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Original Article

Correlation of Placenta Accreta Index with Maternal Outcomes in Patients with Morbidly Adherent Placenta

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ABSTRACT

Objective: To assess the correlation of a novel scoring system, placenta accreta index with maternal outcomes in placenta accreta spectrum disorders.

Study Design: Prospective longitudinal study

Place and Duration of Study: Obstetrics and Gynecology Department of Combined Military Hospital Quetta, Pakistan from Apr 2022- Mar 2023.

Methodology: A comparative study was carried out at Combined Military Hospital, Quetta after ethical approval. The study spanned over a year from April 2022 to March 2023. Thirty patients in second and third trimester of pregnancy with suspicion of placenta accreta on obstetric ultrasound were included in the study. The placenta accreta index (PAI) was calculated for all patients and morbidly adherent placenta categories were defined. The primary maternal outcome was cesarean hysterectomy.

Results: Cesarean hysterectomy was done in none of the low risk and medium risk patients and it was carried out in 11(84.6%) high risk patients with a *p* value of <0.001.

Conclusion: Placenta accreta index (PAI) can reliably identify patients at high risk of having morbidly adherent placenta and adverse outcomes. This scoring system can assist obstetricians in timely counseling of patients, effective pre-operative planning and timely intervention to reduce maternal morbidity and mortality.

Keywords: Placenta accreta index, Placenta accreta spectrum, Morbidly Adherent Placenta and Ultrasonography.

How to Cite This Article: *Khan FS, Khan B, Ansari KS, Andleeb M, Jabeen S, Uzma S. Correlation of Placenta Accreta Index with Maternal Outcomes in Patients with Morbidly Adherent Placenta. Pak Armed Forces Med J 2024; 74(6): 1593-1598. DOI: https://doi.org/10.51253/pafmj.v74i6.10291*

INTRODUCTION

Placenta accreta spectrum encompasses all those clinical situations in which placenta cannot be detached from the uterus resulting in massive obstetric hemorrhage and increased maternal morbidity. The abnormal crossing point of placenta with uterine layers (endometrium, myometrium & serosa) results in this morbidity and sometimes the placental tissue spreads beyond the uterine dimensions and invades surrounding structures like urinary bladder.[1] This abnormal adherence of placenta is attributed to iatrogenic injury inflicted upon decidua by surgical manipulations and curettage in previous interventions.[2] Placenta accreta spectrum disorders are among the leading causes of massive obstetric hemorrhage with approximately eight liters blood loss on average when done in emergency.[3] The most prevalent risk factor linked to invasive placentation is cesarean delivery.[4] Unfortunately there is a steep and disturbing rise in incidence of morbidly adherent placenta in Pakistani females due to cesarean delivery. It is as high as 41 per ten-thousand patients[5] with mortality escalating up to seven percent.[6]

The timely diagnosis of placenta accreta is very important to prevent perils associated with it. Ultrasonography with color Doppler is the first line imaging modality for diagnosis. The presence of lacunae in the scar tissue, absence of hypoechoic interface behind placenta and loss of interface between myometrium and urinary bladder and presence of bridging vessels are ultrasonographic features suggestive of morbid placentation with sensitivity reaching to a hundred percent[7] in some settings. However, there are still some counterfeits associated with ultrasonographic diagnosis, magnetic resonance imaging has also been used in selected cases.[8] The use of imaging modality along with clinical indices seems promising. Placenta accreta index is a novel standardized tool which incorporates both ultrasonographic parameters and clinical factors to make antenatal diagnosis of placenta accreta.[9]

Placenta accreta index (PAI) for diagnosis of placenta accreta spectrum disorders in Combined Military Hospital Quetta has been recently employed. The present study aims to correlate it with maternal

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Received: 30 Apr 2023; revision received: 13 Nov 2023; accepted: 19 Dec 2023

outcomes to assess its reliability and efficacy in a resource limited setting. The results of this study will help in streamlining peri-operative management of patients with PAS disorders.

METHODOLOGY

The prospective longitudinal study was conducted at Combined Military Hospital (CMH) Quetta for a duration of one year. The ethical committee of CMH Quetta granted its permission through ERC# CMH QTA-IERB/05/2023. After addressing ethical concerns, data collection was done. As the prevalence of placenta accreta is very low 0.0029[10] therefore we collected data retrospectively and prospectively over a period of one year.

Inclusion Criteria: Gravid ladies aged between 20 to 45 years in their third trimester of pregnancy who had history of at least one cesarean delivery, low lying placenta in ongoing pregnancy or suspicion of placenta previa or accreta on obstetric ultrasound were included consecutively.

Exclusion Criteria: Primigravida and un-booked patients who came in emergency were excluded.

All the patients were booked through out-patient department of Obstetrics and Gynecology department of CMH Quetta. Detailed history was taken from all patients followed by abdominal examination. The patients who met the inclusion and exclusion criteria were informed about the purpose of study and their written informed consent was taken. Obstetric ultrasound was done to locate placenta in all patients. The suspicion of placenta accreta spectrum was made on initial obstetric ultrasonography if placenta was visualized within two centimeters of internal orifice of uterus or there were any of these features: bridging vessels, neovascularity on uterine serosa/ bladder wall, presence of atypical lacunae, placental bulge into scar or cervix, absence of retro placental hypo echoic interface or myometrial thinning[11].

The recruited patients were sent to department of radiology for ultrasound scan. The radiology department was requested to comment on presence of placental lacunae, myometrial thinning, location of placenta and bridging vessels for calculation of placenta accreta index (PAI). All the ultrasounds were done by single radiologist with 10 years' post-fellowship experience to address the possible bias generated by inter-observer variability. The placenta accreta index was calculated based on radiological findings including following parameters: The number of cesarean sections in the past, presence or absence of lacunae, myometrial thinning, anteriorly lying placenta previa and presence or absence of bridging vessels[12] (Table-I). On the basis of PAI three morbidly adherent placenta (MAP) patient categories were defined: Low risk (PAI 0-3), Medium risk (PAI 4-5) and High risk (PAI 6-9) as shown in Table-II. The primary maternal outcome was cesarean hysterectomy. The secondary outcomes were Post-Partum Hemorrhage (PPH), Intra Uterine Balloon Tamponade[13], B-Lynch Suture[14], Uterine Artery Ligation[15], Internal Iliac Artery Ligation[16], Bladder Injury. Maternal Death, Red Cell Concentrate transfused and Operative Time. Post Partum Hemorrhage (PPH) was defined as cumulative blood loss of greater than five hundred milliliters with in twenty-four hours after birth with following classification: Mild PPH (500ml to 1000ml), Moderate PPH (1001ml to 2000ml) and Severe PPH (>2000ml)[17].

The data was analyzed using Statistical Package of Social Science (SPSS) version 26. Quantitative and qualitative variables were segregated. Mean±SD was computed for quantitative variables and frequency along with percentages were computed for qualitative variables. Cross tabs were used to compare outcomes with MAP Categories and chi-square analysis was used to obtain *p*-value. The statistical significance was considered significant if the *p* value was equal to or <0.05

Table-I: Placenta Accreta Index (PAI)

Parameter		Score
Cesarean Section	<2	0
	>2	3.0
Placental Lacunae	Grade 3	3.5
	Grade 2	1.0
	Grade 1	0
Myometrial thinning	≤ 1mm	1.0
	<1 & ≥ 3mm	0.5
	>3 mm & ≤ 5mm	0.25
Anterior placenta previa		1.0
Bridging vessels		0.5

Table-II: Morbidly Adherent Placenta (MAP) Categories of patients on Basis of Placenta Accreta Index (PAI)

Map Category	Placenta Accreta Index(Pai)
Low Risk	0-3
Medium Risk	4-5
High Risk	6-9

RESULTS

Thirty patients completed study protocol. The demographic parameters of all patients were

corresponding. The mean age of patients in the study group was 29.33±4.48 years. The mean body mass index (BMI) of participants was 30.80±2.60. The mean gestational age was 35.90±1.44 weeks with minimum gestational age to be 30 weeks and maximum gestational age to be 38 weeks. There were 4(13.3%) para one, 15(50%) para two, 6(20%) para three and 4(16.7%) para four patients in the study group. 21(70%) patients had history of greater than two previous cesarean sections and 9(30%) had fewer than two lower segment cesarean sections in the past. 19(63.3%) patients had mild post-partum hemorrhage (PPH), 9(30.0%) had moderate PPH and 2(6.7%) had major PPH. The demographics of different MAP categories are also presented in Table-I. The most common surgical intervention was intra-uterine balloon tamponade which was done in 18(60%).

B-Lynch suture was applied in 17(56.7%) patients; uterine artery ligation was done in 4(13.3%) patients and internal iliac artery ligation was done in 3(27.3%) medium risk patients and 8(61.5%) high risk patients. No internal iliac artery ligation was done in low risk patients (*p* value <0.010). No bladder injury or maternal death was reported in all cases therefore these are not mentioned in tabulated form. The mean operative time in low risk patients was 49.17±5.84 minutes, 49.55±5.68 in medium risk patients and 75.77±10.33 in high risk patients.

Intrauterine balloon tamponade and B-lynch suture were sufficient for 6(100%) low risk patients and the bleeding settled with it (*p* value 0.009). Eight (72.7%) medium risk were successfully managed with these two interventions while in 3(27.3%) medium risk patients placenta was delivered with ease and no intervention was required (*p* value 0.003) , 4(36.4%) high risk patients were managed with intrauterine balloon tamponade along with B-Lynch suture (*p* value (<0.003). However, in two patients the intrauterine balloon tamponade and B-lynch didn't prove successful, and hysterectomy was performed.

Uterine artery ligation was done in only 1(16.7%) low risk and 1(9.1%) medium risk and 2(15.4%) high risk patients with *p* value 0.871. Cesarean hysterectomy was done in none of the low risk and medium risk patients (*p* value <0.001). However, it was done in 11(84.6%) high risk patients with *p* value of <0.001 which means that MAP score corresponded to the maternal outcome. The comparison of maternal outcomes with regard to MAP categories is given in Table-IV.

PPH was mild in all 6(100%) low risk patients. There was no moderate or severe PPH in low risk patients. PPH was mild in 8(72.7%) medium risk patients, moderate in 2(18.2%) medium risk patients and severe in only one (9.1%) medium risk patients. PPH was high risk patients (*p* value<0.092). There was no Moderate PPH is any low risk patient. Moderate PPH was observed in 7(53.8%) high risk and severe PPH was observed in one (7.7%) high risk patient (*p* value <0.04) as presented in Table-V.

DISCUSSION

The findings of this study indicate that the placenta accreta index (PAI) is a reliable indicator of placenta accreta spectrum disorders with a reasonable efficacy as the placenta accrete index greater than 6 corresponded to cesarean hysterectomy. The preparation of operative equipment, arrangement of blood products and counseling of attendants is far easier when the diagnosis is made with level heading accuracy.

Obstetricians are always baffled by the mayhem of placenta accreta and they keep searching for ways to prevent and counter its damages. A scoring system is a modality which always appeals to practicing obstetricians as it can aid diagnosis and timely management of this dreadful condition which can salvage health resources and shield precious lives. The quest for dependable scoring systems for diagnosis of accreta spectrum disorders is still ongoing and has led to development of a few models and scoring systems. Placenta accreta index (PAI) which is focus of our study is a simple score which can be calculated with ease. It reliably correlated with the maternal outcomes in our study. There are also few others scoring systems apart from PAI but each of them has its own merits and demerits.

Tobvin *et al*.[18] developed a scoring system for diagnosis of placenta accreta in 2016. They used grey scale sonographic parameters (dimension and number of lacunae, location of placenta, loss of interface between uterine and placental membranes) and doppler assessment (flow velocity in lacunae and vascularity) to diagnose abnormal placentation. Each parameter was given zero, one or two points. The score of 8 to 12 had highest probability of placental adherence and sensitivity of approximately ninety three percent. They started their screening in second and third trimester. They suggested the option of normal delivery for low probability patients and cesarean delivery for moderate to high risk patients.

Table-III: The Demographics of Study Group with Respect to MAP Categories (n=30)

Parameter		Total (n=30) Mean±SD	Low Risk (n=6) Mean±SD	Medium Risk (n=11) Mean±SD	High Risk (n=13) Mean±SD
Age (Years)		29.33±4.48	26.17±2.56	29.91±3.88	29.91±3.88
Bmi (Kg/M2)		30.80±2.60	31.21±3.89	31.48±2.36	31.48±2.36
Gestational Age (Weeks)		35.90±1.44	36.50±0.837	36.50±0.83	35.64±2.36
Operative Time (Minutes)		60.83±15.43	49.17±5.84	49.55±5.68	75.77±10.33
		Frequency(%)(n=30)	Frequency(%)(n=6)	Frequency(%)(n=11)	Frequency(%)(n=13)
Parity	1	4(13.3)	3(50.0)	-	1(7.7)
	2	15(50.0)	1(16.0)	2(63.6)	7(53.8)
	3	6(20.0)	2(33.3)	2(18.2)	2(15.4)
	4	5(16.7)	-	2(18.2)	3(23.1)
Frequency Of Cesarean Sections	<2	9(30.0)	6(100.0)	1(9.1)	2(15.4)
	>2	21(70.0)	0(0)	10(90.9)	11(84.6)

Table-IV: The Comparison Of MAP Categories With Maternal Outcomes (n=30)

Maternal Outcomes		MAP CATEGORIES			
		Low risk N (%) (n=6)	Medium risk N(%) (n=11)	High risk N (%) (n=13)	*p*-value
Intrauterine Balloon Temponade	Yes	6(100.0)	8(72.7)	4(30.8)	<0.003
	No	0(0)	3(27.3)	9(69.2)	
B_Lynch	Yes	6(100.0)	7(63.6)	4(30.8)	<0.005
	No	0(0)	4(36.4)	9(69.2)	
Uterine Artery Ligation	Yes	1(16.7)	1(9.1)	2(15.4)	0.865
	No	2(83.3)	10(90.9)	11(84.6)	
Cesarean Hystrectomy	Yes	0(0)	0(0)	11(84.6)	<0.001
	No	6(100.0)	11(100.0)	2(15.4)	
Internal Iliac Artery Ligation	Yes	0(0)	3(27.3)	8(61.5)	<0.001
	No	6(100.0)	8(72.7)	5(38.5)	

The assessment of severity of placental adherence was left to discretion and of surgeon. Surgeons took this decision on basis of their clinical acumen and per-operative findings. The presence of extensive placental adherence was diagnosed in all cases by operative surgeon and not by the radiologists. The scoring thus served only as rough guide to suggest the possibility of placenta accreta. The need for a tool which could give a reliable pre-emptive diagnosis to guide surgical intervention would have been a better option.

Table-V: Frequency of Post-Partum hemorrhage (PPH) with respect to Morbidly adherent placenta (MAP) Categories of Participants (n=30)

Map categories	Low risk N (%) (n=6)	Medium risk N (%) (n=11)	High risk N (%) (n=13)	*p*-value
Mild pph	6(100.0)	8(72.7)	5(38.5)	0.04
Moderate pph	0(0)	2(18.2)	7(53.8)	
Major pph	0(0)	1(9.1)	1(7.7)	

In an effort to find a reliable tool for diagnosis of placenta accreta, Fard *et al*.[19] conceived a sonographic model to predict placenta accrete spectrum. They did research on almost three hundred patients, two third of them were at high risk for developing placenta accrete and one third had established placenta accrete spectrum. They used transabdominal ultrasonography, transvaginal ultrasonography and color doppler to visualize lacunae, presence of swiss-cheese morphology, loss of interface between placental tissue and uterine tissue or bladder, marked thinning of uterine layers, neovascularity of uterine serosa and bladder wall and presence of bridging vessels. They also checked velocities of flow to confirm the existence of aberrant connection of feeding vessels with lacunae and high velocity cutoff was 15 centimeters per second. They focused on last trimester for detailed radiological examination in most patients. They summed up their sonograohic findings and suggested that the presence of three signs had hundred percent reliability in diagnosing placenta accreta. These findings were grade two and three lacunae, loss of interface with bladder and increased vascularity. However, they did not add any clinical index in their model. They simplified the diagnosis, but they relied

on radiologist's expertise for diagnosis. Moreover, they didn't classify the severity of placental adherence. We correlated PAI to different outcomes and were able to devise a reasonably clear management strategy.

Mahalingam *et al*., performed a retrospective research study on sixty gravid ladies.[20] To develop a clinico-radiological score for antenatal diagnosis of placenta accreta spectrum disorders on basis of magnetic resonance imaging. They assigned score of one to each of the eight clinical and imaging (MRI) findings. The findings on magnetic resonance imaging were obtained by both T2 and T1 weighted sequences. They categorized the final scores into three possibilities that are low, moderate and high. The prevalence of placenta accreta corresponded reasonably well in high risk and low risk group that is 90% and 3%. They established that myometrial thinning had maximum sensitivity and focal uterine bulge had maxim specificity and accuracy of both was same that is 90%. We focused on ultrasonography as it accurate and cost effective.[21] Ultrasonography is quick, less invasive and comfortable for claustrophobic patients. It is a simple and practical approach for our resource limited setup and has proved to be consistent in predicting maternal outcome.

LIMITATIONS OF STUDY

The retrospective and prospective study design was used as some data was collected in retrospection due to low prevalence of the disease. The paradoxically high number of patients is because, CMH Quetta is a referral hospital functioning in a remote province of Pakistan and most of the patients are referred due to presence of multidisciplinary team of doctors. Transvaginal ultrasound was not used as it is not acceptable to all patients. MRI was not a focus of study as it has higher costs.

ACKNOWLEDGEMENT

We are obliged to the department for their help and support in materializing this project.

CONCLUSION

Placenta accreta index (PAI) can reliably identify patients who are at high risk of having morbidly adherent placenta and adverse outcomes. This scoring system can assist obstetricians in timely counseling of patients and attendants, effective pre-operative planning and timely intervention to reduce maternal morbidity and mortality.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

FSK & BK: Data acquisition, data analysis, critical review, approval of the final version to be published.

KSA & MA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

SJ & SU: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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