Original Article

Prenatal Detection of Invasive Placentation on Colour Doppler Ultrasound in Patients with Previous Caesarean Delivery

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Abstract

Objective: To determine the diagnostic accuracy of Color Doppler ultrasound in diagnosing invasive placentation/morbidly adherent placenta in patients with previous cesarean section keeping per-operative finding as gold standard.

Material And Methods: This descriptive cross-sectional study was conducted at department of Diagnostic Radiology, Combined Military Hospital Lahore from 04/10/2017 to 03/04/2018. Two hundred and thirteen pregnant women aged between 20-40 years having history of at least 1 previous C-section presenting for antenatal scan after 28 weeks of gestation. Color Doppler ultrasound was performed to diagnose invasive placenta while the diagnosis was confirmed later upon surgery which was taken as gold standard and results of color Doppler ultrasound were judged accordingly. Data was collected via study proforma and analyzed by SPSS version 20.

Results: The mean age of the patients was 31.7±4.7 years while the mean gestational age at presentation was 32.2±2.1 weeks. The average of parity was 3.3±1.2 Out of all 61.5% women had 1, 28.6% women had 2 and 9.9% women had 3 previous C-section. Invasive placenta was labeled in 24.9% patients on color Doppler ultrasound while the diagnosis of invasive placentation was confirmed in 22.1% patients per operatively. It increased significantly with increasing number of previous C-sections; 1 vs. 2 vs. (p-<0.001). As per cross-tabulated the color Doppler ultrasound showed 87.23% sensitivity, 92.77% specificity and 91.55% accuracy in the diagnosis of invasive placenta with positive and negative predictive values of 77.36% and 96.25% respectively taking surgical findings as gold standard.

Conclusion: It was concluded that the morbidly adherent placenta increased with increasing number of previous C-sections and color Doppler ultrasound was found to be extremely sensitive and specific tool in its diagnosis which advocate its preferred use in future practice.

Key Words: Cesarean Section, Morbidly Adherent Placenta, Color Doppler Ultrasound

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Introduction

Pakistan is one of those very few countries having alarmingly high maternal morbidity and mortality where maternal mortality ratio (MMR) is 340/100,000 live births and these statistics are among the worst in the world.[1]

Invasive placentation/morbidly adherent placenta is nowadays becoming a major cause of maternal morbidity and mortality as it may result in emergency hysterectomy and life-threatening peri/postpartum bleeding, contributing to about 6-7% of maternal deaths.[2] One of the major risk factors for invasive placentation is previous caesarean section deliveries, i.e. more the number of previous caesarian deliveries more the risk.[3] Invasive placentation/morbidly adherent placenta is a spectrum of conditions, characterized by an abnormal adherence of the placenta to the myometrium to the implantation site with an incidence of 1 per 533 deliveries and its prevalence is up to 24% in patients with history of previous caesarian section delivery.[4-6] Other risk factors for invasive placentation are placenta previa, previous uterine surgery, myomectomy, dilatation and curettage, advanced maternal age & uterine anomalies.[2] With current trends to deliver more babies by caesarian section, the

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incidence of invasive placentation/morbidly adherent placenta has increased up to 10 folds over last 50 years.[7] Invasive placentation may result in serious life-threatening complications such as amniotic fluid embolism, vesicovaginal fistula formation, damage to adjacent organs, postoperative thromboembolism, acute respiratory distress syndrome, consumptive coagulopathy and multisystem organ failure.[8] Accurate prenatal diagnosis is mandatory to prevent such grave complications.[9] There are three types of invasive placentation/morbidly adherent placenta, defined on the basis of the depth of myometrial invasion by chorionic villi. Ultrasound and color doppler are primary tools for the prenatal diagnosis of invasive placentation.[10] The ultrasonographic gray scale findings include: presence of abnormal placental lacunae, loss of retroplacental sonolucent zone and anterior myometrial thinning (thickness less than 1mm) during 3rd trimester and disruption of hyperechoeic serosa-bladder interface.[2,5]

While color doppler features of invasive placentation are: (l) diffuse/ local lacunae with turbulent blood flow (2) sonolucent vascular lakes with turbulent flow typified by high velocity (>15 cm/s) (3) hyper vascularity of uterine-bladder interface (4) gap in the myometrial blood flow/vessels bridging from placenta to uterine margins (5) markedly dilated vessels over peripheral sub placental region.[2,7] For diagnosis of invasive placentation color Doppler ultrasound has more sensitivity (90.74%) and specificity (87.68%).[4] But variation is also noted in literature regarding sensitivity and specificity of color Doppler ultrasound with sensitivity ranging from 33-100% and specificity ranging from 50-96% depending on study type.[3,8,9]

The rationale of this study is that with increasing trend towards caesarean section than the spontaneous vaginal deliveries in Pakistan; risk of invasive placentation in subsequent pregnancies has undoubtedly increased, which affects the prevalence of this condition and in turn creates variation in positive predictive value of color Doppler ultrasound. Other important aspect that should be considered is that most of the deliveries occur at home with no surgical backup facilities, the chances of adverse outcomes become more acute. Antenatal diagnosis of this condition will ensure that the delivery is performed in hospital to obviate complications & the goal to reduce maternal mortality/morbidity can be achieved. This will also lessen the burden over the already exhausted health system of Pakistan. Very little local data is available regarding morbidly adherent placenta therefore this study on the basis of its different prevalence in our population.

Methodology

Combined Military Hospital Lahore. Duration of study was 6 months after the approval of synopsis from 04/10/2017 to 03/04/2018. Sample size of 213 cases was calculated with 95% confidence level, and taking expected percentage of invasive placentation i.e. 24.0% [6] and sensitivity of Doppler ultrasound i.e. 90.74% with 8% margin of error and specificity of Doppler ultrasound i.e. 87.68% with 8% margin of error taking surgical findings as gold standard (4). Patients were selected by Non-Probability, Consecutive Sampling. All the cases with previous history of caesarian section, age 20-40 years, Gravida >1, gestational age> 28 weeks (on ultrasound and single pregnancy were included. All the cases with maternal bleeding disorders and placenta abruption were excluded. After the written and informed consent demographic data was noted and Color Doppler Ultrasound was performed by consultant radiologist with at least 5 years' experience in Color Doppler Ultrasound. Sonographic findings were recorded in predesigned proforma by principal investigator and findings were written in patients antenatal file so the operating gynecologist/ obstetrician may be aware of similar findings and he or she put per-operative findings too, latter on per-operative findings were recorded from surgical notes on research proforma. Data was kept confidential so no one accessed that and at the end of study results were discussed with study participants on demand. All the expenses related with study were borne by researcher herself. All the collected data was entered and analyzed through SPSS version 20.0.

Results

The mean age of the study subjects was 31.7±4.7 years and mean gestational age was 32.2±2.1 weeks, mean of parity was 3.3±1.2. 131 (61.5%) women had 1 CS, 61 (28.6%) women had 2 CS and 21 (9.9%) women had 3 previous C-section. Table I

Invasive placenta was labeled in 53 (24.9%) patients on color Doppler ultrasound while the diagnosis of invasive placentation was confirmed in 47 (22.1%) patients per operatively as shown in Table II. When stratified the frequency of surgically confirmed invasive placenta, there was no statistically significant difference across age (p-value=0.969) and parity (p-value=0.898) groups. However, it increased significantly with increasing

number of previous C-sections; 1 vs. 2 vs. 3 (9.9% vs. 34.4% vs. 61.9%; p-value<0.001) as shown in Table III.

Table I: Baseline characteristics of study sample (n=213)

Variables		Statistics
Age (years)		31.7±4.7 years
Gestational Age (weeks)		32.2±2.1
Parity	≤3	106 (49.8%)
	>3	107 (50.2%)
Previous C-Section	1	131 (61.5%)
	2	61 (28.6%)
	3	21 (9.9%)

Table II: Diagnosis of Invasive Placentation on various Modalities (n=213)

Diagnostic Modality	Invasive Placenta		Total
	Yes	No	
Color Doppler USG	53 (24.9%)	160 (75.1%)	213 (100.0%)
Surgical Findings	47 (22.1%)	166 (77.9%)	213 (100.0%)

Table III: Stratification of Surgically Confirmed Invasive Placentation across various Subgroups (n=213)

Characteristics	N	Invasive Placenta N (%)	P value
Age (years)			
20-30 years	72	16 (22.2%)	0.969
31-40 years	141	31 (22.0%)	
Parity			
≤3	106	23 (21.7%)	0.898
>3	107	24 (22.4%)	
Previous C-Section			
1	131	13 (9.9%)	<0.001*
2	61	21 (34.4%)	
3	21	13 (61.9%)	

When cross-tabulated the results of color Doppler ultrasound with those of surgical findings, there were 41 true positive, 154 true negative, 12 false positive and 6 false negative cases which yielded 87.23% sensitivity, 92.77% specificity and 91.55% accuracy for color Doppler ultrasound in the diagnosis of invasive placenta with positive and negative predictive values of 77.36% and 96.25% respectively taking surgical findings as gold standard.. Similar diagnostic performance was observed across various age and parity groups. It however increased with increasing number of previous C-sections due to increase in the prevalence of invasive placenta in such patients.

Discussion

Morbidly adherent placenta is a spectrum of conditions, characterized by an abnormal adherence of the placenta to the myometrium at the implantation site (2). Recent literature claimed color Doppler ultrasound to be an accurate tool for the diagnosis of MAP. However, the available evidence contained conflicting results due to hardware and operator dependent nature of color Doppler ultrasound and variability of ultrasonographic criteria used for the diagnosis which necessitated the present study. In the present study, the mean age of the patients was 31.7±4.7 years. Naz et al.[10] reported similar mean age of 31.4±4.9 years among pregnant women diagnosed of invasive placenta at Civil Hospital, Karachi. Abdel Moniem et al.[11] reported similar mean age of 31.2±4.8 years among such women in Kuwait (128) while Rac et al.[5] and Bowman et al.[12] reported it to be 31.6±5.2 years and 32.4±5.2 years respectively in American such women. In this study the mean gestational age at diagnosis was 32.2±2.1 weeks. Naz et al.[10] reported similar mean gestational age of 31.8±2.7 weeks at the time of diagnosis of invasive placenta at Civil Hospital, Karachi while Shoukat et al.[13] observed it to be 34.3±1.8 weeks at Allied Hospital, Faisalabad. A similar mean gestational age has been observed by Rac et al.[5] and Bowman et al[12]. Among American such women at the time of diagnosis of invasive placenta and reported it to be 33.8±3.0 weeks and 33.0±2.7 weeks respectively.

In the present study, invasive placenta was confirmed in 47 (22.1%) patients per operatively. A similar frequency of invasive placenta has been reported by Cali et al.[6] (2013) who reported it to be 21.9%. Abdel Moniem et al.[11] reported the frequency of invasive placenta to be 22.0% in Kuwaiti women with history of previous C-section while El Behery et al.[14] reported it to be 20.0% in Egypt. A similar frequency of invasive placenta has been reported by Chou et al.[15] who reported it to be 21.3%.

We observed that the frequency of invasive placentation increased significantly with increasing number of previous C-sections (p-<0.001). A similar increase in frequency of invasive placentation with increasing number of previous C-sections has been reported by Hull et al.[16] who reported it to be 11.0%, 40.0% and

61.0% in women with 1, 2 and 3 or more C-sections respectively.

In the present study, we observed that color Doppler ultrasound was 87.23% sensitive, 92.77% specific and 91.55% accurate in the diagnosis of invasive placenta with positive and negative predictive values of 77.36% and 96.25% respectively taking surgical findings as gold standard. Our results are similar to those of Shoukat et al.[13] who reported similar sensitivity and specificity of 87% and 90% respectively at Allied Hospital, Faisalabad. Esakoff et al.[17] in USA reported similar sensitivity of 89% and specificity of 91%. In another American study, Levine et al.[18] reported sensitivity and specificity of 86% and 92% respectively. Thus we observed that the frequency of morbidly adherent placenta increased with increasing number of previous C-sections and color Doppler ultrasound was an extremely sensitive and specific tool in its diagnosis which advocate its preferred use in future practice. A very strong limitation to the present study was that we didn't stratify the results for various ultrasonographic criteria used for the diagnosis of MAP to determine the reliability of every individual criterion which could have helped in the selection of more appropriate ultrasonographic feature in the diagnosis of MAP. Such a study is definitely required and is highly recommended in future research.

Conclusion

In the present study, the frequency of morbidly adherent placenta increased with increasing number of previous C-sections and color Doppler ultrasound was found to be extremely sensitive and specific tool in its diagnosis which advocate its preferred use in future practice.

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