

M.K. Dwivedi

Abstract

The minimum frequency of transducer should be 7.5 MHz in early pregnancy (up to 8 weeks) and 5 MHz in 9–13 weeks of pregnancy. A duplex Doppler or a triplex Doppler capability is essential for displaying Doppler waveforms and for calculating the resistance index (RI) and pulsatility index (PI) and also the A/B ratio (peak systolic/end diastolic ratio). Doppler ultrasound is a non-invasive method of evaluating blood flow in the fetoplacental and uteroplacental circulation in normal and complicated pregnancy.

Uterine Artery: Diastolic notch of the uterine artery (Fig. 5.1) disappears from 24 weeks (Fig. 5.2) and RI drops from 0.84 to 0.56 (Figs. 5.3 and 5.4) [1]. If the notch does not disappear by 24 weeks, most women will develop a hypertensive complication of pregnancy.

Impaired uterine artery flow velocity is identified by (a) a persistent abnormal index, (b) a persistent notch and (c) significant differences between the indices in two vessels.

The commonly used PI with cut-off value of 1.5 is proved to be the best.

5.1 Umbilical Artery [2]

End diastolic flow is present in all pregnancies by 20 weeks. A mature umbilical artery flow velocity waveform is achieved by 28–30 weeks (Fig. 5.5). Indices mid cord or placental insertion are clinically more reliable. Normal RI ranges from 0.5 to 0.7 and S/D ratio ≤ 3 .

Absent end diastolic velocity is clearly abnormal.

Decreased diastolic flow (RI > 0.7) indicates early placental insufficiency (Fig. 5.6). When there is reversal of flow, it may be a clinical emergency because most of the fetuses die within 2 weeks.

The ratio of intraplacental/UA PI and RI of more than one is associated with increased incidence of IUGR, preeclampsia, foetal distress and neonatal intensive care unit admissions.

M.K. Dwivedi
Department of Radio-Diagnosis, C.C.M. Medical
College & Hospital, Durg, Chhattisgarh, India
e-mail: mahendra_van@yahoo.com

Fig. 5.1 Flow velocity waveform of a uterine artery in a non-pregnant woman showing diastolic notch and RI of 0.8

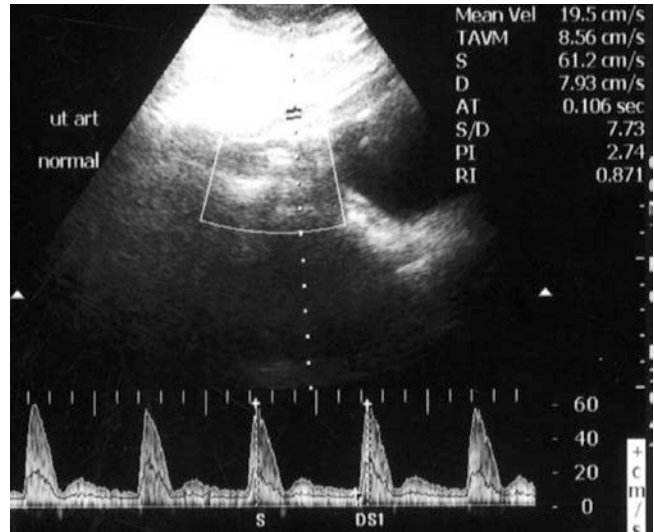


Fig. 5.2 Diastolic notch in 26 weeks of pregnancy

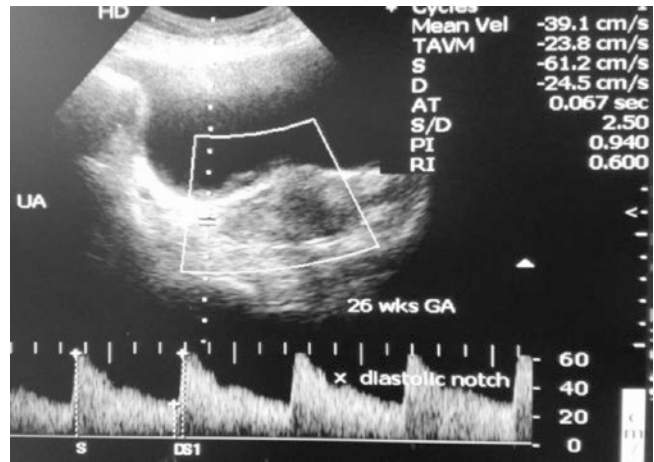


Fig. 5.3 FVW of uterine artery in normal 34 pregnancy weeks with disappearance of diastolic notch and RI of 0.4

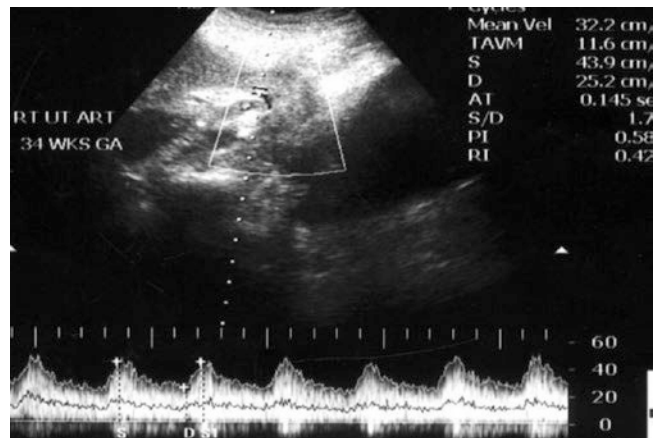


Fig. 5.4 Right uterine artery VF with normal RI, PI and diastolic flow

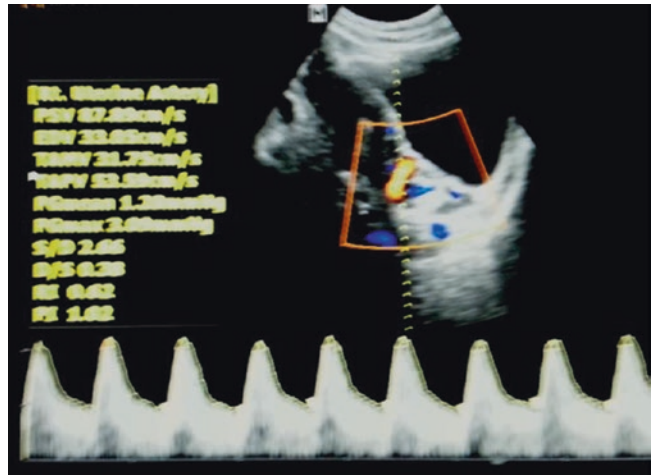


Fig. 5.5 Normal FVW of UA displays forward flow with PI of 1.1

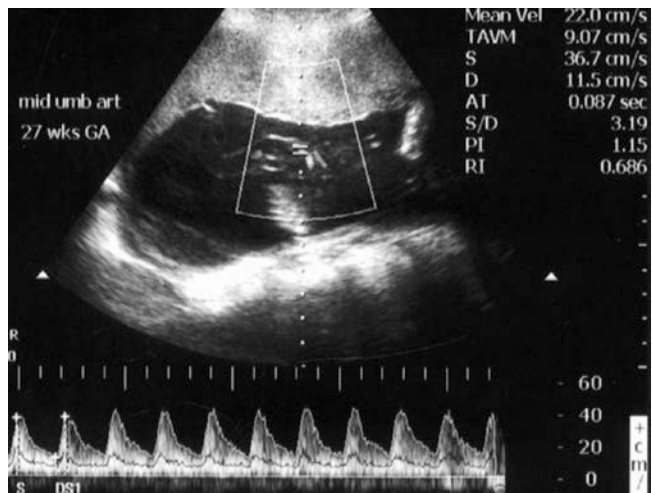
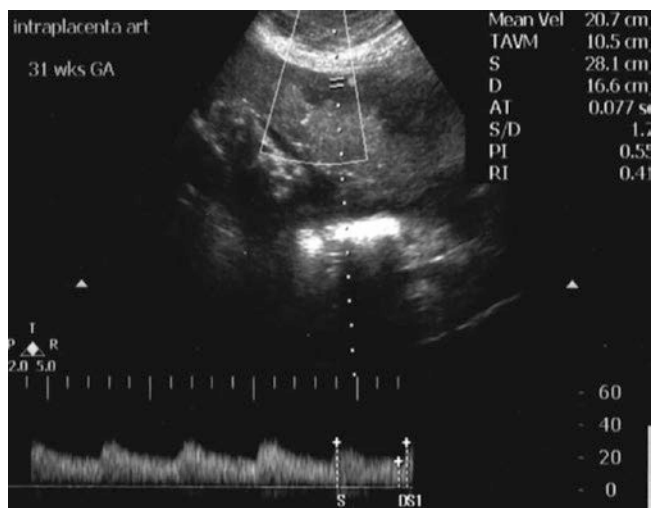


Fig. 5.6 Normal FVW in spiral branch of placenta with normal RI of 0.4



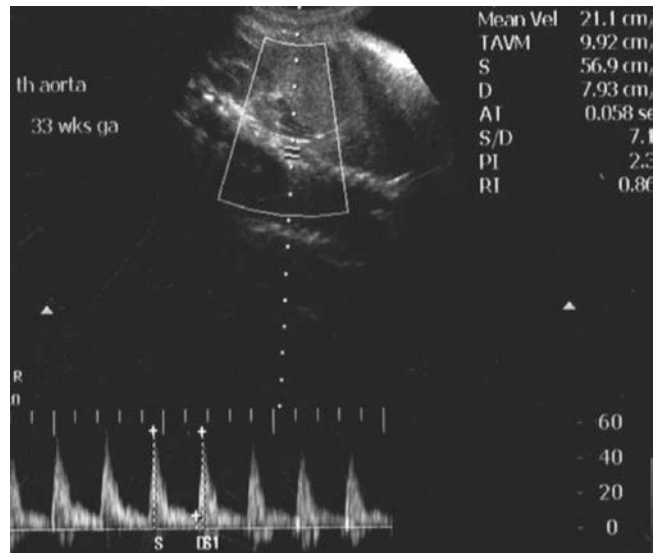
5.2 Foetal Descending Thoracic Aorta

Normal flow wave pattern (Fig. 5.7) shows $RI = 0.82 \pm 0.1$ and $PI = 1.83 \pm 0.3$.

There is increase in RI and PI of growth retarded fetuses. High PI is suggestive of foetal academia.

Absent end diastolic flow is suggestive of perinatal complications such as respiratory distress syndrome, necrotising enterocolitis and renal failure.

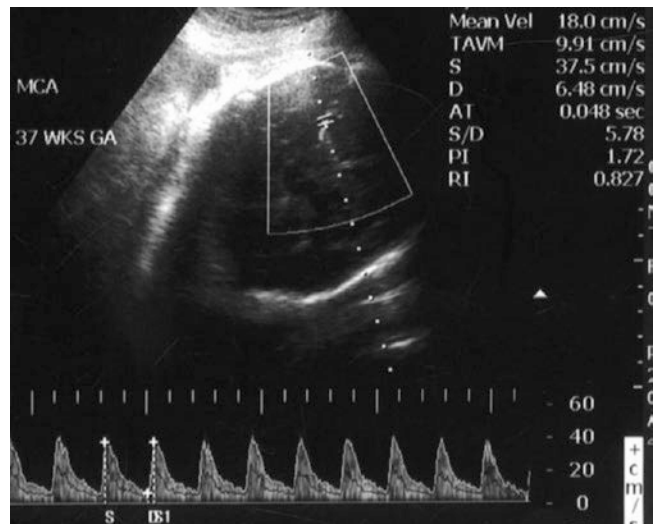
Fig. 5.7 TA FVW with PI of 2.3 indicates normal blood flow



5.3 Foetal Middle Cerebral Artery [3]

Normal RI of MCA is less than 0.7 and PI is >1.3 (Fig. 5.8). Foetus with mild hypoxia shows reduced umbilical artery flow velocity. The pre-terminal flow pattern shows absent diastolic flow in the umbilical artery, aorta, vena cava and umbilical vein pulsations. The PI of MCA is significantly lower and the mean systolic velocity is higher in small-for-gestational-age fetuses than the normal fetuses.

Fig. 5.8 The FVW of MCA displays a continuous forward flow and a high PI of 1.72



Whether growth retarded foetus is normal, it is determined by the state of umbilical and uterine circulation, and foetal hypoxaemia is determined by MCA Doppler. In growth restriction, a rise in PI of UA precedes changes in the MCA and TA.

5.4 Foetal Venous Circulation [4]

Doppler evaluation of the ductus venosus (Fig. 5.9), hepatic veins and umbilical veins (Fig. 5.9) gives an idea of foetal hypoxic and

acidotic state. Absent diastolic velocities and reversal of blood flow in ductus venosus are an absolute indication of delivery.

The umbilical venous flow when measured at an extra-abdominal level displays regular pulsations up to 15 weeks of gestation. Thereafter, venous pulsations gradually disappear (Fig. 5.10). Occurrence of venous pulsations in UV later in pregnancy is a sign that indicates congestive heart failure in compromised foetuses.

Fig. 5.9 FVW of DV displaying continuous forward flow with two surges of velocity peaks and no reverse flow

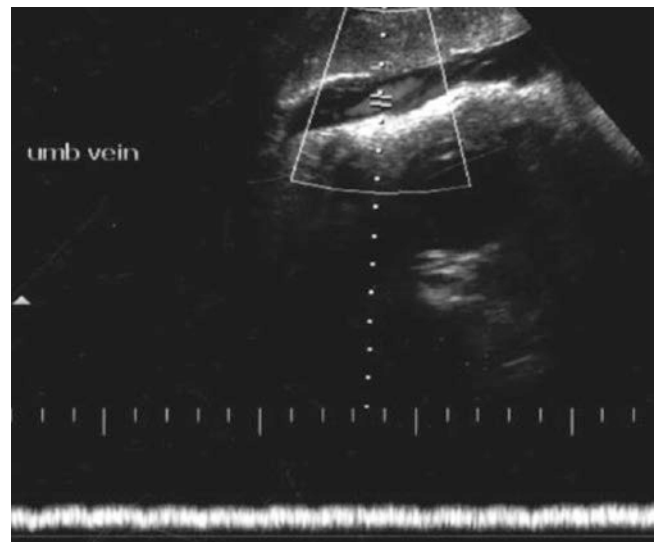
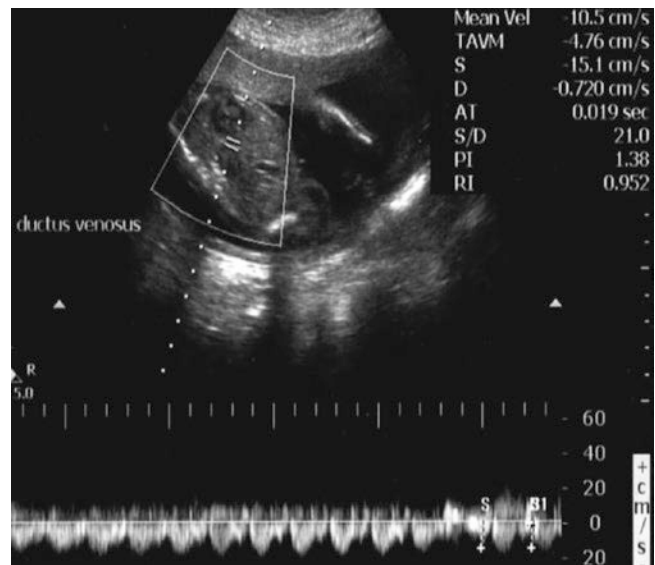


Fig. 5.10 Normal UV FVW with its steady flow and no venous pulsations

References

1. Farrel T, Chien PF, Mires GJ. The reliability of the detection of an early diastolic notch with uterine artery Doppler velocimetry. *Br J Obstet Gynecol.* 1998;105:1308.
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3. Mari G, Deter RL. Middle cerebral artery flow velocity waveforms in normal and small-for-gestational fetuses. *Am J Obstet Gynaecol.* 1992;166:1262.
4. Nishio J, Nakai Y, Mine M, et al. Characteristics of blood flow in intrauterine growth-restricted fetuses with hypocoiled cord. *Ultrasound Obstet Gynecol.* 1999;13:171.