

Transvaginal ultrasonography combined with color velocity imaging and pulsed Doppler to detect residual trophoblastic tissue

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ABSTRACT

The value of transvaginal B-mode ultrasonography combined with color velocity imaging and pulsed Doppler to detect retained trophoblastic tissue was evaluated prospectively in a series of 40 patients with postpartum (n = 15) or postabortion (n = 25) bleeding. Color velocity imaging was used to identify color-coded blood flow signals within myometrium and/or endometrium. Flow was subjectively quantified as absent, scanty or abundant. Pulsed Doppler was used to assess blood flow impedance by calculating the resistance index. The presence of abundant flow with a lowest resistance index of less than 0.45 was considered as suspicious of residual trophoblastic tissue. Twenty-two (55%) out of the 40 patients underwent dilatation and curettage and chorionic villi were demonstrated in 15 of these. Eighteen (45%) patients were managed conservatively. None of these patients suffered complications or needed readmission for curettage, and all of them were considered as not having retained tissue. On color pulsed Doppler ultrasound examination, 15 patients had suspected retained tissue; all of these underwent curettage and residual trophoblast was found in 14 (93.3%). Out of 25 patients considered as having no residual tissue on color pulsed Doppler ultrasound examination, seven underwent curettage and chorionic villi were found in one patient (false-negative rate 6.7%) All patients managed conservatively had an unsuspecting scan. We concluded that transvaginal ultrasonography combined with color velocity imaging and pulsed Doppler could be useful to detect retained trophoblastic tissue and to select patients suitable for conservative management.

INTRODUCTION

Retained trophoblastic tissue should be suspected in every woman presenting with postpartum or postabortion bleed-

ing. However, accurate diagnosis based solely on physical examination is difficult and represents a major clinical challenge. Often, if retained tissue cannot be ruled out, the clinician must perform dilatation and curettage in order to avoid complications due to retained tissue. However, this procedure is not devoid of complications such as hemorrhage, infection, uterine perforation or uterine synechiae¹. A reliable diagnostic method to rule out the presence of residual tissue would therefore be useful to select patients suitable for conservative management and to avoid unnecessary surgical interventions.

Ultrasonography has been traditionally the method used. Early studies using the transabdominal technique reported conflicting results^{2–4}. The introduction of transvaginal ultrasonography improved the diagnostic accuracy of ultrasound to detect retained trophoblastic tissue^{5,6}. Achiron and co-workers⁷ used transvaginal pulsed Doppler ultrasonography in bleeding patients suspected of having residual trophoblastic tissue and concluded that its use could enhance the diagnosis of residual trophoblast.

However, to our knowledge, no study has evaluated the role of transvaginal color and pulsed Doppler to detect retained tissue in patients presenting with postpartum or postabortion bleeding. In the present study, we aimed to evaluate whether transvaginal color velocity imaging and pulsed Doppler ultrasonography could improve the diagnostic accuracy of transvaginal B-mode ultrasonography alone.

MATERIALS AND METHODS

The study group comprised a series of 40 patients, 25 postabortion (mean age 31.0 years, SD 5.6, range 19–44 years) and 15 postpartum (mean age 30.6 years, SD 2.8,

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range 26–36 years), referred to our hospital between April 1995 and December 1996 because of vaginal bleeding and suspected retained trophoblastic tissue.

Patients with immediate (48 h) postpartum bleeding were excluded from the study – to exclude those who had uterine atony, or lacerations of the cervix or vagina – as were those postabortion patients with clear sonographic findings of retained products of conception, such as a gestational sac with a non-living embryo.

All patients were evaluated by transvaginal ultrasonography using a Philips P-700 SE machine (Philips Ultrasound, Santa Ana, CA) with a real-time 6.5-MHz sector electronic-array endovaginal probe with 5-MHz pulsed Doppler and equipped with the color velocity imaging system for color blood flow codification. The system operates at power outputs of less than 80 mW/cm² in the B-mode, pulsed Doppler and color velocity imaging modes.

After the endovaginal probe was inserted into the vagina, the uterus was scanned in the sagittal and coronal planes. The thickness of the endometrial stripe was measured using electronic calipers in the sagittal plane at the level of its maximum thickness. Echogenicity (homogeneous or heterogeneous) and the myometrial–endometrial interface (well-defined or ill-defined) were also evaluated.

On B-mode ultrasound, according to our previously published criteria, retained trophoblastic tissue was suspected in the presence of a heteroechoic ill-defined myometrial–endometrial interface, irrespective of endometrial thickness. No retained tissue was considered when a well-defined myometrial–endometrial interface was found, with homogeneous or heterogeneous echogenicity⁶.

Thereafter, the color velocity imaging gate was activated to evaluate the presence of myometrial and/or endometrial blood flow. The amount of flow was subjectively quantified as absent (no color signals, Figure 1), scanty (few color flow signals, Figure 2) or abundant (highly vascularized, Figure 3). Pulsed Doppler was used to interrogate color signals. The vascular impedance was estimated by calculating the resistance index ($RI = \text{peak systolic velocity} - \text{end-diastolic velocity} / \text{peak systolic velocity}$). If there was more than one arterial signal, the lowest RI detected was used for analysis. The insonation angle was adjusted to obtain the maximum Doppler frequency shift. The high-pass filter was set at 100 Hz in every case. The pulsed Doppler sample volume was set at a width of 1.2 mm. Based on the characteristics of spiral artery blood flow in the first⁸ and the second⁹ trimesters, the presence of abundant flow with a lowest RI of less than 0.45 was considered as suspicious of residual trophoblast (Figure 4).

Patients were managed according to their clinician's decision. Twenty-two (55%) patients underwent dilatation and curettage and a definitive histopathological diagnosis was obtained in each case. Only in those cases with verified chorionic villi in the pathological specimen was residual trophoblastic tissue considered to be present. Eighteen (45%) patients were managed conservatively, on the basis of the clinician's decision, with weekly serial ultrasound scans and/or serum β -human chorionic gonado-

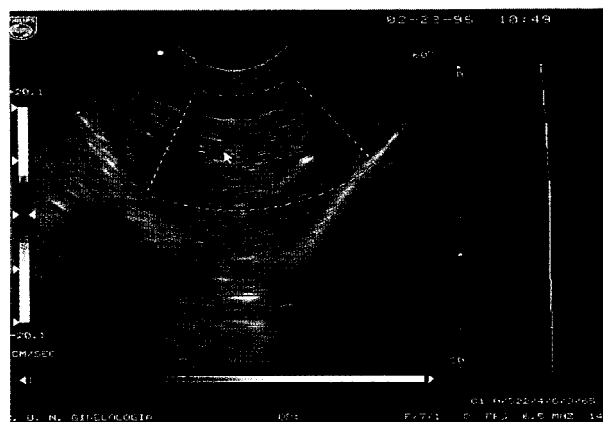


Figure 1 Transvaginal scan showing a heterogeneous well-defined endometrial stripe with absent blood flow in the myometrium and endometrium. No residual tissue was found on the histopathological specimen

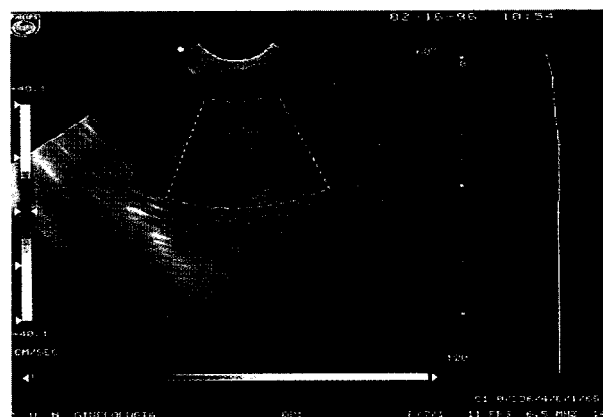


Figure 2 Sonogram showing the presence of scanty blood flow within the myometrium, at the level of the spiral arteries and no retained tissue

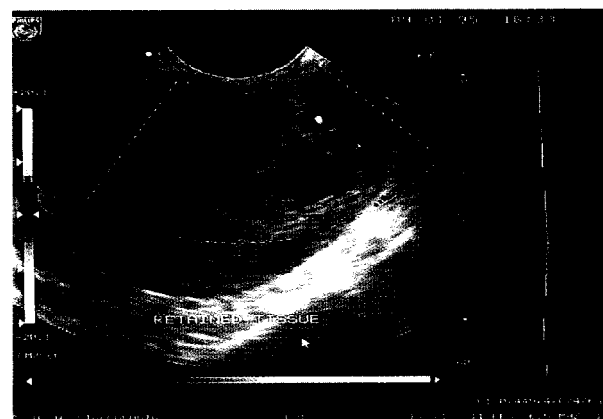


Figure 3 Transvaginal color velocity ultrasound image showing vascularization suspicious of retained trophoblastic tissue. Residual tissue was demonstrated after dilatation and curettage

trophin (β -hCG) measurement until menses (12 patients) or, in six postpartum cases, up to 8 weeks. None of these 18 patients suffered any complications or needed readmission

for uterine curettage. All these patients were considered as having no residual trophoblast.

The Mann-Whitney *U* test was used for comparison of continuous data. Fisher's exact test was used for comparison of categorical data. The Spearman rank correlation coefficient was calculated to establish the relationship of endometrial thickness and resistance index. A *p* value of less than 0.05 was considered as statistically significant. Sensitivity, specificity, and positive and negative predictive

values were calculated for color velocity imaging combined with pulsed Doppler and for B-mode gray-scale sonography alone. Data are expressed as mean and standard deviation (SD).

RESULTS

Patients presented moderate (82%) or severe (18%) bleeding. The mean time from delivery in patients with postpartum bleeding was 19.4 days (SD 17.1, range 3–60). In this group only three out of 15 (20%) had problems in the third stage of labor requiring manual removal of the placenta.

B-mode ultrasonography indicated the presence of residual trophoblast in 15 patients (37.5%). No residual tissue was considered to be present in 25 patients (62.5%). Of these 25, ten had a homogeneous well-defined endometrial stripe and 15 had a heteroechoic well-defined endometrial stripe.

All 15 patients with suspected retained tissue and seven out of 15 patients with a heteroechoic well-defined endometrial stripe underwent dilatation and curettage, on the basis of the decision of the patient's clinician. Of these 22 patients who underwent dilatation and curettage, histopathological diagnosis demonstrated the presence of

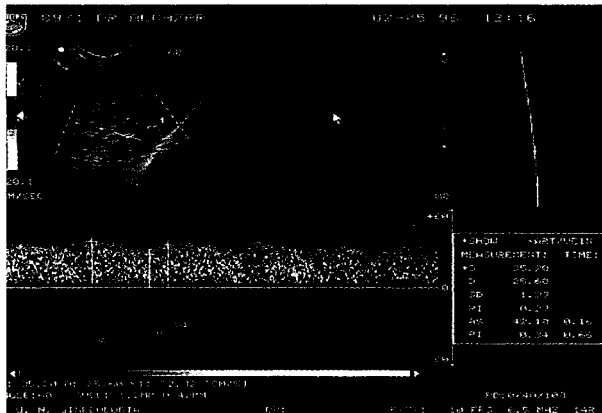


Figure 4 Typical flow velocity waveforms from spiral arteries in a case of residual trophoblastic tissue

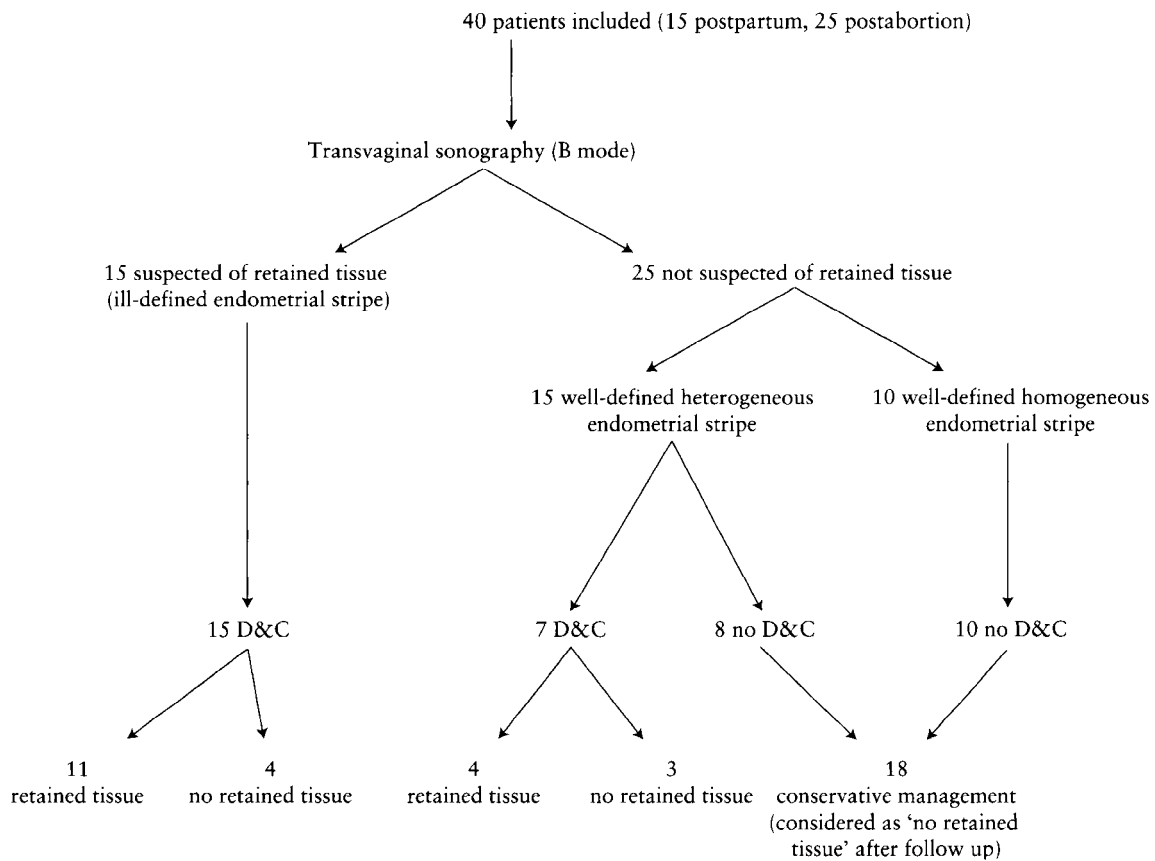


Figure 5 Diagrammatic representation of the findings of B-mode ultrasound and dilatation and curettage (D&C) in the 40 patients. The final diagnosis ('gold standard' for study purposes) was 15 cases with retained tissue and 25 cases with no retained tissue

Table 1 Correlation of B-mode sonography and definitive diagnosis

B-mode	Definitive diagnosis		Total
	No residual tissue	Residual tissue	
No residual tissue	21	4	25
Residual tissue	4	11	15
Total	25	15	40

Fisher's exact test, $p < 0.0001$

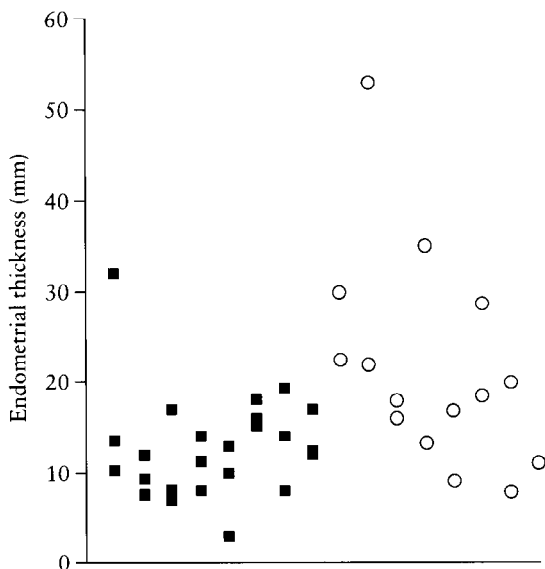


Figure 6 Scatterplot with individual values of endometrial thickness in patients with (circles) and without (squares) retained tissue. A considerable overlap was found

residual trophoblast in 15 (68.2%); 11 patients showed an ill-defined endometrial stripe and four cases had a heteroechoic well-defined endometrial stripe on B-mode sonography. In seven patients no retained tissue was found; four cases showed an ill-defined endometrial stripe and three had a heteroechoic well-defined endometrial stripe.

All cases with a homogeneous well-defined endometrial stripe and eight patients with a heteroechoic well-defined endometrial stripe were managed conservatively. Out of these 18 patients managed conservatively, none had complications such as hemorrhage or infection or were readmitted for uterine curettage. These patients were considered as having no retained tissue, making a total of 25 patients with the final diagnosis of no residual trophoblastic tissue (these 18 patients and those with no retained tissue after dilatation and curettage). Figure 5 summarizes the findings and Table 1 shows the comparison of sonographic and final diagnosis.

The mean endometrial thickness in patients with residual tissue (22.2 mm, SD 11.7) was significantly higher than in those with no retained trophoblast (12.8 mm, SD

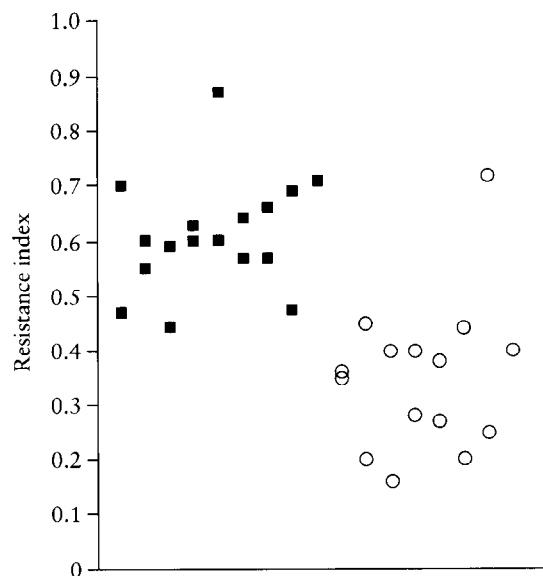


Figure 7 Scatterplot of individual values of lowest resistance index in patients with (circles) and without (squares) residual trophoblast

Table 2 Correlation of color velocity imaging (CVI) and pulsed Doppler (PD) ultrasonography and definitive diagnosis

CVI ± PD	Definitive diagnosis		Total
	No residual tissue	Residual tissue	
No residual tissue	24	1	25
Residual tissue	1	14	15
Total	25	15	40

Fisher's exact test, $p < 0.0000001$

5.8) (U value 64.5, $p = 0.025$). However, considerable overlap was found (Figure 6).

Regarding color velocity imaging and pulsed Doppler ultrasonography, blood flow was absent in eight patients (20%), scanty in 15 (37.5%) and abundant in 17 (42.5%). Blood flow was present in all 15 patients with residual trophoblast. In 14 out of 15 (93.3%), blood flow was abundant. In those 25 patients with no retained tissue, blood flow was present in 17 (68%), but only three had abundant flow.

Out of ten patients with homogeneous well-defined endometrial stripe, four had absent flow and six had scanty flow. Out of 15 patients with heterogeneous well-defined endometrial stripe, blood flow was absent, scanty and abundant in four, seven and four patients, respectively. Out of 15 patients with heteroechoic ill-defined endometrial stripe, 13 had abundant and two had scanty blood flow.

The mean lowest RI in patients with histologically proven residual trophoblast (RI 0.35, SD 0.14) was significantly lower than in patients with no residual tissue

(RI 0.61; SD 0.10) (U value 16.5, $p = 0.0001$). Individual values are shown in Figure 7. The RI had a significant negative correlation with endometrial thickness ($r = -0.523$, $p = 0.002$)

In consideration of the presence of abundant blood flow with a lowest RI of < 0.45 , the sensitivity, specificity, and positive and negative predictive values were 93.3%, 96%, 93.3% and 96%, respectively (Table 2). These figures for gray-scale ultrasound were 73.3%, 84%, 73.3% and 84%, respectively (Table 1).

DISCUSSION

The diagnosis of residual trophoblastic tissue in patients with postpartum or postabortion bleeding presents a major clinical challenge. Often the diagnosis based solely on clinical examination is difficult, because the patient is unaware of the passage of products or the clinician is not able to determine whether there is retained tissue within the uterine cavity. For this reason, many patients have undergone surgical uterine evacuation to avoid complications such as infection or persistent blood loss.

Since the first report of Robinson¹⁰, sonography has been used as a diagnostic tool to help the clinician to manage these patients. However, early reports using transabdominal ultrasound showed conflicting results, some of them with low^{2,3} and others with high sensitivity¹¹⁻¹³. The introduction of transvaginal ultrasonography enhanced the diagnostic accuracy of ultrasound in diagnosing the presence or absence of residual trophoblastic tissue^{6,7}, and sonographic criteria have been defined⁶.

The role of transvaginal pulsed Doppler ultrasonography was addressed by Achiron and co-workers⁷ in a series of 48 (38 postpartum and ten postabortion) patients. They reported a high specificity (100%), although with a rather low sensitivity (60%), using a RI cut-off level of less than 0.35 in 'myometrial arteries'. They concluded that the use of pulsed Doppler ultrasonography could improve the diagnostic accuracy of transvaginal ultrasound in the differentiation of residual trophoblast from clots and decidual debris.

To our knowledge, our study is the first to address the value of transvaginal color and pulsed Doppler ultrasonography in detecting residual trophoblastic tissue in patients presenting with postpartum or postabortion bleeding. Our results indicate that the assessment of the vascularization of the spiral arteries using color velocity imaging is useful to differentiate those patients who have retained tissue from those who have not. If pulsed Doppler is used, this diagnostic accuracy is improved further.

Using the criterion of abundant blood flow with a lowest RI of < 0.45 , we had only one false-negative case. The presence of abundant vascularization is possibly related to the viability of placental villi. Therefore, it could be expected that patients with residual trophoblast would

have areas of abundant blood flow with low impedance, similar to that found in pregnancy⁹.

On the other hand, by using color and pulsed Doppler ultrasonography, false-negative cases in patients who showed a well-defined heteroechoic endometrial stripe could be reduced, in our data in two-thirds of cases.

In conclusion, although we are aware of the weaknesses of our study, i.e. it is a small series and not all patients underwent curettage, these preliminary results suggest that the use of color velocity imaging combined with pulsed Doppler could improve the diagnostic accuracy of transvaginal ultrasonography alone in ruling out the presence of residual trophoblastic tissue in patients presenting with postpartum or postabortion bleeding and contribute to the selection of patients suitable for expectant management. However, further studies with larger series are needed to confirm our results.

REFERENCES

1. Harman CR, Fish DG, Tyson JE. Factors influencing morbidity in termination of pregnancy. *Am J Obstet Gynecol* 1981;139:333-7
2. Malvern J, Campbell S, May P. Ultrasonic scanning of the puerperal uterus following secondary postpartum hemorrhage. *J Obstet Gynaecol Br Commonw* 1973;80:320-4
3. Lee CY, Madrazzo B, Drukker BH. Ultrasonic evaluation of the postpartum uterus in the management of postpartum bleeding. *Obstet Gynecol* 1981;58:227-32
4. Kurtz AB, Shlansky-Goldberg RD, Choi HY, Needleman L, Wapner RJ, Goldberg BB. Detection of retained products of conception following spontaneous abortion in the first trimester. *J Ultrasound Med* 1991;10:387-95
5. Haines CJ, Chung T, Lung DY. Transvaginal sonography and the conservative management of spontaneous abortion. *Gynecol Obstet Invest* 1994;37:14-17
6. Alcázar JL, Baldonado C, Laparte C. The reliability of transvaginal ultrasonography to detect retained tissue after spontaneous first-trimester abortion, clinically thought to be complete. *Ultrasound Obstet Gynecol* 1995;6:126-9
7. Achiron R, Goldenberg M, Lipitz S, Mashlach S. Transvaginal duplex Doppler ultrasonography in bleeding patients suspected of having residual trophoblastic tissue. *Obstet Gynecol* 1993;81:507-11
8. Kurjak A, Kupesic-Urek S, Predanic M, Salihagic A. Transvaginal color Doppler assessment of uteroplacental circulation in normal and abnormal early pregnancy. *Early Hum Dev* 1992;29:385-9
9. Matijevic R, Meekins JW, Walkinshaw SA, Neilson JP, McFayden IR. Spiral artery flow in central and peripheral areas of the placental bed in the second trimester. *Obstet Gynecol* 1995;86:289-92
10. Robinson HP. Sonar in the puerperium, a means of diagnosing retained products of conception. *Scott Med J* 1972;17:364-7
11. Chung THK, Cheung LP, Lau WL, Haines CJ, Chang MZ. Spontaneous abortion: a medical approach to management. *Aust NZ J Obstet Gynecol* 1994;34:432-6
12. Hertzberg BS, Bowie JD. Ultrasound of the postpartum uterus: prediction of retained placental tissue. *J Ultrasound Med* 1991;10:451-6
13. Rulin MC, Bornstein SG, Campbell JD. The reliability of ultrasonography in the management of spontaneous abortion, clinically thought to be complete. *Am J Obstet Gynecol* 1993;168:12-15