Correlation of grayscale combined with color doppler sonography from histopathology in predicting retained products of conception*

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ABSTRACT

Background: Retained products of conception can be troublesome complications following miscarriages. Ultrasound has a significant impact in their diagnosis and with the advent of color doppler sonography can improve the assessment.

Objective: The goal of this study was to evaluate the use of grayscale combined with color Doppler ultrasound findings and correlate with histopathology in predicting retained products of conception in a maternity hospital.

Methods: This was a cross sectional prospective study of 109 patients who underwent transvaginal grayscale ultrasound with color Doppler to evaluate the presence of retained products of conception. Resistance index(RI) is measured in Pulsed doppler to assess the impedance of blood flow. The standard criterion was the histopathologic reports obtained during completion curettage.

Results: Histopathologic results validated the presence of immature placental tissues in 93 (85%) patients and decidua in 16 (15%). Endometrial mass was greater with positive histopath results ($p<0.05$). Endometrial mass had a sensitivity of 83.9% in detecting retained products of conception. Thickened endometrium was detected in 71.4 % of women with positive histopath results, but only in 28.6% with negative histopath results. Color flow was confirmed in 85% with positive histopathology results.

Conclusion: The combination of an endometrial mass with vascular pattern had the highest positive predictive value in determining retained products of conception.

Keywords: retained products of conception, miscarriages, decidua, color Doppler sonography, grayscale sonography, pulsed Doppler

INTRODUCTION

Spontaneous abortion, otherwise known also as miscarriage, refers to non-induced termination or loss of pregnancy from whatever cause before the fetus is capable of extra-uterine life[1].

"Miscarriage or " pregnancy loss" are now the preferred terms over " spontaneous abortion" because of the unfavourable implication related to induced abortion and pregnancy failure.

About 80% of miscarriages occurred in the first trimester with the incidence decreases as the gestational age advances. In about 15% to 20% of all pregnancies end in clinically recognized miscarriage[2].

Incomplete miscarriage typically presents with heavy bleeding, dilated cervix, and uterus smaller than the age of gestation and sometimes associated with cramping, lower abdominal pain and partial expulsion of products of conception. Diagnosis is usually made by correlating clinical with ultrasound findings[1].

Spontaneous miscarriage is one of the most common indications for emergency admission and treatment in gynecology[3]. Retained products of conception (RPOC) refer to the persistence of fetal and/or placental tissue in the uterus after miscarriage, termination of pregnancy or delivery[4]. It can cause prolonged bleeding and unnecessary blind procedure such as dilatation and curettage which lead to complications like infection, hemorrhage, perforation, cervical laceration and late sequel such as intrauterine synechiae (Asherman's Syndrome) which can have impact on future fertility of the patients. Thus, diagnosis of retained products of conception remains a significant dispute.

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Before the era of ultrasound, the detection of retained products of conception was based only on clinical assessment, and the prevalence was reported as high as 4.8% however, only in 60% of the patients were the diagnosis confirmed histologically[5].

In the earlier studies, sonographic features like endometrial mass, thick endometrium, irregular myometrial-endometrial interface, echogenic focus without apparent endometrial mass or a complex fluid may indicate presence of retained products of conception. Endometrial thickness is the commonly used parameters among the above mention. Different literatures have no consensus as to the optimal cut-off value for predicting retained products of conception.

Ultrasound has been an indispensable tool and widely used as first line image modality in the detection of retained products of conception. It has been connected with high false positive rates, mainly after delivery. In a study by Sadan et al[6], showed that women after abortion and after delivery, the false positive rates were 28.9% and 51.5%, respectively. The overall false positive rate for sonographic diagnosis was 34%, sometimes it's difficult to diagnose by ultrasound since blood clots and necrotic decidua is hard to distinguish from retained products of conception. For this reason grayscale combined with color Doppler can improve the evaluation of suspected retained products of conception.

In 2008, Abbasi, et al[7], conducted a retrospective study of 91 first trimester pregnancies with pathologically proven results from dilatation and curettage. About 60% have chorionic villi in 55 women and 40% have decidua in 36 women confirmed by histopathology reports. Endometrial thickness in his study could not be used to differentiate retained products of conception from decidua. Endometrial thickness of more than 8 mm were seen in thirty-one of 36 patients with decidua. This finding is in concurrence with the study in 2007 by Sawyer, et al[3], who conducted a prospective observational study among women with clinical diagnosis of incomplete miscarriage and concluded that endometrial thickness measurement on ultrasound scan are not effective for diagnosing an incomplete miscarriage.

Various literatures describe "thickened endometrium" as ranging from 8 to 13 mm. If a patient at our institution is clinically suspected of having RPOC, we used 10 mm as the cut-off value, which has a reported sensitivity of over 80%. But with 20% low specificity since thickened endometrium is commonly seen in postpartum patients with no retained products of conception. Likewise, the negative predictive value for RPOC is 63% - 80% if the endometrial thickness is less than 10 mm. [11]

Abbasi concluded in his study that the best predictor for diagnosing retained products of conception with 78% sensitivity and 100% specificity is the presence of hyperechoic material on ultrasound.

Because of the different studies that rely more on the measurement of endometrial thickness does not seem logical, evaluations of the endometrial morphology have been proposed as an alternative to improve diagnostic efficacy[8]. Some researchers have evaluated the role of endometrial morphology in the detection of retained products of conception after first trimester abortions and found it useful for triaging patients for expectant management9.

Color Doppler ultrasound further enhances diagnostic confidence in identifying retained products of conception. Blood clots will show no flow, whereas retained products of conception will likely have blood flow in a thickened endometrium or endometrial mass. Color Doppler ultrasound will yield higher likelihood of predicting retained products of conception by approximately a factor of 2 in comparison with clinical presentation alone.[10] The degree of of blood flow or vascularity can aid in the increase diagnostic confidence for detection of retained products of conception. [11]

In 2015, Durfee, et al[12], confirmed previous studies by showing that endometrial mass is the most sensitive findings in the detection of retained products of conception. Retained products of conception are extremely unlikely if absent endometrial fluid or mass is seen and the endometrial thickness is < 10 mm. Retained products of conception have more Color Doppler flow detected in the endometrium than with no retained products of conception (75% versus 40%). However, absent vascularity does not eliminate the possibility of retained products of conception. Their study had limitations with insufficient number of cases in which 17% of their patients had Color Doppler examination since Color Doppler imaging was not part of the standard protocol during the study period.

In 2009, Matijevic et al[10], showed that the likelihood ratio of ultrasound alone was 1.47, compared to ultrasound combined with color Doppler imaging was 2.16, demonstrating statistically significant accuracy in the prediction of retained products of conception. The authors concluded that the major contribution of color Doppler imaging to classic B-mode Sonography is in improving the specificity and Negative Predictive Value in the detection of retained products of conception, justifying their use in modern clinical practice.

Significance of the Study

This study was conducted to determine the use of grayscale combined with color Doppler sonography in correlation with histopathology in predicting retained products of conception in order to avoid blind procedure like dilatation and curettage which may lead to untoward side effects such as infection, hemorrhage, perforation, cervical laceration and late sequel such as Asherman's

Syndrome which can have impact on future fertility.

OBJECTIVES

General Objective: To determine the use of grayscale combined with color doppler sonography in correlation with histopathology in predicting retained products of conception in a tertiary hospital.

Specific Objectives:

1. To describe the demographics of the participants.
2. To determine the sensitivity, specificity, positive predictive value, and negative predictive value of both grayscale and color doppler ultrasound in predicting retained products of conception.
3. To correlate the ultrasound findings with histopathology for retained products of conception.
4. To evaluate the use of grayscale combined with color Doppler sonography in the diagnosis of retained products of conception.

MATERIALS AND METHODOLOGY

This research protocol obtained formal approval from Training, Research and Ethics Committee of Dr. Jose Fabella Memorial Hospital. This study was a cross sectional prospective study conducted at Women's Clinic from October 1, 2017 to May 21, 2018, those patients who were hospitalized and had undergone uterine evacuation with an admitting impression of retained products of conceptions were included in this study. Ultrasound request of the patients have been directed to our clinic from emergency room or from outpatient department with a complaint of persistent vaginal bleeding and with suspected residual gestational material at initial clinical assessment. All patients included have obtained informed consent, hemodynamically stable, with a diagnosis of incomplete miscarriage, Positive urine pregnancy test, absence of infection (fever > 38 ^{o}C, tachycardia, offensive vaginal discharge, -/+ lower abdominal tenderness), </= 20 weeks of gestation and the availability of histopath result. Exclusion criteria were: patient's refusal/ no consent, hemodynamically unstable, with evidence of ectopic pregnancy, diagnosis of missed abortion, anembryonic pregnancy and hydatidiform mole, postpartum vaginal/ caesarean delivery, presence of infection and age of gestation of > 20 weeks.

After the nature and details of the study were thoroughly explained to the subjects, an informed consent will be obtained.

Inclusion and exclusion criteria stratified the population study. Data on demographic, clinical, obstetrical and gynaecological history were recorded. These include the maternal age, parity, age of gestation. All Grayscale and color Doppler transvaginal ultrasound examination was performed only by the principal investigator fellow using Samsung WS80A (Samsung Healthcare Ultrasound, Korea) ultrasound machine with a 5-7MHZ transvaginal tranducer.

The patient was instructed to void immediately before the transvaginal examination. The patient was positioned as comfortable as possible in lithotomy position in a gynecologic examining table and placing a pillow underneath her buttocks to elevate and abduct her hip. Patient was then covered appropriately and draped. A small gel was placed inside the transvaginal probe cover and inserted into the vagina and positioned for longitudinal imaging of the uterus.

The endometrial thickness was measured in the maximum anteroposterior diameter of the uterine cavity at the area of suspected retained products of conception. The grayscale ultrasound diagnosis of retained products of conception was based on the thickened endometrium if it measures > 10mm[12] or hyperechoic or hypoechoic materials seen within the uterine cavity. The characteristic echogenicity, measurement, and location of the intrauterine mass were recorded. An endometrial mass was defined as an intrauterine mass distinct from the endometrium and its location, size and echogenicity are noted. It is measured in three perpendicular planes and volume will be calculated. The absence of endometrial mass and endometrial thickness of less than 10mm was considered normal[12].

Presence of a color Doppler flow of the endometrium determines the endometrial vascularity. Color Doppler imaging was assessed by the degree of vascularity of the endometrial component compared with the myometrial vascularity in the same image section. We designated subjective vascularity scores of the retained tissue with score ranged from 1 to 4. This was adopted on the colour Doppler scoring system used by the International Ovarian Tumour Analysis (IOTA) in women with both benign and malignant ovarian masses which used to delineate the amount of blood flow within the solid components of mass (Timmerman et al., 2000). The same principle have been applied to the retained products of conception within the endometrial cavity. After morphologic assessment of the uterus, the color mode was turned on and the area was carefully observed for the appearance of color within the vessels, a technique known as color flow mapping.Type 1 or avascular was defined as no detectable flow in the endometrium. Type 2 or minimal vascularity, was defined as certain detectable color flow in the endometrium but less than that of myometrium. Type 3 or moderate vascularity, was defined as vascularity nearly equal or same flow in the endometrium and myometrium. Type 4 or marked vascularity, was defined as greater than that of myometrium in the same image area.

Once the area of color was identified, pulse Doppler signals were recorded using a 1 mm volume cursor with at least 5 equal amplitude waveforms 22. The power Doppler box included all the trophoblastic tissue within the endometrium and the angle of insonation adjusted to the optimum between 20 to 60 degrees. Colour power Doppler gain was adjusted until all colour artefacts disappeared. Ultrasound frequency at least 5.0 MHz, pulse repetition frequency 0.3 - 0.9 kHz, wall filter 30 - 50 Hz were set to ensure maximal sensitivity for blood flow. The tracings were characterized as arterial, venous, or both. If arterial waveforms were present, resistive indices (RIs) were calculated as (PSV – end-diastolic velocity)/ PSV[10]. Pulsed Doppler was used to record a flow velocity waveform and to interrogate color signals. The lowest RI of different arterial signals was used for analysis. A retained product of conception was likely when RI was < 0.45.

Correlations were made to all with a reference standard based on the histopathologic reports of all scanned patients who underwent completion curettage. The histopathologic reports of retained products of conception is made based on the presence of immature placental tissues which indicates persistent placental or trophoblastic tissue. Histopathologic readings of decidual tissues signify endometrium of pregnancy only with no retained products of conception.

SAMPLE SIZE COMPUTATION

The number of samples collected was computed using 95% confidence level. With estimated accuracy of grayscale ultrasound and color Doppler of 96%, at least 59 subjects is needed at 5% error.

$$n = \frac{(z_\alpha)^2 pq}{e^2} \quad \rightarrow n = \frac{(1.96)^2(0.96)(0.04)}{(0.05)^2}$$

Where:

n = is the number of subjects needed
p = estimated accuracy at 96% = 0.96
q = 1 – p = 1 – 0.96 = 0.04
Zα = 95% confidence level = 1.96
e = error of 5%

ANALYSIS OF DATA

Data were encoded and tallied in SPSS version 10 for windows. Descriptive statistics were generated for all variables. For nominal data frequencies and percentages were computed. For numerical data, mean ± SD were generated. Analysis of the different variables was done using the following test statistics:

T-test – used to compare two groups with numerical data.

Chi-square test – used to compare/associate nominal (categorical) data

Fisher Exact test - a modification of chi-square used for 2x2 table when there are expected frequencies <5.

RESULTS

A total of 109 subjects were included in the study at Dr. Jose Fabella Memorial Hospital from October 1, 2017 to May 21, 2018. Ninety three (85 %) who were positive with immature placental tissues, based on histopathologic findings. Only sixteen patients were negative for immature placental tissues. They were with decidual tissues with arias stella reactions, rest of endometrium. Mean age of abortive patients were insignificantly lower (29.44 ± 7.02 vs 31.31 ± 5.68, p=0.31) among patients with positive in histopathologic findings. Gestational age was significantly higher among those with negative histopathology result but insignificantly differ between groups (13.08 ± 4.72 vs 11.64 ± 3.32, p=0.18). Similarly, cervical dilatation (p=0.46) didn't statistically differ between cases. Table 1 shows the demographic and obstetric variables of patient with (+) and (-) histopath results. There was no statistically significant difference noted as proven by all p values > 0.05.

Table 2 shows the sonographic findings in patients with or without retained products of conception based on histopath results. There was a statistically significant difference noted in the ultrasound findings as proven by the p value of ≤ 0.05. Significantly more proportion of subjects with endometrial mass in the ultrasound had retained products of conception or were positive for histopath. However, there was no statistically significant difference noted in the proportion according to color Doppler as shown by the p value of 1.00. There was also no statistically significant difference noted in the RI (p=0.14).

Table 3 shows the performance characteristics of sonographic findings for predicting retained products of conception. Endometrial mass has a sensitivity, specificity, PPV and NPV of 83.9%, 37%, 88.6% and 28.6% respectively. This showed that endometrial mass is good in ruling out RPOC. On the other hand, except for specificity, a lower performance characteristic was noted for thick endometrium with sensitivity, specificity, PPV and NPV of 16.1%, 62.5%, 71.4% and 11.4% respectively. Other combinations of Doppler sonography did not reached a better diagnostic value compared with endometrial mass combined with vascularity.

Table 4 shows the color findings in patients with or without retained products of conception based on histopath results. There was a significant difference noted in the color findings as proven by the p value of 0.02. Significantly more proportion of subjects with marked color Doppler had positive for histopath.

Table 1. Comparison of the different demographic variables according to histopath results

	Histopath Results		p-value*
	Positive (n=93)	Negative (n=16)	
Age (in years) Mean ± SD	29.44 ± 7.02	31.31 ± 5.68	0.31 (NS) †
Gravida Mean ± SD	3 ± 2	3 ± 2	0.59 (NS) †
Parity Mean ± SD	2 ± 2	2 ± 2	0.78 (NS) †
Age Of Gestation (in weeks) Mean ± SD	11.64 ± 3.32	13.08 ± 4.72	0.18 (NS) †
Cervical Dilatation Closed Open	 12 (92.3%) 81 (84.4%)	 1 (7.7%) 15 (15.6%)	0.46 (NS) ‡
History of Abortion (+) (-)	 9 (10.6%) 76 (89.4%)	 4 (20.0)% 16 (80.0%)	0.68 (NS) ‡

* p>0.05- Not significant; p ≤0.05-Significant
Data presented as Mean ± S or as frequency (%)
†T-test; ‡ Fisher Exact test

Table 2. Sonographic findings in patients with retained products of conception compared with those without retained products of conception

	Histopath Results		Total	p-value*
	Positive (n=93)	Negative (n=16)		
Ultrasound Findings Endometrial mass Thickened Endometrium (ET>10mm)	 78 (88.6%) 15 (71.4%)	 10 (11.4%) 6 (28.6%)	 88 21	0.05 (S) ‡
Color Doppler With Without	 68(85.0%) 25 (86.2%)	 12 (15.0%) 4 (13.8%)	 80 29	1.00 (NS) ‡
RI <45 ≥45	(n=68) 19 (95.0%) 49 (81.7%)	(n=12) 1 (5.0%) 11 (18.3%)	(n=80) 20 60	0.14 (NS) †

* p>0.05- Not significant; p ≤0.05-Significant
Data presented as frequency (%)
‡ Fisher Exact test

Table 3. Performance characteristics of sonographic findings for predicting retained products of conception

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy
Endometrial Mass	83.9	37.5	88.6	28.6	77.1
Thick Endometrium (ET>10mm)	16.1	62.5	71.4	11.4	22.9
Vascularity (with flow) and Endometrial Mass	65.6	56.3	89.7	22.0	64.2
Vascularity (with flow) and Thickened endometrium	7.5	68.8	58.3	11.3	16.5
Color Doppler	73	25	85	13.8	66
RI <0.45	27.9	91.7	95.0	18.3	27.5

Table 5 shows the performance characteristics of color doppler for detecting retained products of conception. Marked color doppler has a sensitivity, specificity, PPV and NPV of 35.9%, 100%, 100% and 13.8% respectively. This showed that marked color Doppler is good in ruling in retained products of conception.

Table 6 shows the performance characteristics of RI for predicting retained products of conception. An RI of < 0.45 has a sensitivity, specificity, PPV and NPV of 27.9%, 91.7%, 95.0% and 18.3% respectively. This showed an RI of < 0.45 is good in ruling in RPOC.

DISCUSSION

Diagnosis of retained products of conception (RPOC) using transvaginal approach performed by gynaecologists using color Doppler ultrasonography requires significant diagnostic accuracy to verify the claims of literatures. Clinical signs and symptoms with retained products of conception will usually have manifested abdominal pain, bleeding, fever and an open cervical external os6 thus, retained tissue can cause prolonged haemorrhage which can lead to higher risk of infection. The diagnosis of retained products of conception can be confirmed by pelvic ultrasonography and is not being widely confirmed for the detection of retained products of conception among abortive patients. Endometrial mass, thick endometrium, irregular endometrial-myometrial junction, complex endometrial fluid or echogenic focus without apparent endometrial mass are the characteristics that may imply presence of retained products of conception. It is noteworthy to test the method in a prospective study to prove neither Doppler nor sonography to detect endometrial thickness in detecting residual gestational material. RI of < 45 has a high specificity, PPV and NPV of 91.7%, 95.0% and 18.3% respectively. This showed that an RI of < 45 is good in ruling in retained products of conception. Moreover, resistive index of 0.45 was used in the study of Alcazar.[21]

There was a statistically significant outcome of sample collected prospectively of various indicators of color Doppler ultrasonography. Endometrium with more than 10 mm (1 cm) thickness in combination with vascularity flow produces lower sensitivity. Although, endometrial mass and combined vascularity yields higher sensitivity. The results were promising creating the role of transvaginal sonography in the diagnosis of retained products of conception. A study conducted by Ustunyurt, et al [8], showed that the best diagnostic efficiency for detection in retained products of conception after first trimester spontaneous abortion or elective termination has an endometrial thickness of 13 mm or more. The sensitivity of endometrial thickness was higher (67% to 94%) compared to the results of the current study.2 This is in contrast to the study made by Debby, et al[15], repeat evacuation of the uterine cavity is attempted, when an endometrial thickness of 8 mm or more done at the end of suction curettage after first trimester abortion. Endometrial thickness of > 8mm obtained the highest sensitivity compared to > 10mm (1cm) thickness (94% vs 91%). Although, similar results on specificity can be observed, ranging from 8% to 76%. Similarly, sensitivity is highest in endometrial thickness > 5mm (94%) but lowest in terms of specificity (5%) in the study of Sawyer et al.[3] Their study yields similar results with high sensitivity and low specificity. Endometrial thickness of >10mm (1 cm) yields to 75% and 91% sensitivity and between 20% and 37% specificity.[2,6] The study of Sellmyer et al[11] used 10 mm (1 cm) cut-off points for endometrial thickness, which is clinically suspected of having retained products of conception. In the study of Matijevic et al.[10], the highest diagnostic accuracy regarding the prediction of retained products of conception resulted from a combination of sonography and color Doppler assessment of the uterus. Both produce sensitivities of 98.1% and 66.6%, and specificities of 33.33% and 69.20%, respectively. The predefined sonography was in comparison with cervical dilatation and comparison with secondary postpartum hemorrhage. Truly low specificity can be recorded in its ability to detect true negatives.

Transvaginal ultrasonography combines with color Doppler was used in this study. Color Doppler was used to recognize blood flow signals within the endometrium. Color Doppler sonography has been related to improve diagnosis and can be done in all cases of suspected retained products of conception. Flow can be quantified as minimal (Type 1), moderate (Type 2) and marked (Type 3). In turn, pulse Doppler can assess blood flow impedance by measuring the resistance index.

In a study by Casikar et al[16], they investigated the use of power Doppler to confirm the presence or absence of vascularity within retained products of conception in women which can predict subsequent successful expectant management. Absent vascularity on Power Doppler showed characteristic breakthrough in the rate of successful expectant management.

Kamaya et al[14] defined endometrial vascularity as minimal, moderate, and marked flow. The positive predictive value of any vascular flow in the endometrium was 96% and that all of the cases with moderate and marked vascularity had retained products of conception. In this study, 14 patients with positive histopath have marked vascularity and none have negative histopath results which showed that marked color doppler has a sensitivity, specificity, PPV and NPV of 35.9%, 100%, 100% and 13.8% respectively. This made marked color

Table 4. Color Findings in Endometrium

	Histopath Results		Total	p-value*
	Positive (n=93)	Negative (n=16)		
Color Doppler				
Marked	14 (100%)	0	14	0.02 (S) ‡
Moderate	29 (93.5%)	2 (6.5%)	31	
Minimal	25 (71.4%)	10 (28.6%)	35	
No Flow	25 (86.2%)	4 (13.8%)	29	

* p>0.05- Not significant; p ≤0.05-Significant
Data presented as frequency (%)
‡ Chi-square test

Table 5. Color doppler findings in the endometrium

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy
Marked	35.9	100	100	13.8	41.9
Moderate	53.7	66.7	93.5	13.8	55.0
Minimal	50.0	28.6	71.4	13.8	45.3
No Flow	26.9	75.0	86.2	15.0	33.9

Table 6. Diagnostic performance of different cut-off levels of resistance index for the diagnosis of retained products of conception

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy
RI <0. 45	27.9	91.7	95.0	18.3	27.5
RI <0. 50	42.6	75.0	90.6	18.8	47.5
RI <0.55	60.3	50.0	87.2	18.2	58.8
RI <0. 60	75.0	41.7	87.9	22.7	70.0

Doppler a good indicator in ruling in retained products of conception. Casikar et al[16] summarized that absent vascularity on power Doppler have showed higher rate of successful expectant care in women with an incomplete miscarriage. In another study, Atri et al showed that presence of high vascularity with or without an echogenic mass is the best way to predict retained products of conception[17]. In this study, endometrial mass with vascular flow yields a high sensitivity of 65.6% and specificity of 56.3% with the highest predictive value of 89.7%.

Moreover, if any vascularity is detected in a thickened endometrium, the likelihood of retained products of conception increases substantially to sensitivity more than 90%. The three vascularity patterns (minimal, moderate and marked) have been demonstrated to increase diagnostic accuracy (in terms of sensitivity alone) of color Doppler sonography. This is conjunction with the study of Sellmyer et al.[11]

Pulsed Doppler was performed by measuring the resistance index (RI). In a study by Matijevic et al [10], low-resistance index (<0.45) was used and the combination of sonography and color or pulsed doppler assessment had the best diagnostic accuracy regarding the prediction of RPOC compared with all other parameters assessed. Achiron et al studied the role of transvaginal pulsed Doppler sonography in 38 patients with postpartum and posstabortal bleeding. Their results showed 100% specificity and 60% sensitivity using RI cutoff level < 0.35 in myometrial arteries[17]. Moreover, resistive index of 0.45 was used in the study by Esmaeillou[17] and Alcazar[21]. There was no established cut off value for RI but in this study we used < 0.45 and a RI of < 0.45 showed high specificity, PPV and NPV of 91.7%, 95.0% and 18.3% respectively. This showed that an RI of <45 is good in ruling in RPOC.

CONCLUSION

The strengths of this study were its prospective design, including the good sample size, preoperative grayscale and color Doppler images and the histopathology findings correlation. The weaknesses were its subjective assessment of the color flow of the endometrium and the fact that the operator was not blinded to the grayscale and color Doppler results. The findings of this study showed Color Doppler could enhance the accuracy in predicting retained products of conception. Color Doppler in combination with endometrial mass by grayscale sonography had the best predictor of retained products of conception.

RECOMMENDATION

A follow-up study validating the results of the present study is recommended. For patients with false positive or false negative results, it is better to combine the results of the ultrasound with color Doppler. ■

IMAGES

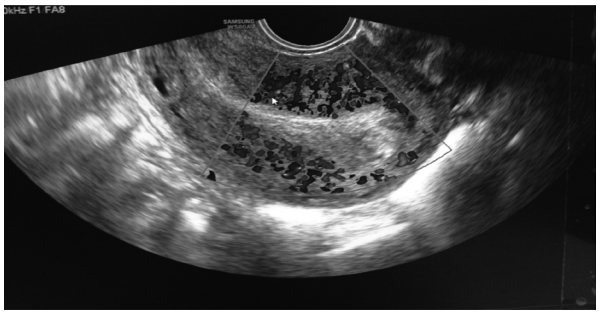

Figure 1. Thickened endometrium with no flow (score of 1)

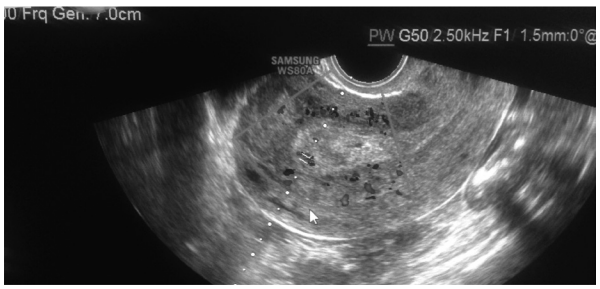

Figure 2. Thickened endometrium with minimal flow (score of 2)

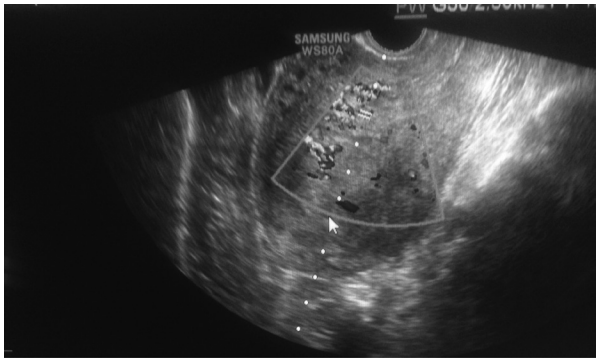

Figure 3. Thickened endometrium with moderate flow (score of 3)

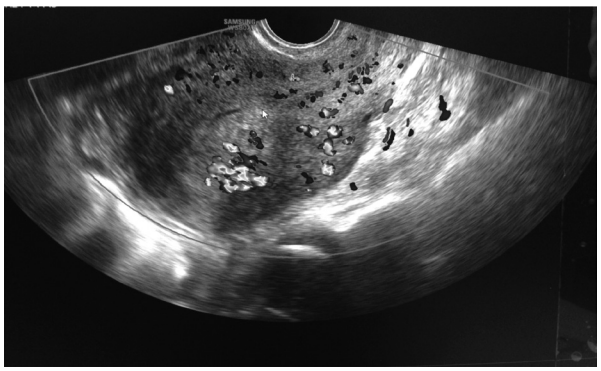

Figure 4. Thickened endometrium with marked flow (score of 4)

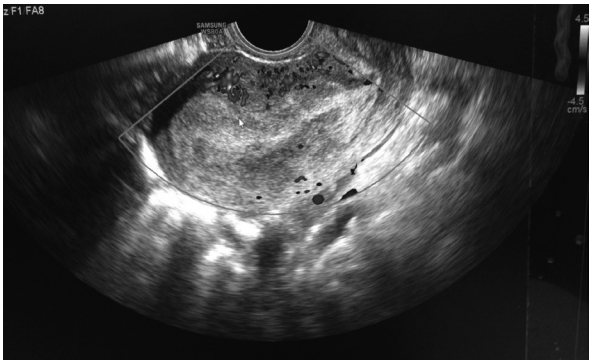

Figure 5. Endometrial mass with no flow (score of 1)

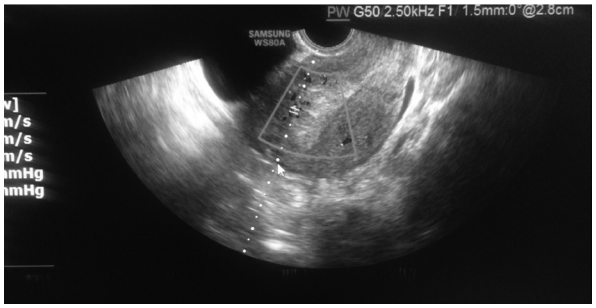

Figure 6. Endometrial mass with minimal flow (score of 2)

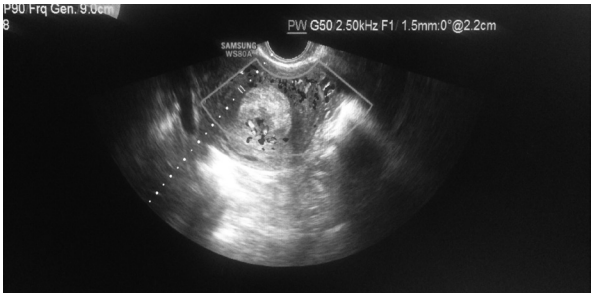

Figure 7. Endometrial mass with moderate flow (score of 3)

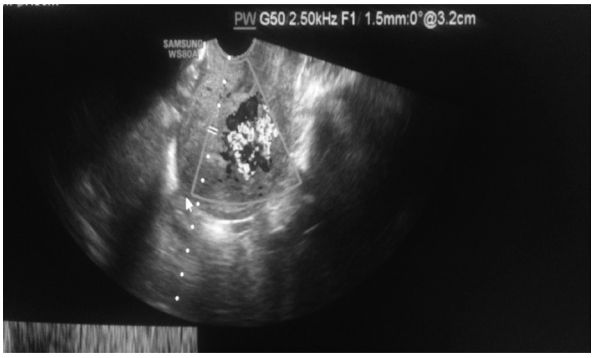

Figure 8. Endometrial mass with marked flow (score of 4)

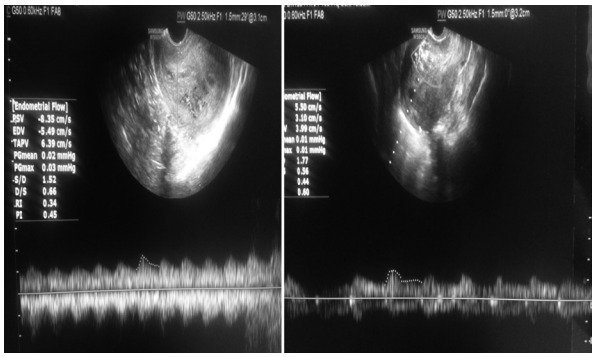

Figure 9. Resistance Index (RI)

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