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Transvaginal versus Transabdominal Ultrasonography in Diagnosis of Degree Placental Invasion of Placenta Previa with Previous Cesarean Section Scar

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Abstract: Background: Placenta accreta spectrum (PAS) disorders encompass a heterogeneous group of anomalies characterized by abnormal adhesion or invasion of the trophoblastic tissue into the myometrium. Advances in prenatal imaging techniques and improved knowledge of the natural history of these anomalies have led to an increase in the prenatal detection rate of PAS disorders. Prenatal diagnosis of a PAS disorder is fundamental as it has been shown to reduce the burden of maternal morbidity by allowing preplanned treatment in centers with high expertise in surgical management of this condition. TVS is often recommended to identify the cervical canal, internal os, and the relationship between the leading placental edge and the internal os; it can also be used for a focused evaluation of the lower uterine wall and the bladder interface Histopathology is now widely considered as the gold standard modality recommended to confirm clinical diagnosis of PAS. The aim of our study was to compare between transvaginal and transabdominal ultrasonography in diagnosis of placental invasion in case of placenta previa with previous cesarean scar. **Methods:** Fifty pregnant women with persistent placenta previa (after 28 weeks‟ gestation) were prospectively enrolled into this study. Both trans abdominal and transvaginal ultrasound were performed using the unified descriptors of the European working group and evaluated by TAS and TVS by two different operators who were blinded to the results of each other. The placenta was studied as regarding the site and the degree of invasion and. The ultrasound findings were analyzed with reference to the final diagnosis made during intraoperative evaluation and histopathological examination in case of hysterectomy. **Result:** Cases statistically evaluated in the study were 50 pregnant females with persistent placenta previa, mean age 32.5 years +/- 3 years SD Eleven patients had placenta previa with no abnormal invasion, whereas **thirty Nine** patients had placenta previa with histopathologically confirmed abnormal invasion with all three grades i.e. accreta, increta and percreta, Each one of the unified descriptors was evaluated both transvaginally and transabdominally, And the accuracy of each route in detection of the criterion was evaluated also the accuracy of the assessed criterion in prediction of abnormal placental invasion; the accuracy of detection of the loss of the retroplacental clear zone was 82%by TVS and 52% by TAS, While that of the abnormal placental lacunae was 54 % by TVS and 90% by TAS, Myometrial Thinning detection accuracy was 84% by TVS and 66%by TAS. While the Doppler assessment showed that the accuracy of detection of the uterovesical hypervascularity was 88% by TVS and 86% by TAS. While the detection of vessels in sub placental zone was 52% by TVS and 26% by TAS. with over all accuracy 72% by TVS and 64 % by TAS. **Conclusion:** Transvaginal ultrasound shows higher accuracy than transabdominal ultrasound in diagnosis of normal and abnormal invasive placenta using the unified descriptors of the European working group and transvaginal is safe in diagnosis of normal and abnormal invasive placenta and both transvaginal and transabdominal complementary to each other and this confirmed by intraoperative findings and histopathological findings in case of hysterectomy. **Recommendations:** Further studies should be performed including larger number of patients from more than one center. For further studies we should include MRI for further evaluation of abnormally invasive placenta and for confirming the accuracy of Transvaginal ultrasound.

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Key words: Abnormal invasion, placenta, transabdominal, transvaginal, ultrasound.

1. Introduction

Morbid adherent placenta (M.A.P) occurs when the chorionic villi invade the myometrium abnormally.

It is divided into three grades based on histopathology: placenta accreta where the chorionic villi are in contact with the myometrium, placenta increta where the chorionic villi invade the myometrium, and placenta percreta where the chorionic villi penetrate the uterine serosa [1].

Placenta accrete syndromes include any placental implantation with abnormally firm adherence to myometrium because of partial or total absence of the decidua basalis and imperfect development of the fibrinoid or Nitabuch layer. If the decidual spongy layer is lacking either partially or totally, then the physiologic line of cleavage is absent and some or all cotyledons are densely anchored [2].

The surface area of the implantation site involved and the depth of trophoblastic tissue in growth are variable between women, but any abnormally adherent placenta can potentially cause significant hemorrhage[3].

Placenta accrete may lead to massive obstetric hemorrhage, resulting in such complications as disseminated intravascular coagulopathy, need for hysterectomy, surgical injury to the ureters, bladder, and other viscera, adult respiratory distress syndrome, renal failure, and even death. The average blood loss at delivery in women with placenta accreta is 3,000–5,000 mL [4].

In the presence of a placenta previa, the risk of having placenta accreta increased from 24% in women with one prior cesarean delivery to 67% in women with 3 or more prior cesareans [5,6].

In Egypt, Placenta accreta became prevalent mainly due to increased number of cesarean sections and multiparity (National Institutes of Health Consensus Development Conference Statement) [7].

In developed countries, placenta previa, associated accrete, is the most common indication for hysterectomy. This is due to the rising incidence of these conditions associated with the increasing number of women previously delivered by Cesarean section. Hysterectomy is used to stem sometimes-frightening hemorrhage associated with placenta previa in the majority of hospitals [5,8].

Woman who have had cesarean section in a previous pregnancy and who subsequently have placenta previa should be considered at high risk of having a morbidly adherent placenta. In such cases, particular attention should be focused on confirming or excluding the diagnosis using ultrasound imaging[9].

Unfortunately, some cases of placenta accreta are diagnosed at the time of delivery when the mother experiences continued vaginal bleeding, or heavy vaginal bleeding [10].

It is important to make the diagnosis of placenta accreta prenatally because this allows effective management planning to minimize morbidity. This diagnosis is usually made by ultrasonography or magnetic resonance imaging (MRI). Placenta accreta should be suspected in women who have both a placenta previa and a history of cesarean delivery or other uterine surgery [11].

Vigilance is particularly indicated when the placenta is anterior and overlies the cesarean scar. The sonographic features suggestive of placenta accreta These include irregularly shaped placental lacunae (vascular spaces) within the placenta, thinning of the myometrium overlying the placenta, loss of the retroplacental “clear space,” protrusion of the placenta into the bladder, increased vascularity of the uterine serosa bladder interface, and, on Doppler ultrasonography, turbulent blood flow through the lacunae [12,13].

Several studies have demonstrated the usefulness of ultrasonography in making this diagnosis, particularly at more than 20 weeks' gestation [14].

Prenatal diagnosis of abnormally invasive placentation (AIP) is commonly accomplished by ultrasound during the second and third trimester of pregnancy and has been shown to have an overall good diagnostic accuracy, especially when a combination of maternal characteristics and imaging signs are integrated into an individualized diagnostic algorithm [15].

Intra- and post-surgical outcomes of women affected by AIP are directly related to the depth and topography of placental invasion with cases affected by placenta percreta and/or showing parametrial invasion being at the highest risk of morbidity [16].

The actual performance of ultrasound in detecting the severity of placental uterine invasion remains elusive. Furthermore, adding transvaginal Ultrasound (TVS) exam using grey scale and Doppler parameters to transabdominal ultrasound TAS reported to improve the accuracy of prenatal diagnosis of abnormally invasive placenta [17].

Aim of the Work

The aim of the current study was to compare between transvaginal and transabdominal ultrasonography in diagnosis of placental invasion in case of placenta previa with previous cesarean scar.

2. Patients and Method

This study was conducted at department of obstetrics and gynecology at Tanta university hospital.

Inclusion criteria:

Pregnant women aged from about 18 to 35 years old

- Placenta previa after 28 weeks of gestation till end of delivery.
- Previous Caesarian Section.
- Who accepted to be enrolled in this study?

- Were hemodynamically stable at the time of the ultrasound examination.

Exclusion criteria:

- **Patient** with unscarred uterus, and
- **Patients** who were hemodynamically unstable

Sample Size patients:

Fifty pregnant women aged from about 18 to 35 years old diagnosed with persistent placenta previa (after 28 weeks' gestation till end of delivery), with history of previous cesarean Section surgery were prospectively enrolled into this study.

All patients in this study were subjected to the following:

I. **History taking:**

a. Personal (age, duration of marriage, special habits).

b. Menstrual:

i. Last menstrual period (LMP).

ii. Regularity of the cycle (had three regular periods before the last one).

iii. Length of the cycle and amount of flow of the last menstrual period (LMP) will be normal in duration and amount of flow.

iv. Breast feeding at the time of conception.

v. Had not used oral contraceptive pills in the three months proceeded the pregnancy or depot injectable contraception for 6-8 months before the last menstrual period (LMP).

c. Obstetric (number of C.S, abortion, placenta previa in previous pregnancy, History of ectopic, medical disorder with pregnancy and number of living children).

d. Present history of any medical or obstetric problems.

e. Past history of postpartum sepsis, postpartum hemorrhage or chronic diseases.

f. Contraceptive history.

g. Family history.

II. **Clinical examination:** General and obstetric examination.

III. **Investigation:**

Complete blood picture, random blood sugar, liver, renal functions and coagulation profile.

IV. **Ultrasound study:**

- Measurement of fetal biometry.
- Detection of congenital malformation.
- Evaluation of the placenta according to:

1- Placental site.
2- Placental size.
3- Distance from internal oss.
4- Penetration of uterine wall.
5- Malformation.
6- Thickness.

(A)Transabdominal ultrasound:

2D ultrasound system equipped with a 4-8-MHz trans-abdominal transducer. The Examined placenta was considered to be suspicious of abnormal invasion in case of having one or more of the unified descriptors described by the European working Group on Abnormally Invasive Placenta "EW-AIP" [18]

2D grayscale;

1- Loss of clear zone: Loss, or irregularity, of hypoechoic plane in myometrium underneath placental bed (‘clear zone’).

2- Abnormal placental lacunae: Presence of numerous lacunae including some those are large and irregular often containing turbulent flow visible on grayscale imaging.

3- Bladder wall interruption: Loss or interruption of bright bladder wall (hyperechoic band or 'line ' between uterine serosa and bladder lumen).

4- Myometrial thinning: Thinning of myometrium overlying placenta to < 1 mm or undetectable.

5- Placental bulge: Deviation of uterine serosa away from expected plane, caused by abnormal bulge of placental tissue into neighboring organ, typically bladder; uterine serosa appears intact but outline shape is distorted.

6- Focal exophytic mass: Placental tissue seen breaking through uterine serosa and extending beyond it; most often seen inside filled urinary bladder.

2D Color Doppler

1- Uterovesical hypervascularity: striking of amount of color Doppler signal seen between myometrium and posterior wall of bladder; this sign probably indicates numerous, closely packed, tortuous vessels in that region.

2- Subplacental hypervasculiarty: Striking amount of color Doppler signal seen in placental bed; this sign probably indicates numerous, closely packed, Tortuous vessels in that region.

3- Briding vessels: Vessels appearing to extend from placenta. across myometrium and beyond serosa into bladder or other organs; often running perpendicular to myometrium.

(B) Transvaginal ultrasound: 2D ultrasound system equipped with a 12 MHz transvaginal transducer

1) Complete imaging using all diagnostic techniques: (gray-scale, color Doppler) by both transabdominal and transvaginal by two expert operators, then an offline analysis of the acquired images & volumes was done. Ultrasound examination was performed by a highly experienced operator whereas the transabdominal ultrasound was performed by a less experienced one and both were blinded from the results of each other Placenta that was examined while the bladder partially full about 300 ml for adequate visualization and precise localization.

2) Gray-scale B-mode transabdominal sonography: was first used to screen the placenta tissue in a systematic fashion. The imaging paid careful attention to the echogenic patterns of the placenta. Absence of normal subplacental various complex placental sonolucent lakes and/or irregularities of bladder uterine serosa were noted. Color Doppler and Power Doppler Ultrasound scans of the most suspicious regions were performed. Doppler power settings at the level approved for fetal use.

3) Gray-scale B mode and color Doppler transvaginal sonography: were also carried out. A small amount of urine in the urinary bladder aided the evaluation of the uterine and bladder serosa. the lateral view was used to observe the intraplacental vasculature and serosa-bladder complex along the sagittal axis of the maternal pelvis, and the basal view illustrated the serosa-bladder interface in a 90• rotation of the lateral view (observing from the direction of the bladder).

Ethical Consideration:

Agreement for this study was obtained from the hospital's ethical committee; in addition, informed consent was obtained from pregnant women after adequate provision of information regarding the study requirements, purpose and risks.

The study was approved by the Ethics Committee of Faculty of Medicine, Tanta University. There was adequate provisions to maintain privacy of participants and confidentiality of the data.

Statistical analysis

Data were collected, tabulated, statistically analysed using a personal computer with statistical package of social science (SPSS) version and the following results were obtained.

3. Results

During study period, a total of 50 women who met the inclusion criteria were enrolled in the study.

- This study is a prospective study aiming to compare between the role of transabdominal ultrasound vs transvaginal ultarsound in assessment of placental invasion in cases of placenta previa with previous uterine scar applying the unified descriptors suggested by the "EW-AIP" also, to evaluate the sensitivity and specificity and accuracy of each of the descriptors.
- Cases statistically evaluated in this study were 50 pregnant females with persistent placenta previa, mean age 32.5 years +/- 3 years SD. The unified descriptors were evaluated by both transabdominal ultrasound and transvaginal ultrasound. The accuracy of each route in detection of the criterion was evaluated.
- The results of both transabdominal ultrasound and transvaginal ultrasound in each descriptors were statistically analysed with both intraoperative findings and postoperative histopathological examination in case of hysterectomy specimens to evaluate sensitivity, specificity and accuracy of each route.

Table (1): Demographic characteristics and medical history in the studied patients:

		All patients (n= 50)				
		Mean & SD	**Median**	**Minimum**	**Maximum**	**IQR**
Age		30.04 ± 3.06	30.00	20.00	36.00	28.75, 32.00
BMI		30.08 ± 2.05	29.83	26.77	33.77	28.42, 31.63
Occupation	**Housewife**	64.0% (32)				
	Worker	36.0% (18)				
Residency	**Urban**	30.0% (15)				
	Rural	70.0% (35)				
DM		20.0% (10)				
HTN		4.0% (2)				
Data is expressed as mean and standard deviation, median, Minimum, Maximum and Inter-quartile range or percentage and frequency.						

Table (2): Gestational age and number of previous CS in the studied patients:

	All patients (n= 50)				
	Mean & SD	**Median**	**Minimum**	**Maximum**	**IQR**
Gestational age	31.46 ± 2.16	31.00	28.00	35.00	30.00, 34.00
Number of previous CS	2.36 ± 0.83	2.00	1.00	5.00	2.00, 3.00
Data is expressed as mean and standard deviation, median, Minimum, Maximum and Inter-quartile range.					

Table (3): Histopathological types of low-lying placenta in the studied patients:

	All patients (n= 50)	
Previa	11	22.0%
Accreta	19	38.0%
Inccreta	15	30.0%
Perccreta	5	10.0%
Data is expressed as percentage and frequency.		

Table (4): Comparison of Loss of clear zone detection by TAS and TVS compared to histopathology: and intraoperative findings

Loss of clear zone		Histopathology and intraoperative		Kappa	p
		Normal (n= 8)	Abnormal (n= 42)		
TAS	**Normal**	75.0% (6)	52.4% (22)	0.112	0.278
	Abnormal	25.0% (2)	47.6% (20)		
TVS	**Normal**	75.0% (6)	16.7% (7)	0.466	**0.002**
	Abnormal	25.0% (2)	83.3% (35)		
Data is expressed as percentage and frequency. P is significant when < 0.05.					

Table (5): Diagnostic profile of TAS and TVS for diagnosis of Loss of clear zone considering histopathology as the gold standard: and intraoperative findings

Loss of clear zone	TAS	TVS
AUC	0.613	0.792
Sensitivity	47.6%	83.3%
Specificity	75.0%	75.0%
PPV	90.9%	94.6%
NPV	21.4%	46.2%
False positive	2	2
False negative	22	7
Accuracy	52.0%	82.0%

Table (6): Comparison of Abnormal lacunae detection by TAS and TVS compared to histopathology and intraoperative findings

Abnormal lacunae		Histopathology intraoperative findings		Kappa	p
		Normal (n= 6)	Abnormal (n= 44)		
TAS	**Normal**	83.3% (5)	9.1% (4)	0.611	**< 0.001**
	Abnormal	16.7% (1)	90.9% (40)		
TVS	**Normal**	100.0% (6)	52.3% (23)	0.180	**0.033**
	Abnormal	0.0% (0)	47.7% (21)		
Data is expressed as percentage and frequency. P is significant when < 0.05.					

Table (7): Diagnostic profile of TAS and TVS for diagnosis of Abnormal lacunae considering histopathology as the gold standard: and intraoperative findings

Abnormal lacunae	TAS	TVS
AUC	0.871	0.739
Sensitivity	90.9%	47.7%
Specificity	83.3%	100%
PPV	97.6%	100%
NPV	55.6%	20.7%
False positive	1	0
False negative	4	23
Accuracy	90.0%	54.0%

Table (8): Comparison of Myometrial thinning detection by TAS and TVS compared to histopathology: and intraoperative findings

Myometrial thinning		Histopathology and intraoperative findings		Kappa	p
		Normal (n= 10)	Abnormal (n= 40)		
TAS	Normal	30.0% (3)	25.0% (10)	0.045	1
	Abnormal	70.0% (7)	75.0% (30)		
TVS	Normal	100.0% (10)	20.0% (8)	0.615	**< 0.001**
	Abnormal	0.0% (0)	80.0% (32)		
Data is expressed as percentage and frequency. P is significant when < 0.05.					

Table (9): Diagnostic profile of TAS and TVS for diagnosis of Myometrial thinning considering histopathology as the gold standard: and intraoperative findings

Myometrial thinning	TAS	TVS
AUC	0.525	0.900
Sensitivity	75.0%	80.0%
Specificity	30.0%	100.0%
PPV	81.1%	100.0%
NPV	23.1%	55.6%
False positive	7	0
False negative	10	8
Accuracy	66.0%	84.0%

Table (10): Comparison of Uterovesical hypervascularity detection by TAS and TVS compared to and intraoperative findings:

Uterovesical hypervascularity		Intraoperative findings		Kappa	p
		Normal (n= 5)	Abnormal (n= 45)		
TAS	Normal	80.0% (4)	13.3% (6)	0.462	**0.004**
	Abnormal	20.0% (1)	86.7% (39)		
TVS	Normal	60.0% (3)	8.9% (4)	0.434	**0.016**
	Abnormal	40.0% (2)	91.1% (41)		
Data is expressed as percentage and frequency. P is significant when < 0.05.					

Table (11): Diagnostic profile of TAS and TVS for diagnosis of Uterovesical hypervascularity considering intraoperative findings

Uterovesical hypervascularity	TAS	TVS
Sensitivity	86.7%	91.1%
Specificity	80.0%	60.0%
PPV	97.5%	95.3%
NPV	40.0%	42.9%
False positive	1	2
False negative	6	4
Accuracy	86.0%	88.0%

Table (12): Comparison of Sub placental hypervascularity detection by TAS and TVS compared to and intraoperative findings

Sub placental hypervascularity		Intraoperative findings		Kappa	p
		Normal (n= 5)	Abnormal (n= 45)		
TAS	Normal	33.3% (3)	75.6% (31)	-0.203	**0.022**
	Abnormal	66.7% (6)	24.4% (10)		
TVS	Normal	88.9% (8)	56.1% (23)	0.168	0.127
	Abnormal	11.1% (1)	43.9% (18)		
Data is expressed as percentage and frequency. P is significant when < 0.05.					

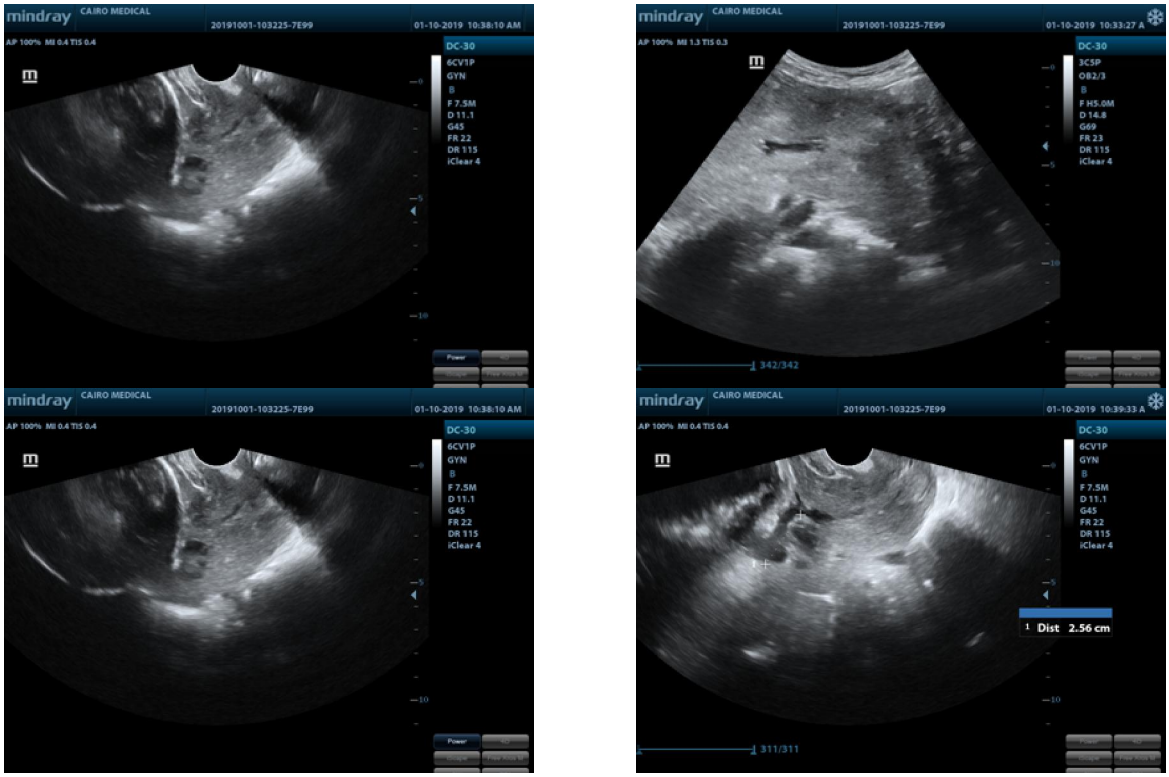
Table (13): Diagnostic profile of TAS and TVS for diagnosis of Sub placental hypervascularity considering: intraoperative findings

Sub placental hypervascularity	TAS	TVS
Sensitivity	24.4%	43.9%
Specificity	33.3%	88.9%
PPV	62.5%	94.7%
NPV	8.8%	25.8%
False positive	6	1
False negative	31	23
Accuracy	26.0%	52.0%

Table (14): Comparison between the overall accuracy of TAS and TVS:

	Transabdominal ultrasound	Transvaginal ultrasound
Sensitivity	64.92%	69.2 %
Specificity	60.32%	84.78%
Positive predictive value	85.92%	96.92%
Negative predictive value	29.78%	38.24%
Accuracy	64%	72%

Case (1)



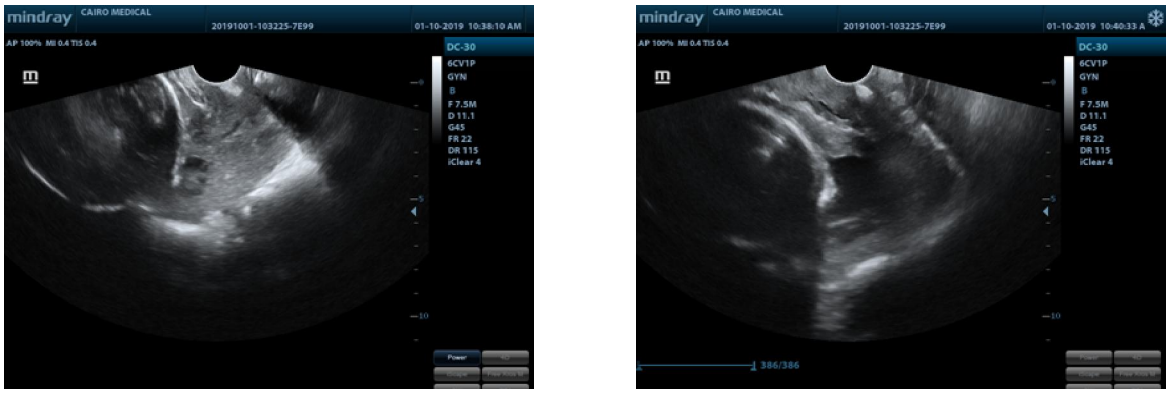
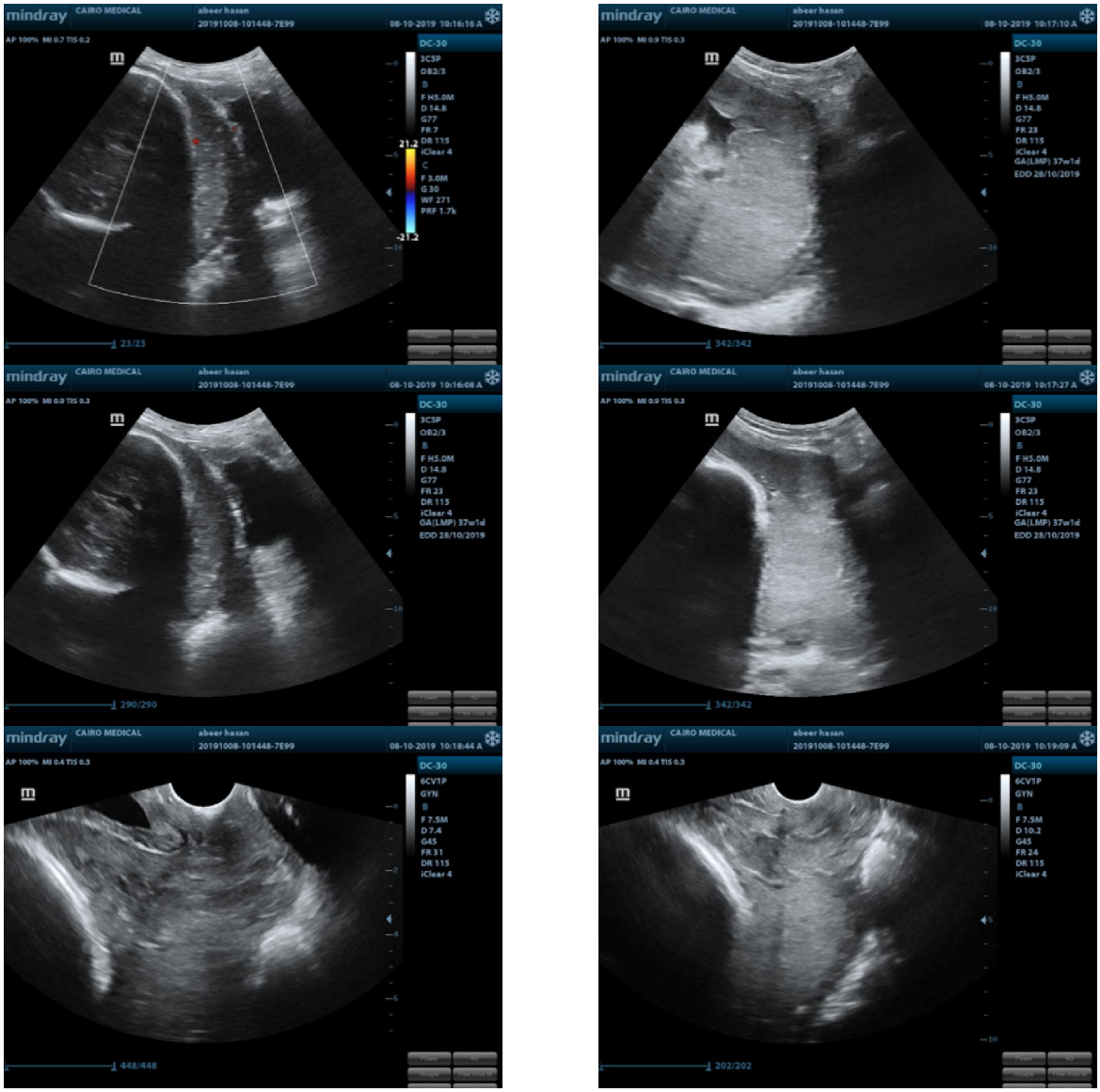


Figure (1): Ultrasound imaging of case 1

Case (2)



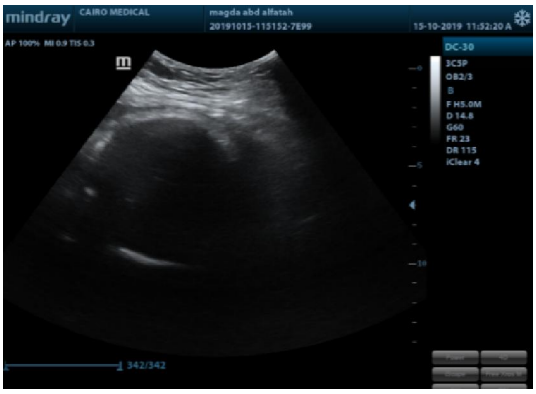


Figure (2): Ultrasound imaging of case 2

Case (3)

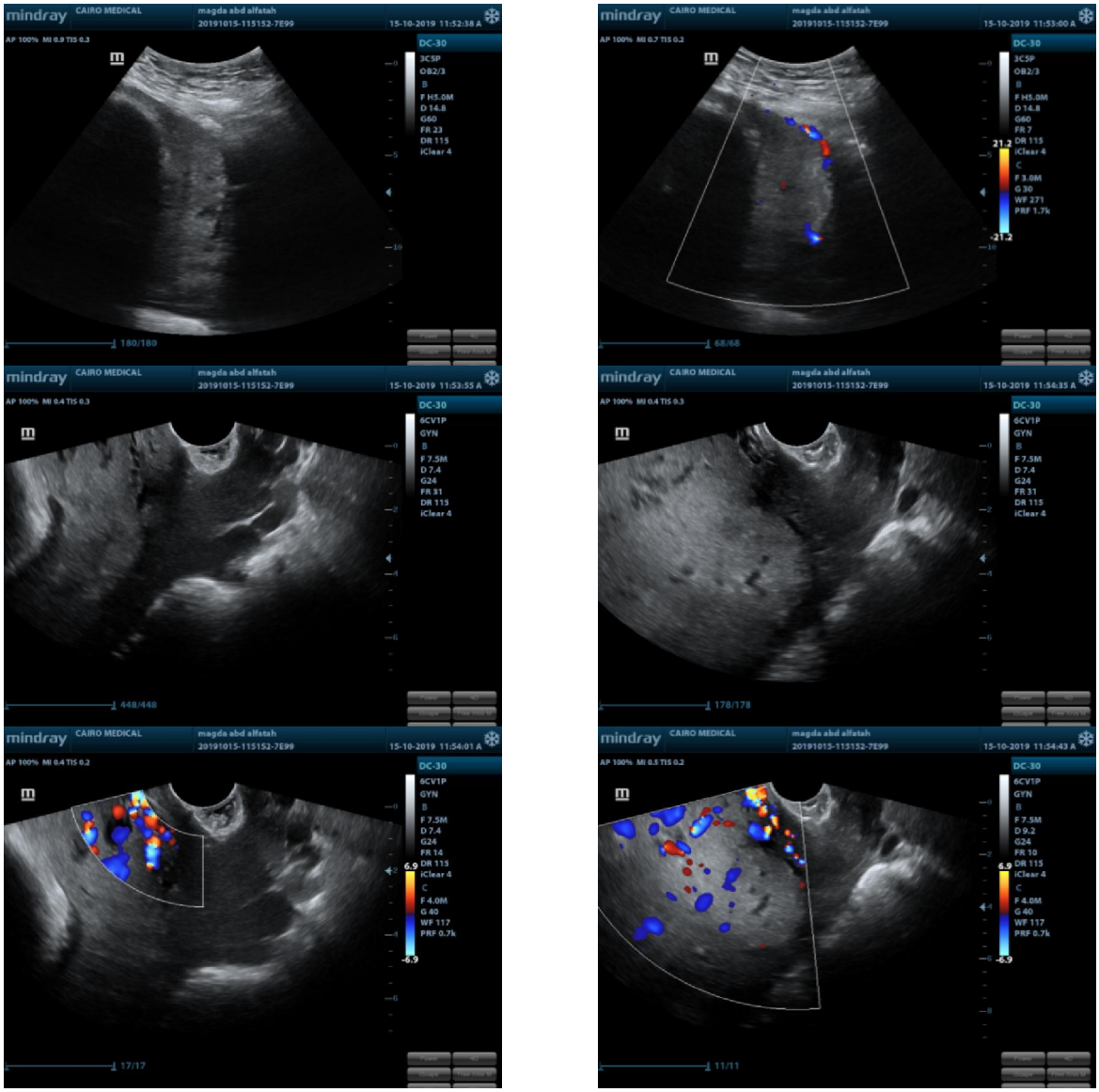


Figure (3): Ultrasound imaging of case 3

Case (4)

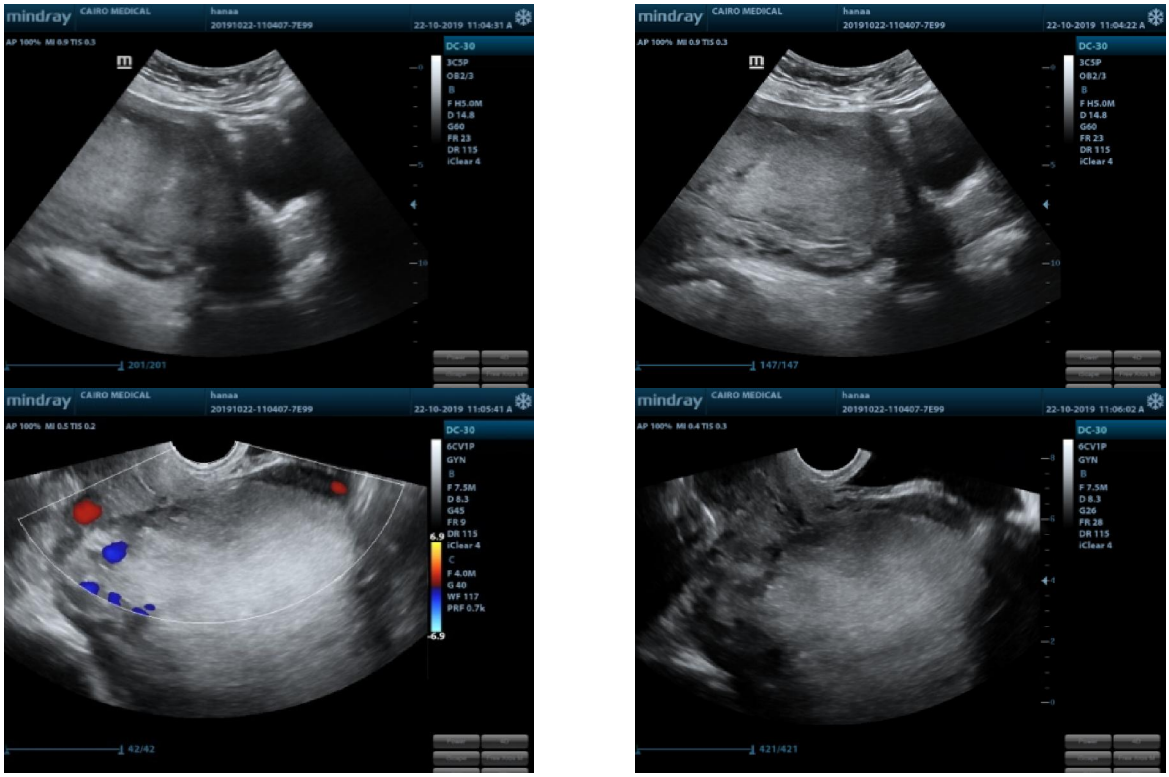
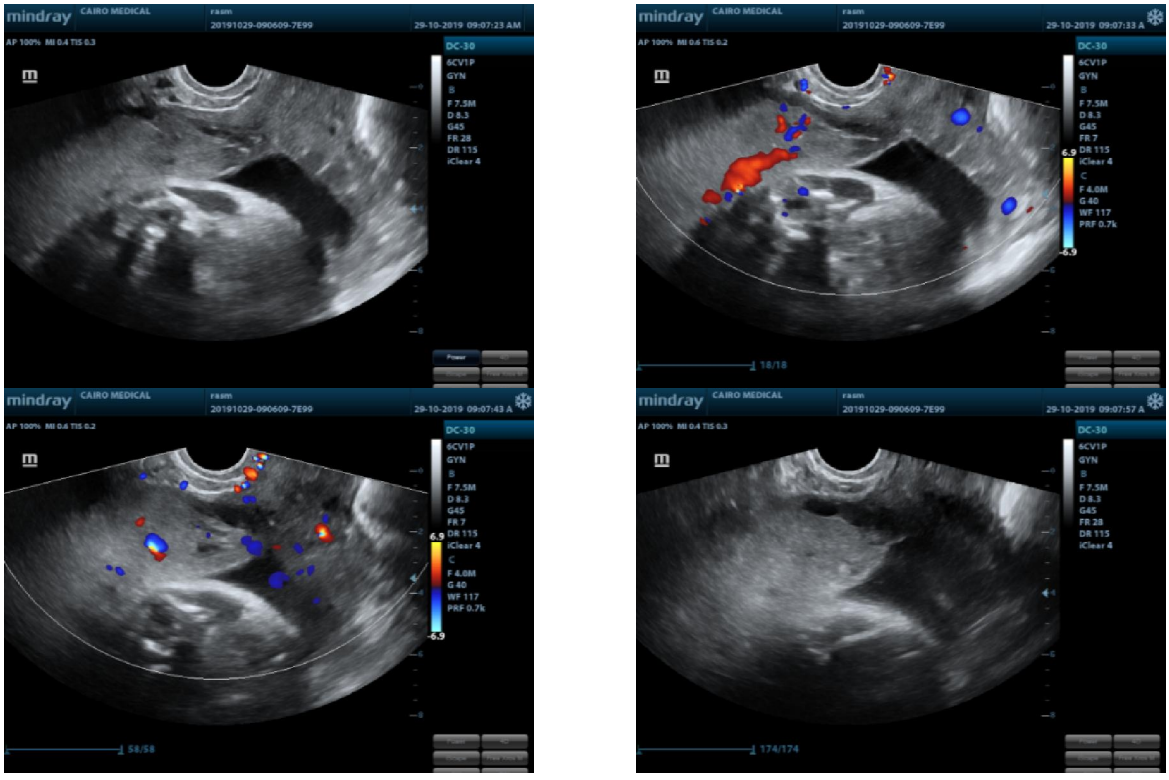


Figure (4): Ultrasound imaging of case 4

Case (5)



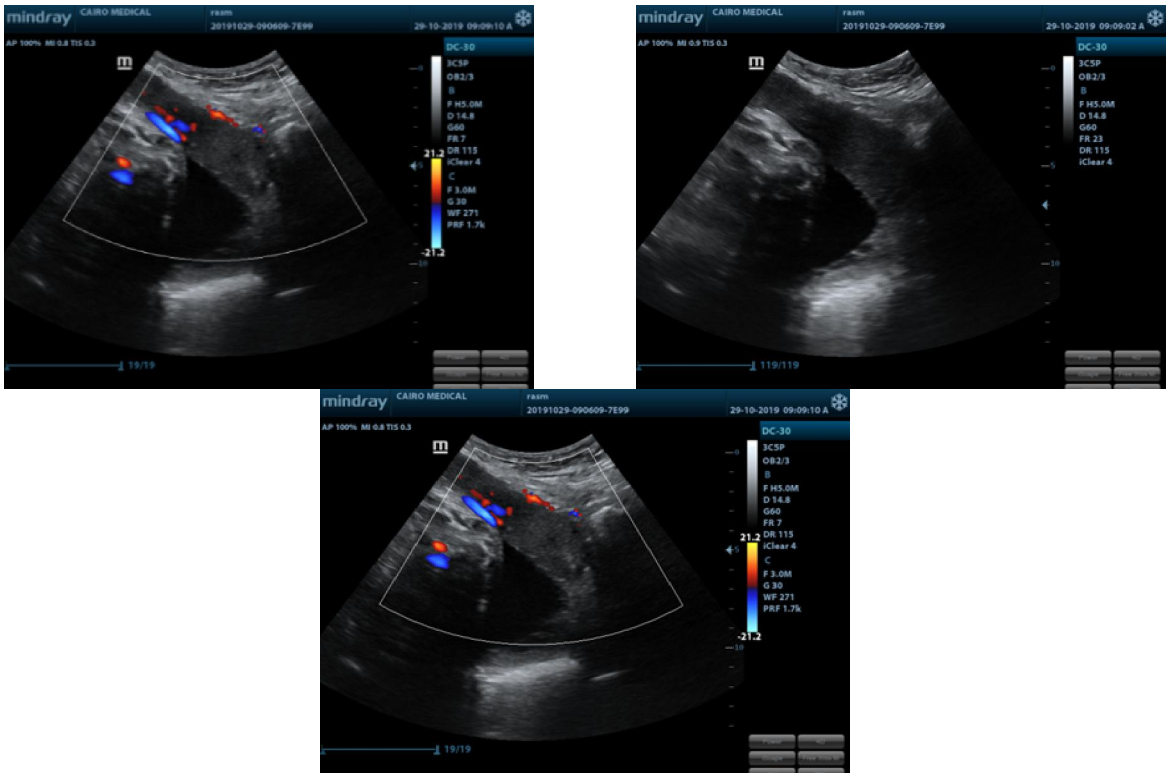
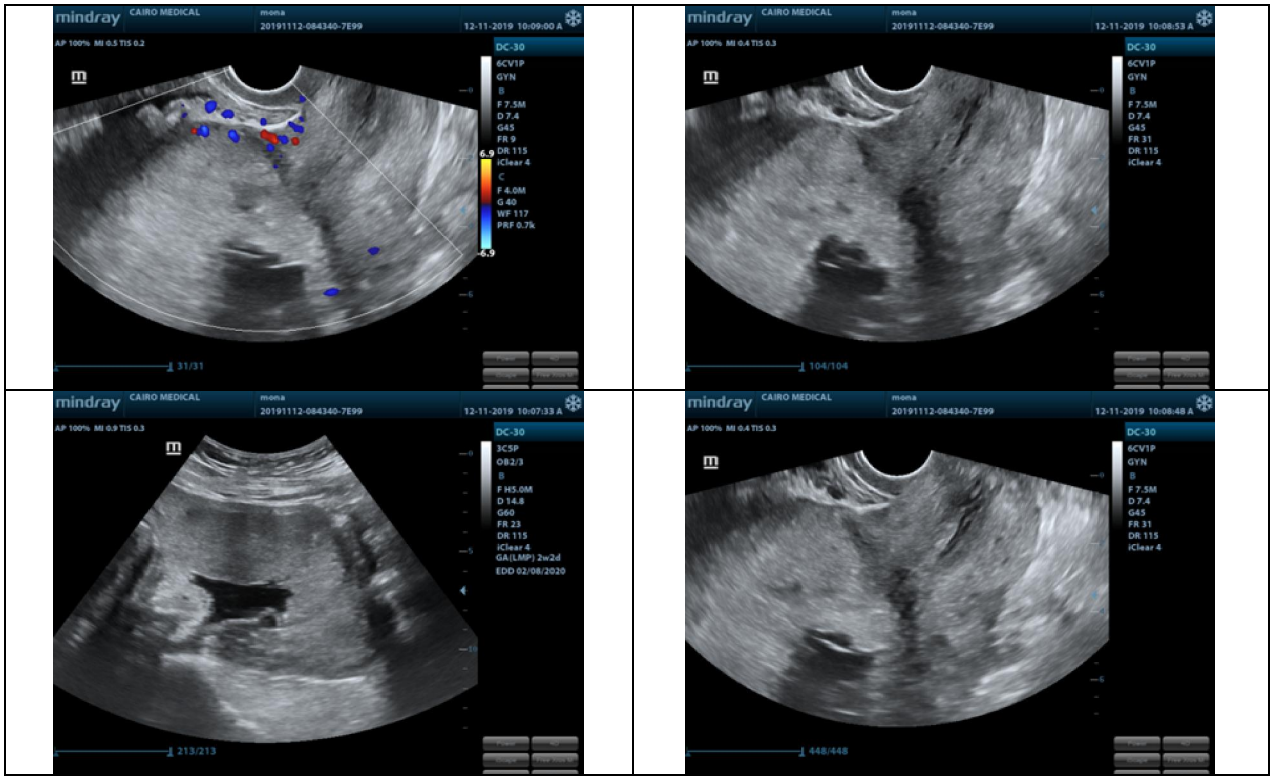


Figure (5): Ultrasound imaging of case 5

Case (6)



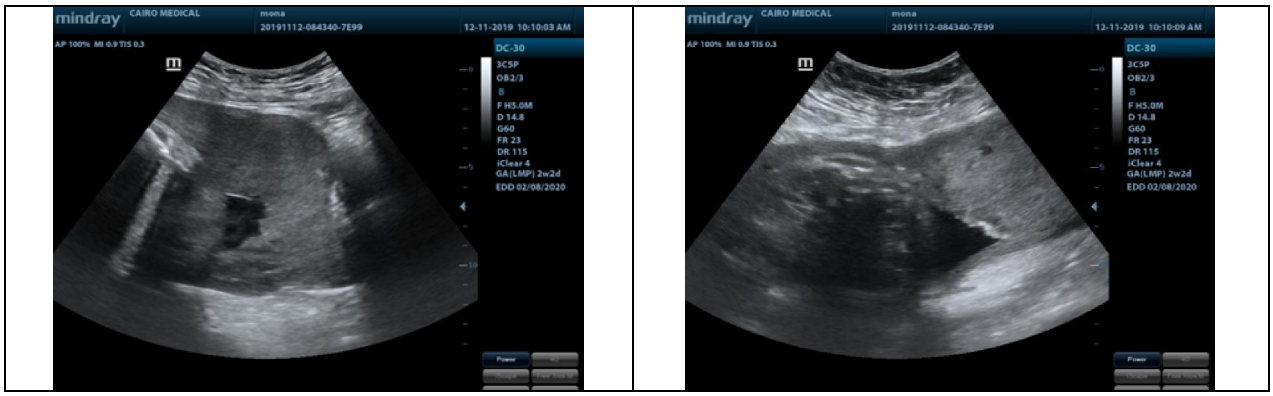


Figure (6): Ultrasound imaging of case 6

Case (7)

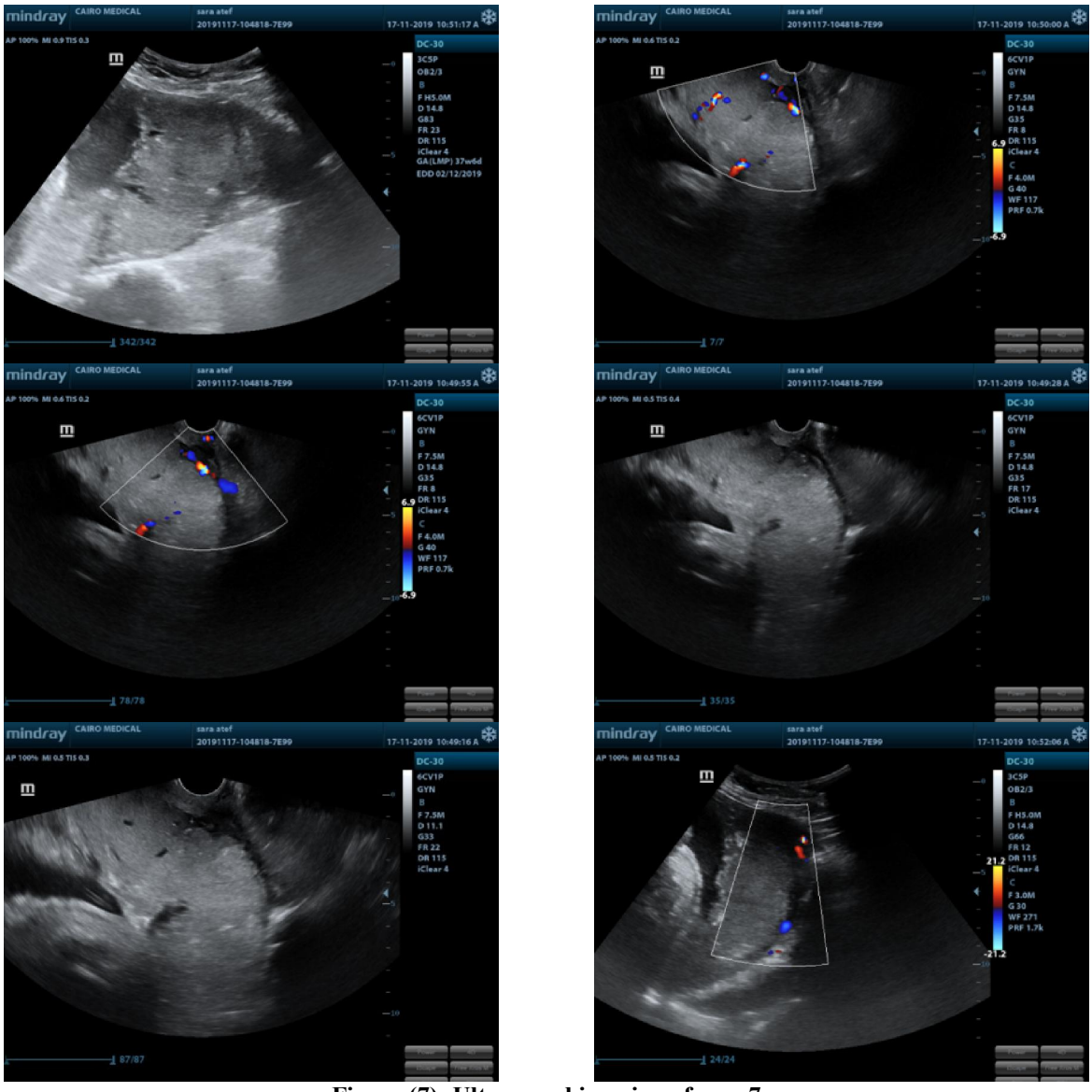


Figure (7): Ultrasound imaging of case 7

Case (8)

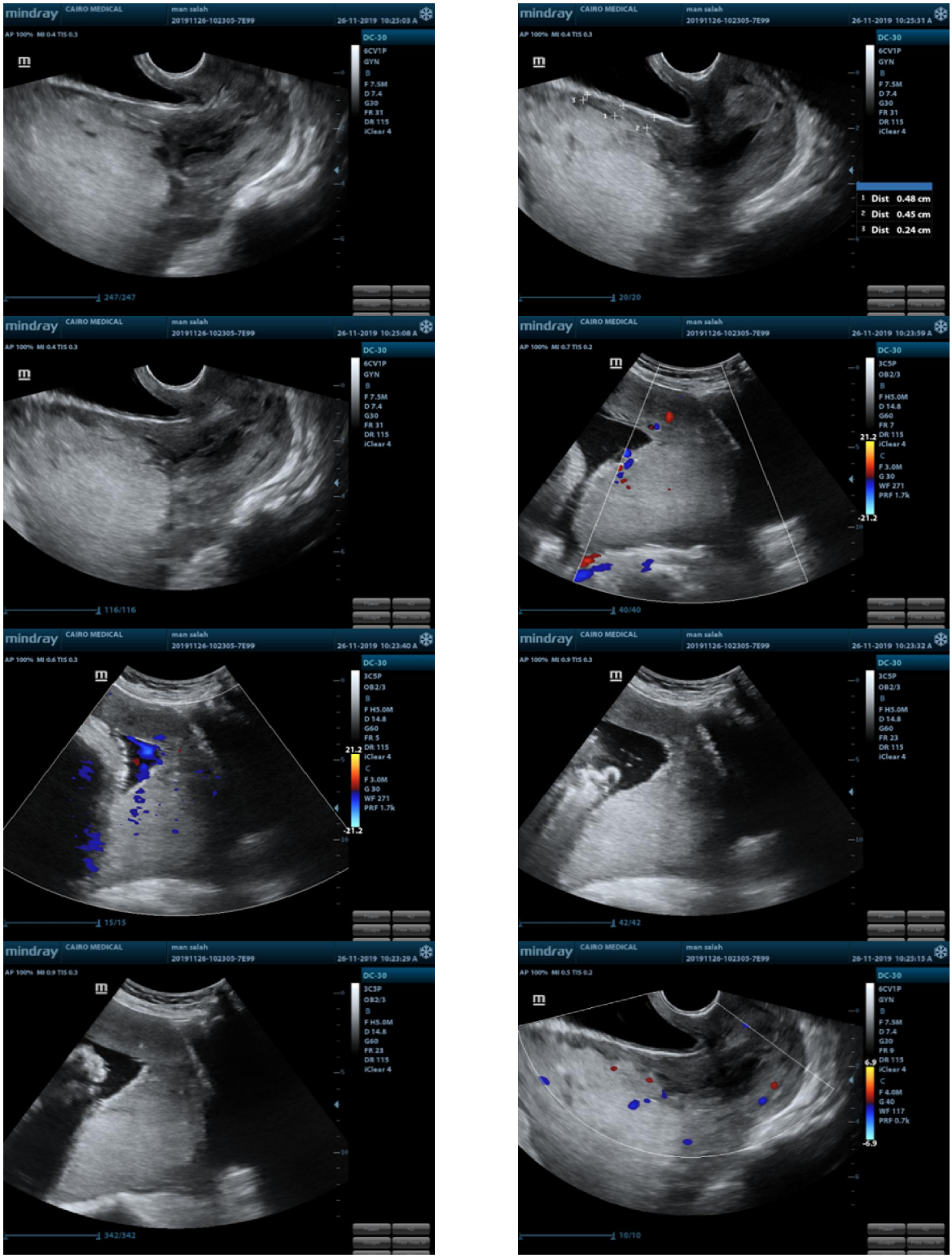


Figure (8): Ultrasound imaging of case 8

Case (9)

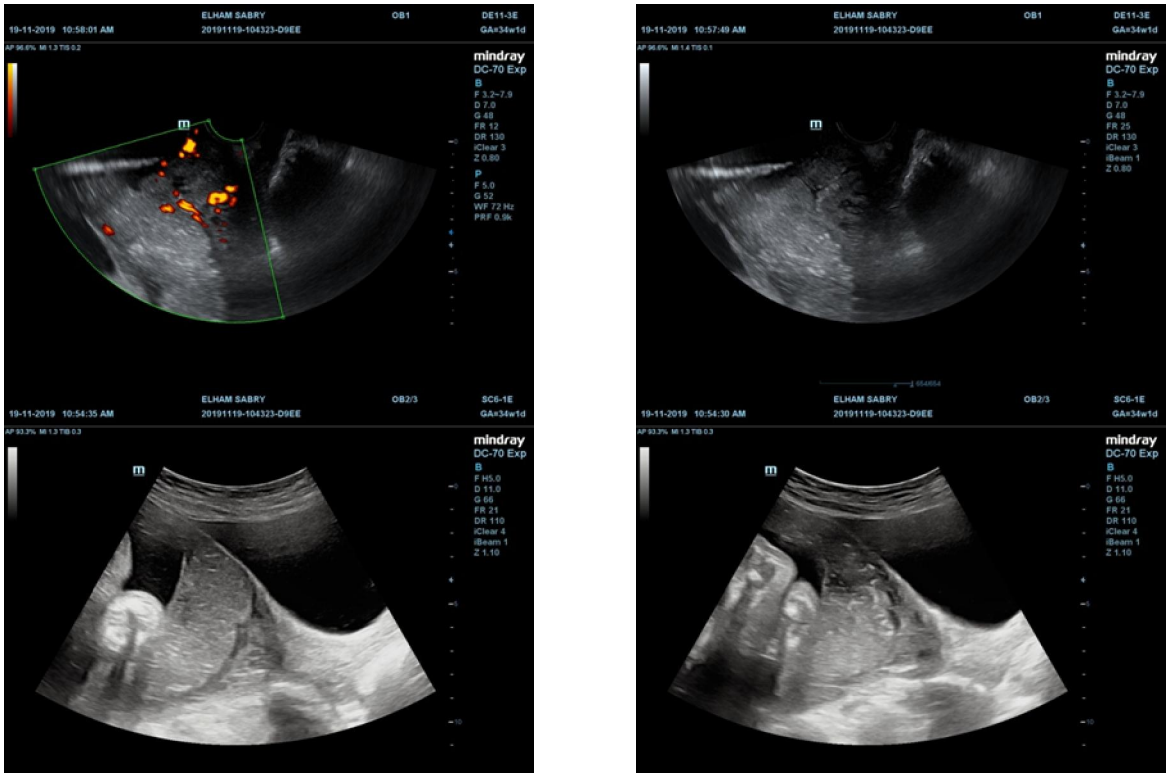
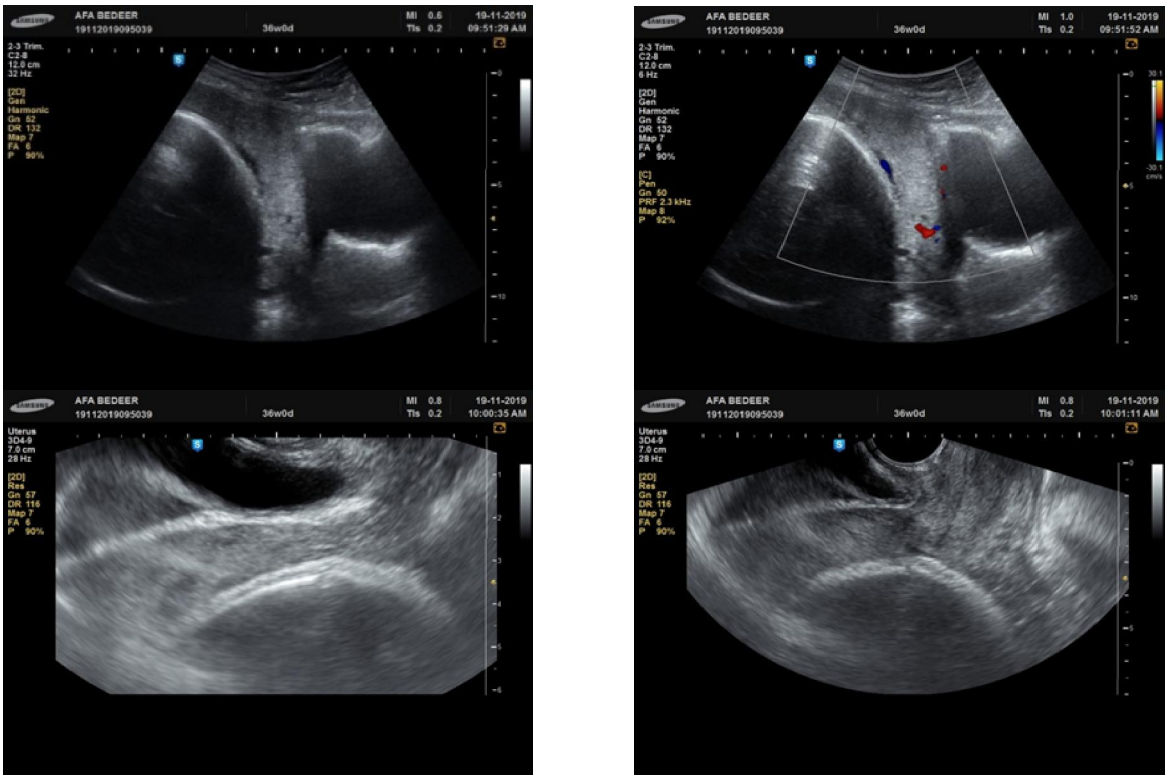


Figure (9): Ultrasound imaging of case 9

Case (10)



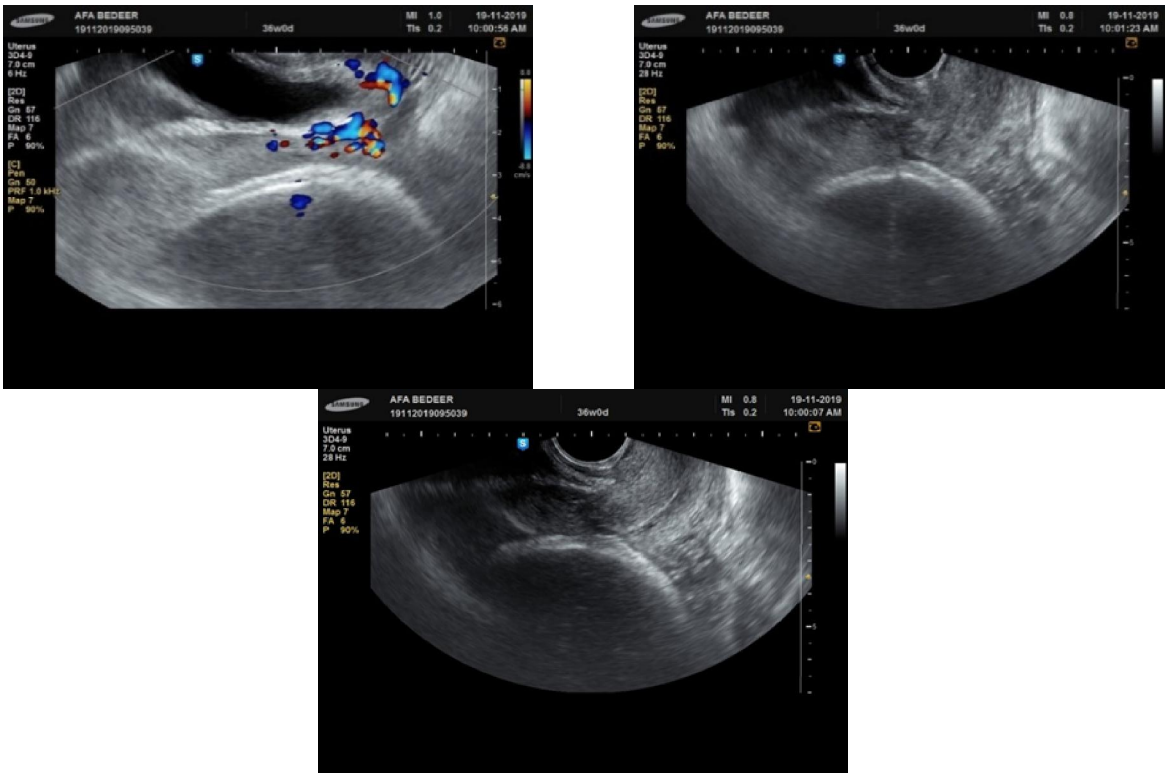


Figure (10): Ultrasound imaging of case 10

4. Discussion

Accurate prenatal diagnosis is essential for the management of PAS, in particular, in cases of placenta previa accreta, as access to the fetus during cesarean delivery can be technically difficult due to the anterior position of the placenta covering the lower segment and the cervix. In cases of false negative prenatal diagnosis, invasive placentation may not be identified by the surgeon during delivery and a routine low transverse uterine incision will lead to major placental blood loss, even before the fetus is delivered [23].

By contrast, a false positive prenatal diagnosis of accreta placentation will lead to an unnecessary midline vertical skin incision and a fundal uterotomy but also in the use of interventional radiology techniques with limited evidence of efficacy but significant morbidity such as intravascular embolization or balloon occlusion [24].

Since histopathological confirmation of adherent or invasive placentation is rarely available in most cases of conservative management and few authors provide detailed clinical information on the differential diagnosis between retained placenta and abnormally adherent placenta or the depth and lateral extension of accreta placentation, we use the term PAS disorders to describe both adherent and invasive placentation. When available we refer to the different depth of PAS disorders, i.e. accreta, increta, and percreta [25].

Histopathology is now widely considered as the gold standard modality recommended to confirm clinical diagnosis of PAS, but it is often unavailable in adherent accreta or conservatively managed cases [19].

The main complication of placenta previa during pregnancy is antepartum hemorrhage, which affects around 50% of cases [26].

The process of clarifying the reporting data on placenta accreta in the international literature started recently with the development of a grading system for the clinical diagnosis of PAS [27].

In an attempt to reduce errors due to the subjectivity involved in making this diagnosis and ensure that all operators are using the same description for the same sign, the European Working Group on Abnormally Invasive Placenta (EW-AIP) recently proposed a standardized description and name for all the ultrasound signs used for the prenatal diagnosis of placenta accrete [18].

The classification was presented and developed from this grading scheme reviewed by members of the FIGO Placenta Accreta Spectrum Disorders Diagnosis and Management Expert Consensus Pan [19].

To avoid further misunderstanding, the Royal College of Obstetricians and Gynecologists (RCOG), the Federation International of Gynecologists and Obstetricians (FIGO), and the American College of Obstetricians and Gynecologists (ACOG) have recently advocated for the use of PAS to include both

the adherent and invasive grades in further publications [21,22,24].

The ultrasound signs of abnormal placental invasion are most often described in the literature using transabdominal scanning and only 6 out of 14 cohort studies of placenta previa accreta reported on the use of transvaginal scanning (TVS) [623].

TVS is often recommended to identify the cervical canal, internal os, and the relationship between the leading placental edge and the internal os; it can also be used for a focused evaluation of the lower uterine wall and the bladder interface. Trans abdominal scans can be improved by selecting a higher frequency (5–9 MHz) transducer (linear if possible), and carefully "walking" the scar from one end to the other, keeping the transducer perpendicular to the uterine wall [28].

Although no studies have been performed that directly compare the diagnostic accuracy of trans abdominal vs transvaginal ultrasound in the setting of suspected placental invasion, transvaginal ultrasound allows for a more complete evaluation of the lower uterine segment and is the current recommended standard of care [20].

This study aims to compare between the role of trans abdominal ultrasound vs transvaginal ultrasound in assessment of placental invasion in cases of placenta previa with previous uterine scar.

Result of our study shows that TVS has higher accuracy than TAS and both are complementary to each other using the unified descriptors, as suggested by the (EW-AIP) for ultrasonographic findings in Abnormally invasive placenta.

Regarding loss of the retro placental clear zone

Regarding loss of the retro placental clear zone, this study showed Sensitivity47.6%, specificity 75%, PPV 90.9%, NPV 21.4%, accuracy 52.0% by TAS. And Sensitivity 83.3%, specificity 75%, PPV 94.6%, NPV 46.2%, accuracy 82.0% by TVS.

Our result regarding loss of retro placental clear zone agreed with those of Maged et al. [29]. As this is a cross-sectional study included 100 patients with placenta previa (PP) anterior with at least one previous CS. Ultrasound and color Doppler were done to all participants and correlated with operative findings. Similar result regarding loss of retro placental clear zone was confirmed by Cali et al. [30] but our result not agreed with. D'Antonio et al. [31].

Maged et al. [29] found that sensitivity, specificity, PPV, NPV, and accuracy of loss of retro placental clear were 87.3%, 89.19%, 93.2%, 80.49%, and 88%.

Our TAS result regarding loss of retro placental clear zone agreed with Maged et al. [29] in specificity and PPV unlike sensitivity, NPV and accuracy.

Our TVS result regarding loss of retro placental clrar zone agreed with Maged et al. [29] in sensitivity, PPV and accuracy unlike specificity and NPV.

Cali et al. [30] found that loss of retro placental clear zone Sensitivity 90%, specificity 81%, PPV 75%, NPV 97%.

Our study TAS regarding loss of retro placental clear zone agreed with Cali et al. 2013[30] in specificity and PPV unlike sensitivity and NPV.

Our study TVS regarding loss of retro placental clear zone agreed with Cali et al. 2013[30] in sensitivity, specificity and PPV unlike NPV.

. Our study not agreed with. D'Antonio et al. [31] found that sensitivity, specificity of loss of retro placental were 66.2 % 59.8%.

The difference in result in our study regarding of loss retro placental clear zone and D'Antonio et al. [31] cause our study included normal and abnormal invasive placenta but D'Antonio et al. [31] included only abnormal invasive placenta accrete increta percreta.

Comstock et al. [32] found that obliteration of the retroplacental 'clear space' is not a reliable diagnostic sign for placenta accreta.

Finberg and Williams [33] stated that the loss of the retro placental clear zone accounts for the majority of False Positive results and the criterion should not be used by itself to make the diagnosis.

Regarding the presence of abnormal placental lacunae:

The results showed that regarding the presence of abnormal placental lacunae. They showed Sensitivity 90.9%, specificity 83.3%, PPV 97.6%, NPV 55.6%, accuracy 90% by trans abdominal ulrasonography (TAS).

And Sensitivity 47.7%, specificity 100%, PPV 100%, NPV.20.7%, accuracy 54% by transvaginal ultrasonography (TVS).

Our result regarding abnormal placental lacunae agreed with those of Maged et al. [29]. Similar result regarding placental lacunae was confirmed by Comstock et al. [32] but our result not agreed with. D'Antonio et al. [31].

The PPV of lacunae shows more variation from author to author than other signs, they were reported as sensitive and specific in some studies and no so in others. Maged et al. [29] found that intraplacental lacunae sensitivity, specificity, PPV, NPV, and accuracy respectively 93.65%, 62.16%, 80.82%, 85.19%, and 82%.

Our TAS result regarding abnormal placental lacunae agreed with Maged et al. [29]. In sensitivity, specificity, PPV and accuracy unlike NPV.

Our TVS result regarding abnormal placental lacunae agreed with Maged et al. [29] in PPV unlike sensitivity specificity NPV and accuracy.

Our study not agreed with. D'Antonio et al. [31] found that sensitivity, specificity of abnormal placental lacunae were77 4% 59.2 %.

The difference between our result regarding abnormal placental lacunae D'Antonio [31] depend on MRI only for evaluation of its ultrasound result but we depend mainly on intar operative finding and histopathology and our study use TVS and TAS but D'Antonio [31] use TAS.

Comstock et al. [32] found that at 15–20 weeks of gestation, the presence of lacunae in the placenta was the most predictive sonographic sign of a placenta accreta, with a sensitivity of 79% and a positive predictive value of 92%.

Our study regarding abnormal placental lacunae agreed with Comstock et al. [32] in PPV unlike sensitivity.

Finberg and Williams et al. [33] found that number and bizarre appearance of lacunar spaces was directly correlated with certainty and severity of morbidly adherent placenta.

Regarding the presence myometrial thinning

Regarding myometrial thining, this study showed Sensitivity 75%, specificity 30%, PPV 81.1 %, NPV 23.1%, accuracy 66% by trans abdominal ulrasonography (TAS). And Sensitivity 80%, specificity 100%, PPV 100% NPV.55.6 %accuracy 84% by transvaginal ultrasonography (TVS)

Our study regarding myometrial thining agreed with Twickler et al. [35] but not agree with Wong et al. [34].

Our study not agree with Wong et al. [34] who found a sensitivity of 22%, specificity of 100%, PPV of 100% and NPV of 89%.

The difference in result in our study regarding of myometrial thining and Wong et al. [34] cause our study included normal and abnormal invasive placenta but Wong et al. [34] study included only abnormal invasive placenta accrete, increta and percreta only.

Twickler et al 2000 [35] found that a smallest myometrial thickness <1 mm identified in third-trimester pregnancies at risk for placental invasion was 100% sensitive and 72% specific with a PPV and NPV of 72% and 100%, respectively.

Our TAS result regarding myometrial thining agreed with Twickler et al., 2000. [35] In sensitivity, PPV unlike specificity, NPV and accuracy.

Our TVS result regarding myometrial thining agreed with Twickler et al., 2000 [35]. In PPV unlike sensitivity specificity NPV and accuracy.

Regarding the uterovesical hypervascualrity using Color Doppler Flow

Regarding uterovesical hyper vascularity, this study showed Sensitivity 86.7%, specificity 80%, PPV 97.5%, NPV 40%, accuracy 86% by trans abdominal ulrasonography (TAS). And Sensitivity 91.1%, specificity 60%, PPV 95.3%, NPV.42.9 %, accuracy 88% by transvaginal ultrasonography (TVS).

Our result regarding uterovesical hyper vascularity agreed with those of Maged et al. [29] and. Cali et al. [30].

Maged et al. [29] found that the sensitivity, specificity, PPV, NPV, and accuracy respectively of hypervascularity in uterine bladder interface were 47.62%, 94.59%, 93.75%, 51.47%, and 65%.

Our TAS regarding uterovesical hypervascularity result agreed with A M Maged et al. [29] specificity, PPV, NPV unlike sensitivity, and accuracy.

Our TVS result regarding uterovesical hypervascularity result agreed with A M Maged et al. [29] s.in PPV, NPV and accuracy unlike sensitivity specificity.

Cali et al. [30] result regarding uterovesical hyper vascularity was Sensitivity 90%, specificity 100%, PPV 100%, NPV 97%.

Our TAS regarding uterovesical hyper vascularity result agreed with Cali et al. [30]. In sensitivity specificity, PPV and accuracy unlike NPV.

Our TVS result regarding uterovesical hyper vascularity result agreed Cali et al. [30]. In sensitivity specificity, PPV and accuracy unlike NPV.

Regarding subplacenal hypervascularity

Regarding presence of sub placental hypervascularity this study showed Sensitivity 24.4%, specificity 33.3%, PPV 62.5%, NPV 8.8%, accuracy 26% by TAS. And Sensitivity 43.9%, specificity 88.9%, PPV 94.7%, NPV 25.8%accuracy 52.0% by TVS.

Our result regarding sub placental hyper vascularity not agreed with both Maged et al. [29] and Cali et al. [30] studies of sub placental hyper vascularity.

Maged et al. [29] found that the sensitivity, specificity, PPV, NPV, and accuracy respectively of hyper vascularity over peripheral sub placental zone were 82.54%, 81.08%, 88.14%, 73.17%, and 82%.

Our both TAS and TVS regarding sub placental hyper vascularity not agreed with Maged et al. [29] results in sensitivity specificity PPV NPV and accuracy of sub placental clear zone.

The difference in results regarding sub placental hyper vascularity may be due to Maged [29] compared its ultrasound results by intraoperative finding only but our study compared both TAS and TVS results with intraoperative finding in case of normal invasive placenta and post-operative histopathology done in case of abnormal invasive placenta accrete increta percreta.

Cali et al. [30] result regarding sub placental hyper vascularity was sensitivity 70%, specificity 100%, PPV 100%, NPV 100%.

Our both TAS and TVS regarding sub placental hyper vascularity not agreed with Cali et al. [30] results in sensitivity specificity PPV NPV and accuracy of sub placental clear zone.

The difference in results regarding sub placental hyper vascularity may be due to Cali et al. [30] study focused only on morbidly adherent placenta but our study include both normal like previa and abnormal invasive placenta like accrete increta and percreta.

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