication of PAS came out to be 11.3%.
Conclusions: The high level of diversity observed in results obtained by diagnostic and qualitative data showed strong emphasis should be made on implementation of standard methods and protocols for assessment and diagnosis of pregnancy complication like placenta previa, its type and PAS.
Keywords: Sonography placenta previa, placenta accreta spectrum

INTRODUCTION

One of the medical pathological conditions during obstetric delivery is known as placenta accreta that has been liked with higher degree of risks of gigantic obstetric hemorrhage. In 1937, this term was introduced by researchers Hertig[1] and Irving as an abnormal attachment of placenta to the walls of uterus (myometrium) as a result of lack of decidua basalis. This concept was again described by Luke *et al*[2]. He redefined it as a spectrum of abnormal adherent and invasive disorders of placenta. Now placenta accreta has been graded depending upon uterine wall villous penetration with abnormally adherent placenta, for example, the villi may attach to myometrium without invasion, secondly, the villi may deeply penetrate into the utrine wall (myometrium) to the uterine serosa, and thirdly, placenta percreta, in which the entire uterine serosa invaded by villous tissues, most of the time making its way to the nearby tissues in pelvic region.[3–5]
From researches, it was found that from more than last two decades one of the highlighted causes of PAS is caesarean delivery.[6–10] Moreover; in addition to this factor the other main contributing factor is to have placenta previa. A cohort study was carried out in USA, observed that females having placenta previa and previous delivery via caesarean are at higher risk of PAS by 3%, 11%, 40%, 61% and 70% with respect to first caesarean, second caesarean, third caesarean, fourth caesarean and fifth caesarean, respectively.[7] With the aid of UK Obstetric Surveillance System, an observational research was carried out known as national case–control study that stated that prevalence of PAS shows an increasing trend from 1.7 per 10,000 births overall to 577 per 10,000 births in females having placenta previa as well as prior caesarean delivery.[8]

Because of attachment as well as villous tissue invasion into myometrium, there is failure of separation of placenta spontaneously from the walls of uterus at delivery time.[2–4] Manual removal of accreta villous tissue at delivery time spontaneously aggravates bleeding via uteroplacental circulation.[5,11] Massive obstetric hemorrhage can happen due to invasion of villous tissues deep inside uterine vasculature of the percreta or increta region.[4,5] Prenatal identification and diagnosis of PAS may result in decline in maternal mortality and morbidity and therefore, one of the most effective tool in its effective management.[12,13] Case regarding placenta increta was firstly reported via ultrasound via Tabish et al prenatal diagnosis.[14] In current era, with meta-analysis and systematic analysis of prenatal ultrasound diagnosis of pathological condition of placenta previa along with PAS in female patients with previous history of caesarean, we can achieve an accurate diagnosis by 90.9%.[15] It has been observed that in countries equipped with modernize screening systems for fetal growth and development unluckily, PAS still remains undiagnosed till the time of birth in few cases.[8,10]

Worldwide, there has been increased prevalence of placenta accrecta observed. The invasive nature of placenta accreta induces great impact on health of pregnant women. Those pregnant women are marked as high risk candidates with respect to delivery complications who have previous history of caesarean delivery along with PAS presentation.[16]

The main aim of this review is to do analysis and assessment of epidemiology and diagnosis with respect to females having placenta previa and to analyze different standards that were previously used by researchers for accurate diagnosis and assessment of placenta previa with PAS before delivery to confirm the diagnosis of PAS at the time of delivery.

MATERIALS & METHODS

A study was conducted that provided information regarding data collection with respect to incidence and prevalence of PAS in females suffering placenta previa. In August 1982, Tabish et al[14] performed research for investigating information regarding prenatal placenta accerta ultrasound and later it was further researched in December 2012. This research work aimed at terms under heading

Received on 11-05-2021
Accepted on 21-10-2021

such as 'placenta accreta, abnormally invasive placenta, placenta percreta, major placenta previa, and morbidly adherent placenta (search strategy in online supplementary data 1). The researches made assessment with respect to data analysis and its content. Moreover additional relevant research was made from editorials, review, websites and journals. All the net results that were obtained by various researches were piled up into reference database. Moreover, it was ensured that no duplicate copy should be made. All these articles were launched in English language. All the work disregarded that was not up to the relevant criteria. In text form, all the remainders were assessed separately. All the articles that were published before January 1992 were not taken into account.

Reviewer undertook the critical quality assessment, as difference shall be decided by mutual consensus. The Newcastle-Ottawa scale studies were used to establish the risk of bias in selection (representativeness of the exposed cohort, ascertainment of exposure and the demonstration that the outcome of interest was not present at the start of the study), comparability (evaluation of the cohorts based on the design or analysis) and outcome assessment. These included retrospective versus prospective studies, single versus multiple institutions studies, prenatal ultrasound description of placenta previa and PAS, histopathological confirmation of the diagnosis of the PAS and corresponding grade of invasiveness and detailed data on management and maternal outcomes.

STATA software (V.15; StataCorp) was utilized for the data assessment. According to the Kurtosis analysis distribution of values was not normal that's why estimation made by specific study and represented as IQR and median. In order to compile data from various studies, a random-effects model was utilized that also include variations among studies. General public and patients were restricted to show any involvement in case study.

RESULTS

The preliminary search shows 294 records with cross- referencing providing an additional six studies, making a total of 300 theoretically related articles. After segregation of facsimiles and the twelve among these not found, total 190 remained. On selection of the titles and abstracts, a more 97 were omitted as they were not up to mark, remaining 93 articles which were considered for review. Furthermore 35 articles were omitted for review containing letters (n=14), narrative reviews (n=7) commentaries (n=10), conference proceedings (n=2) and repetition of data in another study (n=2), remaining 18 studies for the final scrutiny of epidemiology and 15 studies for diagnostic accuracy of ultrasound, among which 4 were common.

Table 1 shows the epidemiology data of the 18 studies. There were 9 retrospective and 9 prospective studies counting a total of 1,116,341 births and 21,652 cases denoted as pregnancies.

These studies included 601 women with placenta previa complicated by PAS out of 6241 cases of placenta previa. The median prevalence of PAS with placenta previa was 0.113% (IQR 0.048–0.17). The median incidence of PAS in women with a placenta previa was 11.3% (IQR 7.3–20.0).

All authors except two[22, 33] reported on the criteria used for the prenatal ultrasound diagnosis of placenta previa. Four studies[23, 25, 31, 35] only included major placenta previa in their cohort defined as the placenta completely covering or partially covering the internal os of the cervix. The others included both major and minor placenta previa. The definition of minor placenta previa varied with two studies[20, 28] using the placental edge being <2 cm from the internal os, two studies using <2 cm[32, 34] and two study using <4 cm or <5 cm if associated with abnormal fetal presentation.[17, 19] The gestational age at confirmation of the prenatal diagnosis of placenta previa was reported in six studies[18–20, 21, 32, 37]and ranged between 21 and 35 weeks and in one study the diagnosis of placenta previa was confirmed at birth when the placenta was found to be inserted in the lower segment.[20]

PAS diagnosis by aid of ultrasound was documented in four case researches [25, 27,31,33] along with three case studies also made use of MRI for accurate diagnosis.[26,34,35] The criteria that was used clinically used for the detection of PAS at child's birth were documented by eight case researches [16,17,20,23,27,31,33,36] and it also included difficult removal of placenta by doctors from the walls of uterus. This scenario required 'piecemeal removal' that includes excessive and heavy bleeding after delivery of placenta from placental bed. One case researcher explained invasive villous tissue presence at time of delivery[26] and one explained the necessity of suturing the placental bed.[24] Not even a single case researcher documented uterus appearance or any surgical discovery at time of caesarean delivery. With the aid of histopathological examination, the clinical diagnosis was assured in 14 cases [18,21,23,28–34,36,37] along with full assessment via microscope was documented in seven case studies. Detailed histopathological findings along with explanation were documented in eight studies from 18 studies. These studies included placenta previa accreta 290 cases that were graded for 168 (58%) as placenta adherent, whereas 72 (24.8%) as placenta increta and 50 (17.2%) as placenta percreta. These studies included a total of 392,452 pregnancies or births and the prevalence for the different grades of placenta previa accreta was 0.04%, 0.02% and 0.01% for accreta, increta and percreta, respectively. The meta-analysis indicated statistically significant ($p<0.001$) level of overall heterogeneity between study estimates for the prevalence of placenta previa, the prevalence of placenta previa with PAS and the incidence of PAS in the placenta previa cohort. The difference in heterogeneity between prospective versus retrospective studies was not statistically significantly different, whereas it was significant for the prevalence of placenta previa accreta. Adjusting for type of study did not reduce inconsistency between studies. The in-between placenta previa major only versus minor and major placental previa was not significant for the incidence of PAS in patient with placenta previa.

Table 2 shows the diagnostic accuracy of the ultrasonography from different researches all over the world. All of these studies basically diagnose placenta aaccreta spectrum in patients of placenta previa using atleast 2 criteria for placental invasion into the myometrium; though all criteria may also be present as loss of retroplacental clear space, number and pattern of lacunae, thinning or loss of visualization of myometrium and bladder wall integrity. Color Doppler ultrasound findings are also described in various researches as presence or absence of subplacental vascularity, vessels bridging from the placenta to the uterine margin, gaps in myometrial blood flow, vessels crossing interface disruption sites, or turbulent flow in lacunae.

Table 1: Prevalence and incidence of placenta previa with placenta accreta spectrum (PAS) per pregnancies or births .

Authors	Obstetric population	Prevalence (%)	Incidence (%)
Kassem and Alzahrani[35]	29053 births	25 (0.085)	25⁄122 (20.5)
Maher *et al*[36]	24661 births	42 (0.170)	42⁄577 (7.3)
Alchalabi *et al*[37]	16845 births	23 (0.137)	23⁄81(28.4)
Asicioglu *et al*[38]	112819 births	46 (0.041)	46⁄364 (12.6)
Sumigama *et al*[39]	96 670 births	46 (0.048)	46⁄954 (4.8)
Ahmed *et al*[40]	3841births	14(0.365)	14⁄52(26.9)
Cheng and Lee[41]	81497 births	39(0.048)	39⁄921(4.2)
Cho *et al*[42]	11 210 pregnancies	39(0.348)	39⁄442(8.8)
Kollmann *et al*[43]	218876 births	13(0.006)	13⁄328(4.0)
Pilloni *et al*[44]	108 000 births	37(0.034)	37⁄314(11.8)
Rezk and Shawky[45]	12654 pregnancies	53(0.419)	53⁄74(71.6)
Chattopadhyay *et al*[27]	41206 births	26(0.063)	26⁄222(11.7)
Zaki *et al*[28]	23070 births	12(0.052)	12⁄110(10.9)
Ziadeh *et al*[29]	18651 births	13(0.070)	13⁄65(20.0)
Ghourab[30]	18670 births	11(0.059)	11⁄138(8.0)
Bahar *et al*[31]	42487births	53(0.125)	53⁄306(17.3)
Hamada *et al*[32]	2413 births	5(0.207)	5⁄70(7.1)
Jang *et al*[33]	35030 births	53(0.151)	53⁄560(9.5)

Table 2: Sensitivity, Specificity, PPV (positive predictive value) and NPV (negative predictive value) of the various selected research articles.

Authors	Sensitivity	Specificity	PPV	NPV
Kassem[35]	83.33%	94.17%	80.65%	95.10%
Challubinski[47]	91.4%	95.9%	80.0%	98.4%
Chou[48]	82.4%	96.8%	87.5%	95.3%
Li Zhang[49]	77.3%	98.4%	85.0%	97.4%
Pilloni[44]	81.1%	98.9%	90.9%	97.5%
Garofalo[50]	60%	98.8%	85.7%	95.7%
F Daney de Marcillac[51]	92%	67%		
Robert P Japaraj[52]	100%	100%		
Zachary & Bowman[58]	53.5%	88.0%	82.1%	64.8%
Rezk M AA[45]	94.34%	91.67%	96.15%	88%
Hong Soo Wong[59]	89%	98%		
Yan Liu[60]	50.8%	72.7%	86.7%	40.0%
Anne-Sophie[61]	100%	37.5%		
Maher MA[36]	95.1%	95.5%		
Warshak CR[62]	77%	96%		

DISCUSSION

This case research focuses on evaluating the diagnostic accuracy of ultrasonography in patients of PAS with placenta previa. Secondly it also aimed at evaluation of prevalence and incidence of PAS in females having placenta previa. Females that have already previous history of caesarean delivery presenting with low-lying placenta show greater than 90% PAS cases.[8,10,16] According to meta-analysis there is great heterogeneity found with respect to both the prenatal placenta previa diagnosis and PAS diagnosis at delivery time. From all these findings it is clear that international standardized protocols should be used clinically in order to cope up this complication technically and mind-fully. Moreover more training of medical staff should be done with latest guidelines.

One of the basic aims of obstetric ultrasound examination is to accurately diagnose the location of placenta with respect to the uterus. Mid pregnancy ultrasound provides placental location more accurately. Initially with the aid of trans-abdominal scan, placenta previa was detected. Since development of placenta in cases of previa takes place from lower uterine segment, the classification was made depending upon its distance between the placental lower edge and the internal cervical os of the uterus. The patient will have minor placenta previa if the lower edge lying within 2-5cm from the lower uterine segment down to the internal os whereas major placenta previa said to occur if placenta completely or partially covers the cervix.

More over at times of diagnosis different gestational ages were detected. The detection of diagnosis directly affects the epidemiology data since 70% cases of minor placenta previa at 20–23 weeks of pregnancy will be settled by 32–35 weeks. A panel of expert doctors from American Institute of Ultrasound[46] has ordered to stop using terms such as 'marginal' and 'partial' and recommend to use term 'placenta previa' in cases only where placenta places with respect to the internal os directly. Low-lying placenta is said to occur when the edge of placenta is less than 2 cm with respect to internal os whereas in case of normal scenario, the edge of placenta is greater than 2 cm with respect to the internal os. From our case research, it is further verified that there is demand of this type of classification in future researches.

Complete histopathological reports were made for only those patients who went under partial myometrial resection or hysterectomy. For the confirmation of accreta placentation, there should be no decidua between the myometrium and tip of anchoring villi.[5] Thus, compiling up data on clinical basis that is failed to make difference between adherent accreta and placenta retention and using non-diagnostic criteria in regards to villous invasiveness may end up into over diagnosis of the adherent grade with respect to PAS (table 1), specifically in those cases that represent decreased rate of hysterectomy.[28,36]

On the whole, results and different strategies showed dissimilarities in final results depending upon prenatal diagnosis accuracy, local expertise by doctors and multidisciplinary team protocols.[53,54] Peripartum hysterectomy was opted by 60%–70% of gynecologists where there is higher risk of PAS associated with caesarean delivery.[55,56] In opposite to above approach, conservative management was opted by various gynecologists that involved radical surgery and considered to be more safer for PAS.[57] The co-occurance of placenta previa and PAS is dangerous for both baby and mother as it can cause morbidity and mortality. Now days about 70% hysterectomy was opted as primary management in cases where patients presented with PAS and a placenta previa. From the interstudy, four case researches[19,21,29,37] had <50%, peripartum hysterectomy rates, five case researches[28,31,32,34,36] had rates between 50% and 99% and whereas four[22,30,35,38] had rates of 100%.

There are various sonographic features for finding placenta accreta using both grey-scale and color Doppler imaging. Grey-scale imaging shows number and shape of lacunae, loss of retroplacental clear space, thinning or loss of visualization of the myometrium and bladder wall irregularity; whereas color Doppler helps us to identify presence or absence of subplacental vascularity, vessels bridging from the placenta to the uterine margin, gaps in myometrial blood flow, vessels crossing interface disruption sites or turbulent lacunae. These signs may be found focally or throughout. The articles in table 2 which have been selected atleast mentioned 2 of the above crieteria for the diagnosis of placenta accrete spectrum in cases of placenta previa, although all signs may also be present.

Four of the total studies have also used MRI for comparison of the detection of the PAS in cases of placenta previa with the ultrasonography.[36,45,50,61] Rezk *et al* compared the sensitivity, specificity, PPV and NPV for ultrasound was 94.34%, 91.67%, 96.15% and 88% in total of 74 patients ; whereas he found these values for MRI as 96.08%, 87.50%, 94.23% and 91.3%, respectively.[45] So, the results are comparable. Maher *et al* did a research for comparison and described sensitivity and specificity of ultrasound as 95% and 95.5%, whereas 85.7% and 76.9% for MRI respectively[36], so we can see that diagnostic accuracy of ultrasound is comparable to MRI. Ultrasound is cheaper, easily available with immediadte reporting and even portable and as efficient as MRI. According to these studies, MRI is helpful in cases where there is suspicion of accreta in high-risk cases of placenta previa or when placenta is located laterally or posteriorly.

One study done by Yan Liu *et al* compared ultrasonography with cystoscopy for the detection of PAS and they found that the diagnostic accuracy was same for ultrasound and cystoscopy according to the results of this study[60]. So, ultrasound remains the main tool for diagnosis of PAS in patients of placenta previa. If the patient is accurately diagnosed, it is the responsibility of a radiologist to counsel the patient and the concerned obstetrician to accurately describe the condition, so that patient can be managed effectively in a specialized tertiary care centre to deal with the complications and maternal morbidity and mortality.

CONCLUSION

There is a need for further prospective multi-center studies with participatory methodologies involving local service providers and facility management to accurately evaluate the consequences of high caesarean sections rates on maternal health within a particular population. Within this context, accurate epidemiological data on PAS disorders are essential in planning screening programs and in making facility for the development of centers of excellence for the management of this increasingly common complex obstetric condition. While the concept of core outcome measures within clinical trials is now well recognized and championed, greater efforts are required to disseminate this approach in epidemiological research to facilitate global estimation and recognition of problems emerging on a worldwide scale. Our study supports implementation, in both clinical practice and in reporting data on placenta previa accreta in the medical literature, of standardized protocols for prenatal diagnosis of both placenta previa and PAS, for the clinical diagnosis of PAS at birth and for the histopathological confirmation examination.

REFERENCES

1. Irving C, Hertig AT. A study of placenta accreta. Surg Gynecol Obstet1937;64:178-200
2. Luke RK, Sharpe JW, Greene RR. Placenta accreta: the adherent or invasive placenta. Am J Obstet Gynecol 1966; 95:660-8.
3. Fitzpatrick KE, Sellers S, Spark P, *et al*. Incidence and risk factors for placenta accreta/increta/percreta in the UK: a national case-control study. *PLoS One*2012;7:e52893.
4. Bowman ZS, Eller AG, Bardsley TR, *et al*. Risk factors for placenta accreta: a large prospective cohort. *Am J Perinatol*2014;31:799–804.
5. Thurn L, Lindqvist PG, Jakobsson M, *et al*. Abnormally invasive placenta-prevalence, risk factors and antenatal suspicion: results from a large population-based pregnancy cohort study in the Nordic countries. *BJOG: Int J ObstetGy*2016;123:1348–55.
6. Silver RM, Branch DW, Spectrum PA. Placenta accreta spectrum. *NEngl J Med*2018;378:1529–36.
7. ChantraineF, Braun T, Gonser M, *et al*. Prenatal diagnosis of abnormally invasive placenta reduces maternal peripartum hemorrhage and morbidity. *ActaObstetGynecolScand*2013;92:439–44.
8. Wortman A, Schaefer S, McIntire D, *et al*. Complete placenta previa: ultrasound biometry and surgical outcomes. *AJP Rep*2018;08:e74–8.
9. Gottesfeld KR, Thompson HE, Holmes JH, *et al*. Ultrasonic placentography--a new method for placental localization. *Am JObstetGynecol*1966;96:538–47.
10. Kohorn EI, Walker RH, Morrison J, *et al*. A comparison between ultrasonic compound B scanning and radioisotope scanning. *Am JObstetGynecol*1969;103:868–77.
11. Ballas S, Gitstein S, Jaffa AJ, *et al*. Midtrimester placenta previa: normal or pathologic finding. *Obstetrics & Gynecology*1979;54:12–14.
12. Leerentveld RA, Gilberts ECAM, Arnold MJCWJ, *et al*. Accuracy and safety of transvaginalsonographic placental localization. *Obstetrics& Gynecology*1990;76:759–62.
13. Smith RS, Lauria MR, Comstock CH, *et al*. Transvaginal ultrasonography for all placentas that appear to be low-lying or overthe internal cervical os. *Ultrasound ObstetGynecol*1997;9:22–4.
14. TabshKM. Brinkman Cr 3rd, King W. ultrasound diagnosis ofplacenta increta. *J Clin Ultrasound*1982;10:288–90.
15. Dashe JS, McIntire DD, Ramus RM, *et al*. Persistence of placenta previa according to gestational age at ultrasound detection. *ObstetGynecol*2002;99:692–7.
16. Quant HS, Friedman AM, Wang E, *et al*. Transabdominal ultrasonography as a screening test for second-trimester placentaprevia. *Obstetrics & Gynecology*2014;123:628–33.
17. Reddy UM, Abuhamad AZ, Levine D, *et al*. Fetal imaging: Executive summary of a joint Eunice Kennedy Shriver NationalInstitute of child health and human development, Society for Maternal- Fetal medicine, American Institute of ultrasound in medicine, American College of obstetricians and Gynecologists, American College of radiology, Society for pediatric radiology, and societyof radiologists in ultrasound fetal imaging workshop. *J Ultrasound Med* 2014;33:745–57.
18. Jauniaux E, Collins SL, Jurkovic D, *et al*. Accreta placentation: a systematic review of prenatal ultrasound imaging and grading of villous invasiveness. *Am J ObstetGynecol*2016;215:712–21.
19. Collins SL, ChantraineF, Morgan TK, *et al*. Abnormally adherent and invasive placenta: a spectrum disorder in need of a name. *UltrasoundObstetGynecol*2018;51:165–6.
20. Collins SL, Ashcroft A, Braun T, *et al*. Proposal for standardized ultrasound descriptors of abnormally invasive placenta (AIP).*Ultrasound ObstetGynecol*2016;47:271–5.
21. Hall T, Wax JR, Lucas FL, *et al*. Prenatal sonographic diagnosis of placenta accreta-Impact on maternal and neonatal outcomes. *J. Clin. Ultrasound*2014;42:449–55.
22. Wright JD, Silver RM, Bonanno C, *et al*. Practice patterns and knowledge of obstetricians and gynecologists regarding placenta accreta. *J Matern Fetal Neonatal Med*2013;26:1602–9.
23. Jauniaux E, Bhide A. Prenatal ultrasound diagnosis and outcome of placenta previaaccreta after cesarean delivery: a systematic reviewand meta-analysis. *Am J ObstetGynecol*2017;217:27–36.
24. Jauniaux E, ChantraineF, Silver RM, *et al*. Figo placenta accretadiagnosis and management expert consensus panel. FIGO consensus guidelines on placenta accreta spectrum disorders: epidemiology. *Int J GynaecolObstet*2018;140:265–73.
25. Collins SL, Stevenson GN, Al-Khan A, *et al*. Three-Dimensional power Doppler ultrasonography for diagnosing abnormally invasive placenta and quantifying the risk. *Obstetrics & Gynecology*2015;126:645–53.
26. Wells GA, Shea B, O'Connell D, *et al*. The Newcastle-Ottawa scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses, 2014. Available: www.ohri.ca/programs/clinical epidemiology/oxford.asp [Accessed 10 Jun2018].
27. Chattopadhyay SK, Kharif H, Sherbeeni MM. Placenta praeviaand accreta after previous caesarean section. *Eur J ObstetGynecolReprodBiol*1993;52:151–6.
28. Zaki ZS, Bahar A, Ali M, *et al*. Risk factors and morbidity in patients with placenta previaaccreta compared to placenta previa non-accreta. *ActaObstetGynecolScand*1998;77:391–4.
29. Ziadeh SM, Abu-HeijaAT, El-JalladMF. Placental praevia and accreta: an analysis of two-years' experience. *J ObstetGynaecol*1999;19:584–6.
30. Ghourab S. Third-trimester transvaginal ultrasonography in placenta previa: does the shape of the lower placental edge predict clinical outcome? *Ultrasound ObstetGynecol*2001;18:103–8.
31. Bahar A, Abusham A, Eskandar M, *et al*. Risk factors and pregnancy outcome in different types of placenta previa. *Journal of Obstetrics and Gynaecology Canada*2009;31:126–31.
32. Hamada S, Hasegawa J, Nakamura M, *et al*. Ultrasonographic findings of placenta lacunae and a lack of a clear zone in cases with placenta previa and normal placenta. *PrenatDiagn*2011;31:1062–5.
33. Jang DG, We JS, Shin JU, *et al*. Maternal outcomes according to placental position in placental previa. *Int J Med Sci*2011;8:439–44.
34. Rosenberg T, Pariente G, Sergienko R, *et al*. Critical analysis of risk factors and outcome of placenta previa. *Arch GynecolObstet*2011;284:47–51.
35. Kassem GA, Alzahrani A. Maternal and neonatal outcomes of placenta previa and placenta accreta: three years of experience witha two-consultant approach. *Int J Womens Health*2013;28:803–10.
36. Maher MA, Abdelaziz A, BazeedMF. Diagnostic accuracy of ultrasound and MRI in the prenatal diagnosis of placenta accreta.*ActaObstetGynecolScand*2013;92:1017–22.
37. AlchalabiHaifa'a, Lataifeh I, Obeidat B, *et al*. Morbidly adherent placenta previa in current practice: prediction and maternal morbidity in a series of 23 women who underwent hysterectomy. *J Matern Fetal Neonatal Med*2014;27:1734–7.
38. Asıcıoglu O, Şahbaz A, Güngördük K, *et al*. Maternal and perinatal outcomes in women with placenta praevia and accreta in teaching hospitals in Western turkey. *J ObstetGynaecol*2014;34:462–6.
39. Sumigama S, Sugiyama C, KotaniT, *et al*. Uterine sutures at prior caesarean section and placenta accreta in subsequent pregnancy: acase-control study. *BJOG: Int J ObstetGy*2014;121:866–75.
40. Ahmed SR, Aitallah A, Abdelghafar HM, *et al*. Major placenta previa: rate, maternal and neonatal outcomes experience at a tertiary MaternityHospital, Sohag, Egypt: a prospective study. *J ClinDiagn Res*2015;9:17–19.
41. Cheng KK, Lee MM. Rising incidence of morbidly adherent placenta and its association with previous caesarean section: a 15-year analysis in a tertiary hospital in Hong Kong. *Hong Kong Med J*2015;21:511–7.
42. Cho HY, Hwang HS, Jung I, *et al*. Diagnosis of placenta accreta by uterine artery Doppler velocimetry in patients with placenta previa. *JUltrasound Med* 2015;34:1571–5.
43. Kollmann M, Gaulhofer J, Lang U, *et al*. Placenta praevia: incidence, risk factors and outcome. *J Matern Fetal Neonatal Med*2016;29:1395–8.
44. Pilloni E, Alemanno MG, GagliotiP, *et al*. Accuracy of ultrasound in antenatal diagnosis of placental attachment disorders. *UltrasoundObstetGynecol*2016;47:302–7.
45. Rezk MA-A, Shawky M. Grey-Scale and colour Doppler ultrasound versus magnetic resonance imaging for the prenatal diagnosis of placenta accreta. *The Journal of Maternal-Fetal & Neonatal Medicine*2016; 29:218–23.
46. Alfirevic Z, Tang A-W, Collins SL, *et al.*Palacios-Jaraquemadas, on behalf of the ad-hoc international AIP expert group. pro Forma for ultrasound reporting in suspected abnormally invasive placenta (AIP); an international consensus. *Ultrasound ObstetGynecol*2016; 47:276–8.
47. K M Chalubinski, P Speiser, M Langer, S Pils, K Klien *et al.* Prenatal sonography can predict degree of placental invasion. *Ultrasound Obstet Gynecol* 2013; 42(5): 518-24.
48. MM Chou, Es Ho, Y H Lee. Prenatal diagnosis of placenta previa accrete by transabdominal color Doppler ultrasound. . *Ultrasound Obstet Gynecol* 2000; 15(1): 28-35.
49. Li Zhang, Ping Li, Guo-Lin He, Zhonghia Fu, Chan Ke Za Zhi. Value of prenatal diagnosis of placenta previa with placenta increta by transabdominal color Doppler ultrasound. 2006; 41(12): 799-802.
50. Garofalo A, E Pilloni, Alemanno M G, Garofalo G. Ultrasound accuracy in prenatal diagnosis of abnormal placentation of posterior placenta previa. *Eur J Obstet Gynecol Reprod Biol.* 2019; 242: 86-91.
51. F Daney de Marcillac, S Moliere, A Pinton, G Fritz. Accuracy of placenta accrete; Prenatal diagnosis by ultrasound and MRI in a high-risk population. *J Gynecol Obstet Biol Repro.* 2016; 45(2): 198-206.
52. Robert P, Japara J, Tarmini S, Mimin, Krishnan Mukudan. Antenatal diagnosis of placenta previa accrete in patients with previous cesaerean scar. *J Obstet Gynecol.* 2007; 33(4): 431-7.
53. Allen L, Jauniaux E, Hobson S, *et al.* Figo placenta accreta diagnosis and management expert consensus panel. FIGO consensus guidelines on placenta accreta spectrum disorders: nonconservative surgical management. *Int J GynaecolObstet*2018;140:281–90.
54. Farquhar CM, Li Z, Lensen S, *et al*. Incidence, risk factors and perinatal outcomes for placenta accreta in Australia and New Zealand: a case–control study. *BMJ Open*2017; 7:e017713.
55. Sargent W, Collins SL. Are women antenatally diagnosed with abnormally invasive placenta receiving optimal management in England? an observational study of planned place of delivery. *ActaObstetGynecolScand*2019; 98:337–41.
56. Cresswell JA, Ronsmans C, Calvert C, *et al*. Prevalence of placenta praevia by world region: a systematic review and meta-analysis. *TropMed Int Health*2013; 18:712–24.
57. Allen L, Jauniaux E, Hobson S, *et al.* Figo placenta accrete diagnosis and management expert consensus panel. FIGO consensus guidelines on placenta accrete spectrum disorders:nonconservative surgical management. *Int J Gynaecol Obstet* 2018; 140:281-90.
58. Zachary S, Bowman, Alexandra G Eller, Anne M Kennedy. Accuracy of ultrasound for the prediction of placenta accrete. *Am J Obstet Gynecol.* 2014; 211(2): 177.
59. Wong H S, Cheung Y K, Zuccollo J, Tait J, Pringle K C. Evaluation of sonographic diagnostic criteria for placenta accrete. *J Clin Ultrasound.* 2008; 36(9): 551-9.
60. Liu Y, Fan D, Wu S, Fu Y, Wang W. Diagnostic accuracy of cystoscopy and ultrasonography in the prenatal diagnosis of abnormally invasive placenta. *Medicine* 2018; 97(15): e0438.
61. Anne Sophie Riteau et al. Accuracy of ultrasound and magnetic resonance imaging in the diagnosis of placenta accrete. *Plos One.* 2014; 9(4): e94866.
62. Warshak C R et al. Accuracy of Ultrasonography and Magnetic Resonance Imaging in the diagnosis of placenta accreta. *Obstet Gynecol.* 2006; 108: 573-81