

ANTENATAL FETAL TESTINGS BY B MODE ULTRASOUND, BIOPHYSICAL PROFILE AND DOPPLER VELOCIMETRY

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SUMMARY

B mode ultrasound proves fundamental to antenatal fetal studies. In the second trimester it is precise for gestational age determination, and study of fetal anatomy and fetal malformations (92.31% accuracy). In the third trimester, ultrasound forms the nucleus for fetal well being studies and identification of fetal compromise. Doppler velocimetry studies and fetal Biophysical scoring form the two cardinal wings that balance the ultrasound in fetal surveillance. Remaining as a common denominator, ultrasound is sensitive for fetal well being studies when coupled with Doppler, and is good for diagnosis of fetal disease and altered fetal growth when combined with BPP.

Coupled with Doppler profile, ultrasound is an excellent predictor of fetal well being, and ensures the best perinatal outcome with 99.28% confidence limit. Seldom a fetus is lost if B mode ultrasound and Doppler profile are normal. Whereas, fetal disease and altered fetal growth are best assessed by combining BPP with ultrasound, with a diagnostic precision of 63.16% for IUGR, and 52.38% for macrosomia.

We have set the normal cut off for SD ratio of the umbilical artery as 2.6 and uterine as 1.90, as proved in our study of 109 subjects who had normal perinatal outcome.

Antenatal fetal testing has become an integral part of obstetric care, which includes clinical evaluation, FHR monitoring at CTG, B mode ultrasound study and Doppler blood flow velocimetry. Doppler measurements are not made in isolation, but are complementary to B mode ultrasound evaluation of the fetus

(Schulman et al., 1989). In the general obstetric population abnormal fetal testings are less often encountered with a significantly low incidence of 6.40 to 12.83% (Rajan, et al., 1994), and hence majority of times the role of antenatal surveillance is to ensure fetal well being, and thus assure a good perinatal outcome.

The fetal disease and pathophysiology that should be identified antenatally include fetal hypoxia, IUGR, anomaly and jeopardy caused by maternal diseases such as PIH and diabetes. The specificity for the various fetal testings vary in their capacity in identifying fetal disease. The purpose of this communication is to critically evaluate the role and the extend to which ultrasound and Doppler could assist the obstetrician in recognizing the antenatal fetal status. Perinatal outcome evaluated in 212 pregnancies, majority having risk factors, forms the basis for this study.

MATERIALS AND METHODS

Between March, 1992 and February, 1994, over a period of 2 years, 1321 pregnant subjects had undergone ultrasound evaluation including Doppler blood flow velocimetry studies. B mode ultrasound evaluation included study of gestational age, fetal anatomy, growth parameters, and fetal well being including biophysical profile (BPP). Doppler profile included blood flow velocity studies in the uterine, umbilical and cerebral arteries. Among the 1321 subjects 710 had atleast one third trimester USG-cum-Doppler evaluation, and of them 212 (majority of whom were high risk pregnancies) could be followed closely for their perinatal outcome.

RESULTS AND DISCUSSION

Among the 1321 subjects who had Doppler flow velocimetry studies, 1183 (89.22%) had normal umbilical flow velocity (Table I). Abnormal flow velocity for umbilical artery was 138 (10.44%).

Table I
NORMAL DOPPLER PROFILE

Gestational Age Weeks	SD Ratio Percentiles		
	10th	50th	90th
	Umbilical		
15 to 20	2.20	3.00	4.00
21 to 24	2.40	3.00	3.80
25 to 28	2.20	2.60	3.20
29 to 32	2.00	2.40	3.00
33 to 36	1.90	2.30	2.60
37 to 40	1.80	2.10	2.40
	Uterine		
15 to 20	1.40	1.70	1.90
21 to 24	1.50	1.60	1.90
25 to 28	1.40	1.60	1.80
	Middle Cerebral		
15 to 20	2.20	2.90	3.60
21 to 24	2.30	2.50	3.00
25 to 28	2.50	3.10	3.90
29 to 32	2.50	3.20	4.00
33 to 36	2.60	3.20	4.20
37 to 40	2.50	3.00	3.80

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Among them 49 i.e., 6.90% were third trimester, and 87 i.e., 14.26% in the midtrimester.

Third analysis centers mainly around the 212 high risk pregnant subjects, who had atleast one USG and Doppler study in the third trimester, and in whom the perinatal outcome was known. Among these 212 subjects, 142 (66.98%) had various high risk factors such as PIH (21.23%), IUGR (17.92%) bad obstetric history (13.21%), gestational diabetes (9.91%), fetal anomaly (6.13%) and others. The incidence of LSCS in this group has been 50%, perinatal morbidity of Apgar <8 was 63 (29.72%), and the perinatal mortality was 23 (10.85%).

NORMAL TESTINGS

Among the 212 subjects, B mode and Doppler mode studies were normal in 138 (65.09%) of whom 109 had good perinatal outcome (78.99%) with a perinatal morbidity of 20.29% (27 subjects). Thus, altogether 136 subjects had a live birth and acceptable neonatal salvage (99.28%). Perinatal mortality in this group was 2 for 138, giving an incidence of 0.72% (Tables II & III). In effect, high risk pregnancies with normal B mode and Doppler mode studies in the third trimester are assured of negligible perinatal mortality and low perinatal morbidity. Naturally this should as well be applicable to the low risk population and hence, by

Table II
Sensitivity of Fetal Testings

Fetal's status	USG & BPP	USG & Doppler
Live birth	151/155 :: 97.42%	137/138 :: 99.28%
Neonatal Morbidity	36/55 :: 55.38%	20/65 :: 30.71%
IUGR	22/38 :: 57.87%	18/38 :: 47.37%
Mortality	19/23 :: 82.61%	13/23 :: 56.52%

Table III
Comparison of B Mode and Doppler Mode Accuracy

Normal Test	Normal	Morbidity	Mortality
Doppler	67.36	27.38	5.95
B Mode & BPP	78.71	18.71	2.58
B Mode & Doppler	78.79	20.29	0.72

and large, to the general obstetric population. In other words, seldom a fetal loss is encountered in an obstetric population when both the B mode and the Doppler mode are normal in the third trimester, with 99.28% specificity for neonatal well being. Next best in this order will be a B mode study combined with BPP, which gives almost the same result except for a slightly high perinatal mortality of 2.58% (4 fetal loss for 155 normal pregnancies reported). Moreover, we have observed that Doppler studies are quicker (3 minutes) as against BPP and FHR studies (20 to 30 minutes) (Rajan, et al., 1994). These are convincing reasons for combining B mode ultrasound with Doppler velocimetry study as an excellent method of identifying and prognosticating normal perinatal outcome in any obstetric population.

ABNORMAL TESTINGS

When both B mode and Doppler mode were abnormal in 28 fetuses, fetal disease was confirmed in all, with 11 fetal losses (39.29%) and 17 (60.71%) fetal morbidity. However, the sensitivity for predicting fetal disease was poor by this method because both tests remaining abnormal was seen only in a very small percentage of high risk obstetric population, namely 28 of 212 subjects (13.21%). On the contrary B mode and BPP abnormalities (irrespective of umbilical Doppler velocimetry) had a higher predictive value for fetal disease (Tables II and III). Among the 57 subjects (26.89%), there were 19 perinatal deaths (33.33%), and 36 fetal morbidity (63.15%), and only 2 fetuses were born healthy (3.50%).

Umbilical Doppler as a single parameter had a poor predictive value for fetal disease, with 11 born alive among the 44 abnormal umbilical Doppler (false positive: 25.00%) and hence abnormal Doppler velocimetry of the umbilical artery has poor predictive value for abnormal perinatal outcome. Absent end diastolic velocity in umbilical artery (AEDV) was the severe form of umbilical flow resistance observed in 12 of the 44 abnormal umbilical Doppler (27.27%), and this group, of course, had the highest specificity for fetal disease with 75.% perinatal mortality and 25% morbidity. However AEDV is a less frequent event, seen in 5.66% of the high risk population. Thus it could be concluded that B mode studies carry the maximum predictive value for fetal disease, with umbilical AEDV indicating end stage fetal disease. A better approach to employing Doppler velocimetry studies for prediction of fetal disease will be to prefer the Doppler profile which includes uterine, umbilical and cerebral flow velocity studies. Obstetric decision making in otherwise inconclusive situations will be possible by considering the Doppler profile (Rajan, 1993).

IUGR

Of the 38 cases of IUGR confirmed at birth for 212 deliveries (17.92%), 22 had been sensed at B mode study (57.89%), and 18 at umbilical Doppler studies (47.37%). However, abnormality in one of the two tests had a better correlation of 24 for 38 fetuses (63.16%). Hence, by complementing B mode with Doppler studies 63.16% of IUGR will be diagnosed accurately, and individually these testings

have only 57.89 and 47.37% predictive value. By assessing AC growth rate by serial B mode studies more accurate prediction of IUGR should be possible.

MACROSOMIA

Macrosomic births which amounted to 21 of the 212 deliveries (9.91%), were antenatally detected at B mode with 52.38% accuracy (11 fetuses). Doppler mode did not have any role in suspecting macrosomia, with umbilical Doppler remaining abnormal in only one of the 21 fetuses (4.75%). Hence fetal macrosomia diagnosis, just as IUGR, mandates repeated careful B mode studies. A single third trimester study could miss as much as one half of the macrosomic fetuses.

FETAL ANOMALIES

Of the 13 fetuses born anomalous 12 could be diagnosed antenatally by B mode, which gives a predictive accuracy of 92.31%. On the contrary the Doppler mode abnormalities attended with fetal anomaly have been observed only in 4 for 13 (30.77%). Hence it is evident that Doppler velocimetry, unlike B mode imaging, has no role in detection of fetal anomalies.

NEONATAL MORBIDITY

Neonatal morbidity (Apgar <8) was recorded in 65 of 212 (30.66%), among them 36 were predicted at B mode combined with BPP (55.38%), and only 20 by umbilical Doppler (30.71%). Hence neonatal morbidity is better predicted by B mode and BPP rather than umbilical Doppler velocimetry.

PERINATAL MORTALITY

Among the 212 pregnancies studied the perinatal mortality was recorded in 23 (10.85%), of which 11 were due to fetal anomalies. B mode study could sense the fetal calamity in 19 of the 23 (82.61%), whereas Doppler mode abnormalities were present only in 13 (56.52%). This disparity between B mode and Doppler mode in prediction of fetal loss is mainly due to inclusion of fetal anomalies where the Doppler umbilical flow velocity is usually normal.

DOPPLER PROFILE

The normal range of S/D ratio for the uterine, umbilical and cerebral arteries were determined by perusing the values recorded for the 109 normal pregnancies in whom the perinatal outcome was normal

Table IV
Doppler Profile and Fetal Status

Outcome	Uterine	Umbilical	Cerebral
Normal	140-180	160-240	200-350
IUGR	150-230	190-400	220-420
APGAR < 8	150-220	190-400	210-290
Still Born/IUD	-	A.E.D.V.	-

(Table I). Accordingly a low cut off value of 2.6 for umbilical and 1.90 for the uterine have been set as against the respective figures of 3 and 2.6 described by Fleischer, et al.,(1989). It is worth analyzing the Doppler profile in the different categories of fetal conditions, such as normal, IUGR, neonatal morbidity and fetal loss (Table IV). In the IUGR fetuses abnormality was observed in uterine and umbilical, and in those with neonatal morbidity there was a generalized affection seen in all vessels. The fetal demises were usually heralded by AEDV in the umbilical artery.

CONCLUSION

Antenatal fetal monitoring certainly improves the quality of obstetric services offered to the pregnant subjects. An overall improvement in perinatal outcome has been achieved, with a perinatal mortality of 2.2% in the general obstetric community, 10.85% in the high risk and 0.4% in the low risk populations, with perinatal morbidity ranging from 20 to 30%. In

the general obstetric population incidence of abnormal fetal testings recorded by various methods range from 6 to 12%. For these reasons the main purpose of fetal testings in majority of occasions is to exclude fetal disease and to ensure the best perinatal outcome. B mode ultrasound excludes fetal anomalies with 92.31% confidence, and altered fetal growth and neonatal morbidity with 50 to 60% confidence when combined with BPP. The role of Doppler velocimetry is mainly in predicting a normal perinatal outcome. A normal B mode ultrasound and Doppler velocimetry study in the third trimester assures an acceptable neonatal salvage of 99.28%.

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