



## Colour Doppler Imaging in the Evaluation of Complicated First Trimester Pregnancies

### KEYWORDS

Colour Doppler Imaging, Transabdominal Sonography, First Trimester.

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**ABSTRACT** *Objectives: To evaluate the role of colour Doppler imaging in detecting complications of pregnancy in the first trimester.*

*Materials and Methods: Forty six women with clinically suspected complications in the first trimester of pregnancy were evaluated by gray scale imaging followed by color Doppler imaging. The results were correlated with findings at evacuation/ surgery and/ or histopathological evaluation.*

*Result: The addition of color Doppler imaging to gray scale imaging improved the sensitivity for the diagnosis of viable pregnancy, non-viable pregnancy and ectopic pregnancy from 90%, 93.33% and 80% to almost 100%. The presence of perigestational venous lakes and the absence of functional luteal flow were found to predict an abortion in a nonviable gestation. Color Doppler imaging could reliably distinguish an early intrauterine pregnancy from ectopic pregnancy by the presence of low resistance peritrophoblastic flow in the former. In case of incomplete abortion, the addition of color Doppler imaging confirmed the presence of retained gestational tissue. The diagnostic sensitivity for an adnexal mass in ectopic pregnancy was also improved by the addition of colour Doppler imaging to gray scale imaging.*

*Conclusion: Colour Doppler imaging serves as a useful adjunct to gray scale imaging by distinguishing a viable from a non-viable pregnancy with greater confidence. Hence, we recommend that colour Doppler sonography should always be employed as an adjunct to gray scale imaging.*

The introduction of Doppler technology into obstetrics has given us the opportunity for non-invasive evaluation of uteroplacental and foetal circulation in both normal and abnormal pregnancies. Endovaginal color and pulsed Doppler US improve diagnostic sensitivity by adding physiological information to the anatomic information provided by transvaginal sonography (TVS). High, velocity, low impedance flow around gestations result from the hemodynamics of early placentation. This process has been shown to be the same whether the pregnancy is intrauterine or ectopic. Studies of first trimester uteroplacental circulation have shown that invasion of decidual spiral arteries by trophoblastic cells occurs as early as 4-5 weeks of gestational age and that low resistance to blood flow is found in these vessels as early as 5 weeks of gestation (1). Peritrophoblastic flow typically produces disorganized signals with such extreme spectral broadening that the upper border of the waveform is not sharply defined. This disorganization reflects the variability in RBC velocities within the intervillous spaces in the developing placenta (2). The functioning corpus luteum associated with a low impedance ovarian waveform compared with the high impedance of the non-functioning ovary. A functioning corpus luteum is necessary for the maintenance of pregnancy through most of the first trimester. Correspondingly, luteal signals should be detectable in a viable pregnancy during this period (3). The purpose of this study was to ascertain the role of color Doppler US in the evaluation of complicated first trimester pregnancies.

### Materials and Methods

The present study is carried out in the Department of Radiology at Jawaharlal Nehru Medical College and Hospital, Bhagalpur between May 2015 to April 2016. The material for the study consisted of patients admitted in

the Obstetrics & Gynaecology wards of Jawaharlal Nehru Medical College and Hospital. A total of 46 women with suspected complications in the first trimester of pregnancy (clinically presenting with bleeding per vaginum, discrepancy between clinical size and menstrual dates, and lower abdominal pain) were included in the study. All patients were subjected to transabdominal sonography (TAS) and TVS followed by transvaginal color Doppler imaging (TVCDI). TAS and TVS were performed with a 3.5 MHz sector transducer and a 6.5 MHz straight handed, end firing transvaginal transducer, respectively. TVCDI was carried out in all patients with a 6.5 MHz-transvaginal transducer using a slow real-time frame rate, low pulse repetition frequency, a narrow gate (0.6-1.2mm), low wall filter setting (50-100 Hz) and a high Doppler gain setting. These parameters were chosen to maximize Doppler sensitivity so that flow in small vascular structures could be detected. Signals were sought from the thickened endometrium surrounding the sac-like structure. The developing placenta was visualized from the endomyometrial junction, from the corpus luteum when present, and from the adnexa. After the visualization of blood flow by color flow mapping, a pulsed Doppler beam was placed over the vessel of interest and blood flow velocity waveforms were recorded. The findings of the above were correlated with clinical findings; findings at evacuation/ surgery and/ or histopathological evaluation. For patients in whom a surgical exploration was not performed, an ultrasonographic follow up was conducted till the lesion resolved, or the diagnosis was confirmed.

### Results

The final sonographic diagnosis in the 46 patients included in the study is presented in Table 1.

**Table 1:**  
**Final Sonographic diagnosis**

Diagnosis	No. of cases	percentage
Embryonic demise	13	28.26
Blighted Ovum	05	10.87
Incomplete Abortion	10	21.74
Hydatidiform mole	02	4.35
Ectopic pregnancy	06	13.14
Threatened abortion with viable intrauterine pregnancy	10	21.73

One case of misdiagnosis by US was that of a hydatidiform mole, which on histopathological evaluation, turned out to be an incomplete abortion on evacuation. Another case, wrongly diagnosed by US as ectopic pregnancy, proved to be an inflammatory adnexal mass on laparoscopy. In the threatened group, all patients, images revealed increased peritrophoblastic flow on color velocity imaging (CVI). In one patient with early pregnancy, a small gestational sac (6mm) with no intrasac contents was seen on gray scale imaging. The presence of low resistance peritrophoblastic flow and functional luteal flow on TVCDI supported the diagnosis of a viable intrauterine pregnancy, which was confirmed on follow-up scans. On Duplex Doppler imaging (DDI), flow velocity waveforms (FVWs) were observed in 60% of patients. The mean resistivity index (RI) of peritrophoblastic flow was 0.42 (0.36-0.47). One of the three patients with subchorionic hematoma on gray-scale imaging revealed subchorionic bleeding as evidenced by color on CVI. These patients subsequently revealed resolution of the hematoma and a normal outcome. Another patient with a viable foetus revealed absent functional luteal flow on CVI. This patient subsequently aborted. Functional luteal flow was observed in the remaining nine cases.

Whenever there was a diagnosis of embryonic demise on gray scale imaging, there was increased peritrophoblastic flow on CVI. On DDI, FVWs were visualized in 69.23% of patients. The mean RI value for peritrophlastic flow was 0.55 (0.32-0.7) Perigestational venous lakes, visualized as anechoic spaces on gray scale imaging and showing continuous glowing color suggesting venous flow on CVI and venous FVW on DDI were observed in three patients (23.08%). Functional luteal flow was detected in only three patients (23.08%) on CDI.

In the blighted ovum group, increased peritrophoblastic flow was observed on CVI. The visualization rate of spiral arterial FVWs was 60%. The mean RI value of spiral arterial FVWs was 0.54 (0.43-0.65). Functional luteal flow was observed in 40% cases on CDI. Whenever there was a diagnosis of incomplete abortion on gray scale imaging, increased vascularity of the retained gestational tissue was seen on. The visualization rate of spiral arterial FVWs was 60%. Perigestational venous lakes were seen in one patient. Functional luteal flow was demonstrable in only two patients (20%) on CDI. In the instance of a correct diagnosis of hydatidiform mole on gray scale imaging, a rich perfusion of the molar tissue was revealed on CVI. On DDI, the observed RI observed RI was 0.34. Low resistance arterial as well as venous FVWs were observed.

Of the five patients from the ectopic pregnancy, four revealed increased vascularity of the cystic/ noncystic adnexal mass. In the fifth patient subsequently proven to have an ectopic pregnancy, the only abnormal adnexal finding was markedly increased vascularity on CVI, which revealed a low resistance pattern on DDI. An extrauterine tropho-

blastic FVW was obtained in 60% of patients. The mean RI of extrauterine trophoblastic flow was 0.37. The uterus failed to reveal peritrophoblastic flow on CDI in any of the five patients, including the one with a gestational sac-like structure on gray scale imaging. The corpus luteum was unilateral in 80% of patients. Luteal flow was detectable in 80% of patients with a mean RI of 0.68. Transvaginal color Doppler imaging following preliminary gray scale imaging confirmed the diagnosis made on the latter with more confidence in 23.91% patients and altered the diagnosis in 6.52%. The diagnostic accuracy of TVCDI versus gray scale imaging (TAS and TVS) is shown in Table 2.

**Table No. 2**  
**Accuracy in Detection of intra / extrauterine Pregnancy: Gray Scale Imaging Only vs. Color Doppler Imaging Only vs. Color Doppler Imaging (CDI) Flowing a Preliminary Gray Scale Imaging (GSI)**

Sr. No.	Group	Method	Sensitivity%	Specificity%	Accuracy%
1.	Viable IUP	GSI	90	100	97.83
		CDI	100	100	100
2.	Nonviable IUP	GSI	93.33	99.35	98.37
		CDI	96.67	99.35	98.91
3.	Ectopic Pregnancy	GSI	80	97.56	95.62
		CDI	100	97.56	97.83

**Discussion**

As pregnancy is a vascular phenomenon, it is now possible to study the etiology of early pregnancy failure with the use of color flow mapping and duplex Doppler imaging which improves diagnostic sensitivity by adding physiologic information to the anatomical information provided by gray scale imaging. The visualization rate of spiral arterial FVWs and observed RI values compared to observations made by Kurjak (4) in the various categories of complicated first trimester pregnancy are presented in Table 3.

**Table No. 3**  
**Complicated First Trimester Pregnancy: Color Doppler Imaging**

	Visualisation Rate		Resistive index	
	Kurjak %	Present Study %	Kurjak %	Present Study %
Embryonic demise	69	69.23	0.43	0.55
Blighted Ovum	69	66.67	0.43	0.54
Hydatidiform mole	100	100	0.38	0.34

The visualization rates of spiral arterial FVWs gradually enhanced with advancing menstrual age. Similar observations were made by Jaffe and Wars (1), who detected peritrophoblastic flow in all women from week seven onwards. Kurjak et al (5) observed that visualization of blood flow in the trophoblast gradually enhanced with advancing menstrual age and it was due to falling resistance in the spiral arteries with advancing gestation. A falling trend in RI values of uteroplacental circulation in the trimester of pregnancy whether complicated by threatened miscarriage or not was also observed Stabile et al (6).

The RI values in various categories of complicated early pregnancy observed in the present series were not much

different from those observed by various authors in normal early pregnancy (0.41±0.1: range 0.25-0.66: Dillon et al (7); 0.45±0.04 Kujak et al (4). Stabile et al (6) also observed that foetal demise (either missed abortion or subsequent spontaneous abortion) did not appear to alter resistance to flow within the uteroplacental circulation. From our experience, RI of peritrophoblastic flow in early pregnancy does not appear to influence the outcome of pregnancy.

CDI of a viable gestation revealed low resistance peritrophoblastic flow and luteal flow. Absence of functional luteal flow could predict an abortion in a viable intrauterine gestation and support the diagnosis of a nonviable gestation. Similar findings were reported by Taylor et al. The presence of perigestational venous lakes also supported the diagnosis of a nonviable gestation. The addition of CDI to gray scale imaging improved the sensitivity in the diagnosis of viable pregnancy, nonviable pregnancy and ectopic pregnancy from 91.0%, 93.33% and 80% to 100%, 96.67% and 100 % respectively.

CDI could reliably distinguish an early intrauterine pregnancy from a pseudogestational sac by the presence of low resistance peritrophoblastic flow in the latter. Similar observation was made by Dillon et al (3). This additional information provided by color Doppler imaging is important as the double decidual sac sign occasionally may not be visible for small (< 10mm) normal gestational sacs may occasionally be observed in cases of pseudo sacs of ectopic pregnancy.

In case of incomplete abortion, the presence of retained gestational tissue could be confirmed by the addition of CDI to gray scale imaging. Emerson et al also observed that CDI could reliably distinguish incomplete from complete abortion.

CDI also improved the diagnostic sensitivity for adnexal masses in cases of ectopic pregnancy by revealing low resistance flow in the adnexa with or without a demonstrable adnexal mass on gray scale imaging. Improved diagnostic sensitivity with the addition of CDI in suspected cases of ectopic pregnancy was also reported by Emerson et al (from 71% with TVS to 87% with addition of color and pulsed Doppler US) and Pallerito et al (from 54% with TVS to 95% with TVCDI).

Thus, from the result of our study we conclude that CDI is a useful adjunct to gray scale imaging in that it aids in distinguishing viable from non-viable pregnancies with greater confidence, an important advantage from the point of view of patient management. It also improves the sensitivity in the diagnosis of viable intrauterine pregnancy, non-viable intrauterine pregnancy and ectopic pregnancy. We recommend that in patients with clinically suspected complications in the first trimester of pregnancy, color Doppler sonography should be employed as an adjunct to gray scale imaging whenever additional information or confirmation of diagnosis is required and when this information is important for patient management.

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