

DETERMINE THE DIAGNOSTIC ACCURACY OF TRANSABDOMINAL COLOR DOPPLER ULTRASOUND FOR DIAGNOSING PLACENTA ACCRETA TAKING PER OPERATIVE (CESAREAN SECTION) FINDINGS AS GOLD STANDARD

Shazia Alam, Capt. Rahat Shahid

Department of Radiology, PNS Shifa Hospital, Karachi, Pakistan.

PJR January - March 2014; 24(1): 06-11

ABSTRACT

OBJECTIVE: The objective of this study was to determine the diagnostic accuracy of transabdominal color Doppler ultrasound for diagnosing placenta accreta taking per operative (cesarean section) findings as gold standard. **MATERIAL AND METHOD:** This was a cross sectional survey which was conducted in the Department of Radiology, PNS Shifa, Karachi. The duration of study was 06 months (07-01-14 to 02-06-14 and 01-07-14 to 07-08-14). The study cohort included 270 women who had their transabdominal color Doppler ultrasound in our section as routine obstetrical survey. **RESULTS:** In our study, out of 270 cases, 52.96% (n=143) were between 20-30 years and 47.04% (n=127) were between 31-40 years of age, mean \pm sd was calculated as 28.94 ± 5.03 years. Frequency of placenta accreta on the gold standard was recorded in 38.15% (n=103). Transabdominal Color Doppler Ultrasound for diagnosing placenta accreta showed that 29.26% (n=79) were true positive, 5.93% (n=16) were false positive, 8.89% (n=24) were false negative and 55.93% (n=151) were true negative, while sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate were calculated as 76.70%, 90.42%, 83.16%, 90.42 and 85.19% respectively. **CONCLUSION:** We determined a higher diagnostic accuracy of transabdominal color Doppler ultrasound for diagnosing placenta accreta taking per operative (cesarean section) findings. It is recommended that this diagnostic modality for evaluation of potentially life threatening obstetric disorder is useful.

Key words: Placenta accreta, diagnosis, color Doppler ultrasound, diagnostic accuracy

Introduction

Placenta accreta is one of the major predisposing factors for massive obstetric hemorrhage and leading cause of pregnancy-related deaths.¹ With the increasing rate of cesarean delivery, the incidence of both placenta previa and placenta accreta is steadily increasing in frequency.^{2,3}

We therefore anticipate more cases of placenta accreta in our obstetric practice. In several recent series, placenta accreta has emerged as the major

indication for peripartum hysterectomy, accounting for 40–60% of cases,³ Given the significant morbidity and mortality associated with placenta previa accreta, antepartum diagnosis is important to allow the obstetrician to properly prepare for management of associated complications.^{3,4}

Gray-scale ultrasound (US) and Doppler imaging have been shown to be effective imaging strategies for the detection of placenta accreta when applied to a clinically high-risk population, such as those with prior uterine surgery or placenta previa.⁶

Correspondence : Dr. Capt. Rahat Shahid
Assistant Professor,
Department of Radiology,
PNS Shifa Hospital, Karachi.
Email: r66rao@yahoo.com

Submitted 24 January 2015, Accepted 28 January 2015

Sonographic features of placenta accreta include loss of the normal retroplacental clear space, anomalies of the bladder-myometrium interface, prominent placental lacunae, and increased vascularity at the interface of the uterus and bladder.^{5,6} Color Doppler ultrasound has been suggested to aid in the diagnosis of placenta accreta because it highlights abnormal areas of hyper-vascularity with dilated blood vessels within the placental and uterine tissues.^{6,7}

Previously Chou MM and co-workers⁸ evaluated the efficacy of transabdominal color Doppler ultrasound in diagnosing placenta accreta and recorded 87.5% as positive predictive value, the sensitivity of color Doppler imaging in the diagnosis of placenta accreta was 82.4% and the specificity was 96.8%, while another recent study by Shih JC et al⁶ revealed 47% positive predictive with 92% sensitivity and 69% specificity, followed for diagnosing placenta accreta which shows a significant difference between the two studies. Another limitation of the above study was that they did not calculate the diagnostic accuracy of the technique.

The rationale of the study is that the data regarding sensitivity, specificity is significantly variant while diagnostic accuracy in the above studies is not calculated which needs this study to be done so that positive predictive value and diagnostic accuracy in our population may be determined, which will be helpful for making decision to use this diagnostic modality for evaluation of potentially life threatening obstetric disorder.

The objective of this study was to Determine the diagnostic accuracy of transabdominal color Doppler ultrasound for diagnosing placenta accreta taking per operative (cesarean section) findings as gold standard.

Material and Method

This was a cross sectional survey conducted in the Department of Radiology, PNS Shifa, Karachi. The study duration was 06 months (07-01-14 to 02-06-14 and 01-07-14 to 07-08-14).

It is estimated as 270 patients using 95% confidence level, with an expected percentage of sensitivity 92% with margin of error, specificity 69% with 6% margin of error taking an expected percentage of placenta accreta as 40%. The sampling technique was non-probability purposive. The inclusion criteria were: all pregnant female patients diagnosed as placenta previa between 20 to 40 yrs of age with a parity: 2-5 (on history), patients with ≥ 28 weeks of gestation (on dating scan), patient with history of previous LSCS or any kind of intrauterine instrumentation. (on history and medical record) or patients with history of antepartum bleeding. (on history). While patients with any coexistent placental pathology with placenta previa e.g. submucosal fibroid (on history and medical record) were excluded from study.

Operational Definitions

PLACENTA ACCRETA: Placenta accreta is an abnormal attachment of part or all of placenta to the uterine wall. It was determined in patients with ≥ 28 weeks of gestation on color Doppler ultrasound by using following criteria:

- Placental lacunae with turbulent blood flow and;
- Hyper vascularity of serosa-bladder interface

While an abnormal attachment of part or all of placenta to the uterine wall on per operative findings was considered as placenta accreta.

TRUE POSITIVE:

Cases which are having placenta accreta on both: Color Doppler Ultrasound and Cesarean delivery

FALSE POSITIVE:

Cases which are having placenta accreta on Color Doppler Ultrasound but not on Cesarean delivery

TRUE NEGATIVE:

Cases which are negative for placenta accreta on both Color Doppler and Cesarean Delivery

FALSE NEGATIVE:

Cases which are negative for placenta accreta on Color Doppler Ultrasound and positive on Cesarean Delivery

All patients fulfilling the inclusion criteria were selected referred from Obs and Gynae department for ultrasonography to Department of Radiology PNS Shifa Hospital Karachi. Informed consent was taken from the patients to take their data in the study. The demographic information like age, gestational age and parity were recorded. Color Doppler Ultrasonography according to departmental protocols was performed using Toshiba Sonographic Unit (Nimio) using 7.5 MHz convex probe. Sonographic criteria for presence/absence of placenta accreta (according to operational definitions) were interpreted independently by the researcher under supervision of Senior Consultant and findings were confirmed by consultation with peroperative findings from relevant obstetricians. All information was collected through specially designed proforma (Annexure).

Data Analysis

The data was entered in SPSS version 20.0. Quantitative variable like age, gestational age was calculated as mean \pm SD. Frequency and percentage were calculated for presence / absence of placenta accreta on Doppler and peroperatively. A 2x2 table was constructed to determine the following by taking per operative findings as gold standard:

Color Doppler Ultrasound	PER OPERATIVE FINDINGS (CESAREAN DELIVERY)	
	POSITIVE	NEGATIVE
POSITIVE	TRUE POSITIVE (a)	FALSE POSITIVE (b)
NEGATIVE	FALSE NEGATIVE (c)	TRUE NEGATIVE (d)

$$\text{Sensitivity} = \frac{a}{a+c} \times 100$$

$$\text{Specificity} = \frac{d}{d+b} \times 100$$

$$\text{Positive Predictive Value} = \frac{a}{a+b} \times 100$$

$$\text{Negative Predictive Value} = \frac{d}{c+d} \times 100$$

Results

A total of 270 cases fulfilling the inclusion/exclusion criteria were enrolled to determine the diagnostic accuracy of transabdominal color Doppler ultrasound for diagnosing placenta accreta taking per operative (cesarean section) findings as gold standard.

Age distribution of the patients was done which shows that 52.96% (n=143) were between 20-30 years and 47.04% (n=127) were between 31-40 years of age, mean+sd was calculated as 28.94 \pm 5.03 years. (Tab. 1)

Age (in years)	No. of patients	%
20-30	143	52.96
31-40	127	47.04
Total	270	100

Table 1: Age Distribution (n=270)
mean \pm sd: 28.94 \pm 5.03

Gestational age of the patients was done which shows that 34.81% (n=94) were between 29-36 weeks of gestation and 65.19% (n=176) were between 37-40 weeks of gestation, mean \pm sd was calculated as 38.65 \pm 3.54 weeks. (Tab. 2)

Gestational Age (in Weeks)	No. of patients	%
29-36	94	34.81
37-40	176	65.19
Total	270	100

Table 2: Gestational Age (n=270)
mean \pm sd: 38.65 \pm 3.54

Frequency of placenta accreta on gold standard was recorded in 38.15% (n=103) while 61.85% (n=167) had no findings of this morbidity. (Tab. 3)

Placenta accreta	No. of patients	%
Yes	103	38.15
No	167	61.85
Total	270	100

Table 3: Frequency of Placenta Accreta on gold standard (n=270)

Diagnostic accuracy of Transabdominal Color Doppler Ultrasound for diagnosing placenta accreta taking per operative (cesarean section) findings as gold standard was recorded in Table No. 4, where 29.26% (n=79) were true positive, 5.93% (n=16) were false positive, 8.89% (n=24) were false negative and 55.93% (n=151) were true negative, sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate was calculated as 76.70%, 90.42%, 83.16%, 90.42 and 85.19% respectively. (Tab. 4)

Color Doppler Ultrasound	Operative findings (Cesarean delivery)	
	POSITIVE	NEGATIVE
Positive	True positive (a) 79 (29.26%)	False positive (b) 16 (5.93%)
Negative	False negative (c) 24 (8.89%)	True negative (d) 151 (55.93%)
Total	a + c 103 (11.59%)	b + d 167 (88.41%)

Table 4: Diagnostic accuracy of transabdominal color doppler ultrasound for diagnosing placenta accreta taking per operative (cesarean section) findings as gold standard (n=270)

$$\text{Sensitivity} = \frac{a}{a+c} \times 100 = 76.70\%$$

$$\text{Specificity} = \frac{d}{d+b} \times 100 = 90.42\%$$

$$\text{Positive Predictive Value} = \frac{a}{a+b} \times 100 = 83.16\%$$

$$\text{Negative Predictive Value} = \frac{d}{c+d} \times 100 = 90.42\%$$

$$\text{Accuracy rate} = \frac{a + d}{a + d + b + c} \times 100 = 85.19\%$$

Discussion

Placenta accreta is the abnormal implantation of the placenta into the uterine wall, and it complicates around 0.9% of all the pregnancies. Clinical risk factors include placenta previa and prior uterine surgery, including cesarean delivery.⁹⁻¹⁰ Prenatal diagnosis of placenta accreta has historically been difficult. The accuracy of sonography using gray scale and color Doppler techniques for prenatal diagnosis of placenta accreta varies widely in different studies. Its sensitivity has been reported as anywhere between 33% and 100%, and the specificity also varies widely.¹¹⁻¹⁶

We planned this study to determine the data regarding sensitivity, specificity is significantly variant which needs to be clear and helpful for making decision to use this diagnostic modality for evaluation of potentially life threatening obstetric disorder.

In our study, out of 270 cases, 52.96% (n=143) were between 20-30 years and 47.04% (n=127) were between 31-40 years of age, mean \pm sd was calculated as 28.94 ± 5.03 years. Frequency of placenta accreta on gold standard was recorded in 38.15% (n=103). Diagnostic accuracy of Transabdominal Color Doppler Ultrasound for diagnosing placenta accreta shows that 29.26% (n=79) true positive, 5.93% (n=16) were false positive, 8.89% (n=24) were

false negative and 55.93% (n=151) were true negative, sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate was calculated as 76.70%, 90.42%, 83.16%, 90.42 and 85.19% respectively.

We found similar findings with Chou MM and co-workers⁸ who evaluated the efficacy of trans-abdominal color Doppler ultrasound in diagnosing placenta previa accrete and recorded 87.5% as positive predictive value, the sensitivity of color Doppler imaging in the diagnosis of placenta previa accreta was 82.4% and the specificity was 96.8%. Our findings are contrast with a study by Shih JC et al⁶ who revealed 47% positive predictive which is less than calculated in our study, however, in our study diagnostic accuracy rate was calculated as 85.19% of the patients which was not ruled out in the above study.

Another study evaluated the efficacy of trans-abdominal color Doppler ultrasound in diagnosing placenta accreta and recorded that out of the 64 patients with negative color Doppler imaging results, three had placenta accreta, while two required cesarean hysterectomy; the remaining patient underwent uterine artery ligation for bleeding from the lower uterine segment. The sensitivity of color Doppler imaging in the diagnosis of placenta accreta was 82.4% (14/17) and the specificity was 96.8% (61/63). The positive and negative predictive values were 87.5% (14/16) and 95.3% (61/64), respectively, our findings are closely in agreement with the above study.

Finberg and Williams¹⁷ found that gray-scale ultrasound had a sensitivity of 93% (14/15) and a specificity of 79% (15/19) in the diagnosis of placenta accreta, our results are slightly improved as compare to their findings.

The sensitivity and specificity of color Doppler imaging for diagnosing placenta accreta, especially anterior placenta accreta, have been high, because abnormal uteroplacental hypervascularity caused by the angiogenesis of placental invasion can be detected with a high level of confidence. Lerner and colleagues¹⁸ reported the sensitivity as 100% (5/5) and the specificity as 94% (15/16). Levine and colleagues¹⁹ found that color Doppler imaging had a sensitivity of 86% (6/7) and a specificity of 92% (11/12). Our transabdominal color Doppler diagnostic

efficacy was comparable with that of previous reports. Color Doppler evaluation of a placenta accreta has not been shown to have superior sensitivity to gray-scale B mode sonographic evaluation. However, the advantages that color Doppler ultrasound provide are a greater specificity in the diagnosis of placenta accreta and a better assessment of the depth of myometrial or serosal invasion.²⁰


Our findings are helpful for making decision to use this diagnostic modality for evaluation of potentially life threatening obstetric disorder.

Conclusion

We determined a high diagnostic accuracy of transabdominal color Doppler ultrasound for diagnosing placenta accreta taking per operative (cesarean section) findings. It is recommended that this diagnostic modality should be used for evaluation of this potentially life threatening obstetric disorder in cases with previous caesarian section.

References

1. Japaraj RP, Mimin TS, Mukudan K. Antenatal diagnosis of placenta previa accreta in patients with previous cesarean scar. *J Obstet Gynaecol Res* 2007; **33(4)**: 431-7.
2. Dwyer BK, Belogolovkin V, Tran L, Rao A, Carroll I, Barth R, Chitkara U. Prenatal diagnosis of placenta accreta: sonography or magnetic resonance imaging? *J Ultrasound Med*. 2008; **27(9)**: 1275-81.
3. Doumouchtsis SK, Arulkumaran S. The morbidly adherent placenta: an overview of management options. *Acta Obstet Gynecol Scand* 2010; **89(9)**: 1126-33.
4. Oyelese Y, Smulian JC. Placenta previa, placenta accreta, and vasa previa. *Obstet Gynecol* 2006; **107(4)**: 927-41.
5. Ferrazzani S, Guariglia L, Triunfo S, Caforio L, Caruso A. Conservative management of placenta previa-accreta by prophylactic uterine arteries ligation and uterine tamponade. *Fetal Diagn Ther* 2009; **25(4)**: 400-3.
6. Shih JC, Palacios Jaraquemada JM, Su YN, Shyu MK, Lin CH, Lin SY. Role of three dimensional power Doppler in antenatal diagnosis of placenta accrete. Comparison of gray scale and color Doppler Ultrasound *Obstet Gynecol*. 2009; **33(2)**: 193-203.
7. Tikkanen M, Paavonen J, Loukovaara M, Stefanovic V. Antenatal diagnosis of placenta accreta leads to reduced blood loss. *Acta Obstet Gynecol Scand* 2011; **90(10)**: 1140-6.
8. Chou MM, Ho ES, Lee YH. Prenatal diagnosis of placenta previa accreta by transabdominal color Doppler ultrasound. *Ultrasound Obstet Gynecol* 2000; **15(1)**: 28-35.(for rationale).
9. 69 Gielchinsky Y, Rojansky N, Fasouliotis SJ, Ezra Y. Placenta accreta - summary of 10 Years: a Survey of 310 Cases. *Placenta*. 2002; **23**: 210-4.
10. Miller DA, Chollet JA, Goodwin TM. Clinical risk factors for placenta previa-placenta accreta. *Am J Obstet Gynecol*. 1997; **177**: 210-4.
11. Lam G, Kuller J, McMahon M. Use of magnetic resonance imaging and ultrasound in the antenatal diagnosis of placenta accreta. *J Soc Gynecol Investig*. 2002; **9**: 37-40.
12. Finberg HJ, Williams JW. Placenta accreta: prospective diagnosis in patients with placenta previa and prior cesarean section. *J Ultrasound Med*. 1992; **11**: 333-43.
13. Levine D, Hulka CA, Ludmir J, Li W, Edelman RR. Placenta accreta: evaluation with color Doppler US, power Doppler US, and MR imaging. *Radiology*. 1997; **205**: 773-6.

-
- 
14. Chou MM, Tseng JJ, Ho ESC. Prenatal diagnosis of placenta previa accreta by transabdominal color Doppler ultrasound. *Ultrasound Obstet Gynecol.* 2000; **15**: 28-35.
 15. Comstock CH, Love JJ, Jr, Bronsteen RA. Sonographic detection of placenta accreta in the second and third trimesters of pregnancy. *Am J Obstet Gynecol.* 2004; **190**: 1135-40.
 16. Wong HS, Zucollo J, Parker S, Burns K, Tait J, Pringle KC. Antenatal diagnosis of non-previa placenta increta with histological confirmation. *Ultrasound Obstet Gynecol.* 2006; **27**: 467-9.
 17. Finberg HJ, Williams JW. Placenta accreta: prospective sonographic diagnosis in patients with placenta previa and prior cesarean section. *J Ultrasound Med* 1992; **11**: 333-43.
 18. Lerner JP, Deane S, Timor-Tritsch IE. Characterization of placenta accreta using transvaginal sonography and color Doppler imaging. *Ultrasound Obstet Gynecol* 1995; **5**: 198-201.
 19. Levine D, Hulka CA, Ludmir J, Li W, Edelman RR. Placenta accreta: evaluation with color Doppler US, power Doppler US, and MR imaging. *Radiology* 1997; **205**: 773-6.
 20. Hudon L, Belfort MA, Broome DR. Diagnosis and management of placenta percreta: a review. *Obstet Gynecol Surv* 1998; **53**: 509-17.