BIOEFFECTS OF DIAGNOSTIC ULTRASOUND EXPOSURE DURING PREGNANCY ON THE FETUS

K. Bucksiiee • A. Haldar • N. Agarwal • S. Mittal

SUMMARY

Bioeffects of diagnostic ultrasound exposure during pregnancy were studied on 106 newborns at birth and early neonatal period. The mean birth weight of the foetuses exposed from the embryonic period was reduced significantly (2640 + 90 gm) as compared to those exposed in the fetal period (2660 + 42 gm) P < 0.001). It was also reduced in neonates exposed for six or more times during pregnancy (2932 + 67 gm) than those exposed three time or less (2940 + 46gm) (P < 0.001). Crown heel length was also reduced in the fetuses exposed for the first time in the embryonic period as compared to those of unexposed group. Neonatal problems were also observed more frequency in the more than 6 times exposed groups as compared to the less than 3 times exposed group. Thus the frequency, time of first exposure and total duration of diagnostic ultrasound exposure in utero should be used judiciously.

INTRODUCTION

Ultrasound (US) is the investigation of choice during pregnancy to detect various foetal abnormalities and to monitor growth, development and wellbeing of the foetus in high risk obstetric situations. This is not only the best non-invasive and extremely informative technique but is also considered to be safe for the human foetus. But available information from animal studies indicate adverse effects on the various neurological, immunological, haematological, development and genetic status of the newborn exposed to diagnostic ultrasound during pregnancy. With the above facts in mind present prospective study was carried out for immediate postnatal problems affecting the newborn exposed to antenatal diagnostic ultrasound compared to those born without any ultrasound exposure during pregnancy.

Dept. of Obst. & Gyn. A. I. I. M. S., New Delhi.
Accepted for Publication on 23.10.1993.

MATERIALS AND METHODS

One hundred and forty two (exposed 106 unexposed 36 pregnancy women were

selected from antenatal care clinic. Selection criteria were as under :

1. Age between 18-35 years.
2. No history of congenital malformation in family or in past Obst. history.
3. No history of recurrent spontaneous abortions, late fetal death, exposure to X-rays, teratogen, viral fever in early pregnancy and with no systemic disorders in the mother. Mother with congenital malformation of the fetus detected in first ultrasound examination, or poor socioeconomic or very short statured were excluded from the study. Unexposed pregnancy women were not allowed any sort of ultrasound examination or nonstress testing (NST). The parameters noted in the neonate at delivery were :
   1. Birth Weight
   2. Apgar Score
   3. Congenital malformation and congenital infection. During Hospital Stay : Head Circumference, Crown-heel length, Jaundice, Seizures neonatal infection and any other abnormality were noted.

During the study, real time pulsed wave linear transducer with 3.5 MHZ frequency of 96 mm width (80-100 db) was used for all obstetric ultrasound imaging. No Polaroid film was taken.

RESULTS

The exposure range for the sitting varied from 55 seconds to 15 minutes 25 seconds (mean being 5'27") The median exposure time was 4 minutes 30 seconds and most frequent exposure time was 3 minutes. The total number of exposures in exposed group : 2 to 7 (mean 3.93) times. The maximum total duration of exposure was 54 minutes and most frequent was 25 minutes. The mean birth weight of the neonates exposed in utero during embryonic, fetal period and the unexposed group is depicted in Table I. When the mean birth weight of neonates in exposed group was co-related to the time of first exposure it was observed that fetuses exposed in embryonic period weighed less as compared to those exposed in fetal period (Table I) ($P < 0.001$). Mean birth weight of foetuses exposed in embryonic period (2640 + 90 gms) was also significantly less than unexposed group (2822 + 33 gms) ($P < 0.001$). However mean birth weight in fetal exposed group (2960 + 42 gms) and unexposed group (2822 + 33 gms) were not different statistically. Significant differences were also noted in mean birth weight and minor neonatal problems in patients who had 6 or more exposures to diagnostic ultrasound during pregnancy than who had less than 3 exposures (Table II).

The crown heel length was also affected significantly in the embryonic ex-

Table I

Birth weight in relation to time of first diagnostic ultrasound exposure during pregnancy

Birth weight in Gms	Embryonic exposed Group	Fetal exposed Group	Statistical value	Significance
	N = 15	N = 91	t = 13.54	
Mean birth weight	2640 + 90	2960 + 90	P < 0.001	Highly Significant

posed group as compared to the unexposed group (Table III).

The mean age of mothers in unexposed group was 24.17 ± 3.75 and in exposed group was 25.43 ± 3.21 years (P > 0.05). Previous obstetric history of mothers in both the groups was not statistically different (P > 0.05). Period of gestation at time of delivery, head circumference (33.73 cms + 10.9, unexposed, Vs. 33.78 cms = 1.18 cms exposed), mode of delivery, sex of the neonate, one and five minute Apgar score, crown heel length (48.27 ± 1.51 unexposed Vs exposed 47.97 + 1.94), fetal distress [5(13.9% unexposed-12 (11.3%) exposed] and neonatal hyperbilirubinemia [8(22.2% unexposed 23) (21.7%) exposed] were not statistically different in two groups (exposed and unexposed).

There was no fetal death in either group, but there was one neonatal death in the exposed group due to prematurity (28 weeks due to incompetent cervical OS). Neonatal problems like diarrhoea, sticky eyes, toxic erythema, apnoeic spells, poor sucking, hyaline membrane disease, pneumonia, hypoglycemia, hypocalcemia, nasal discharge and other problems were not statistically different in the study and control group. Pregnancy complications like hypertensive disorders of pregnancy, gestational, or Insulin dependent diabetes and other problems

Table II

Birth weight and neonatal problems in relation to number of diagnostic ultrasound expousre during pregnancy

Birth weight in Gms	Three Exposure or less	> 6 Expsoure	Stastical Value	Significance
	N = 43	N = 17		
Mean Birth Weight	2940 + 46 —	2832 + 67 —	t = 7.08 p < 0.001	Highly
Neonatal Problems	1	4	$x^2 = 5.08$	Just Significant

Table III

Crown heel length in relation to embryonic exposed and unexposed group

Subject	Unexposed Group	Embryonic exposure group	Statitical value	Significance
	N = 36	N = 15	t = 2.21	
Crown heel length in cms.	48.27 + 1.51	46.81 + 3.22	P < 0.05	Just Significant

were not statistically different in the study and control group. Pregnancy complications like hypertensive disorders of pregnancy, gestational, or Insulin dependent diabetes and other obstetrical problems did not differ in the two groups.

DISCUSSION

To a body of literature that exonerates diagnostic ultrasound exposure during gestation to the human fetus the present study is added (Moore et al 1982, Stark et al 1984, Cartwright et al 1984, Falus et al 1972) Bernstine (1969) studied safety studies with doppler technique while Kinner Wilson (1984) followed US exposed children for childhood malignancies. The effects of US on rat and mice embryos are studied by various authors (Kohorn et al 1967, Shozi et al 1975, Scheidt et al (1978) followed US exposed fetuses in utero on a broad spectrum of dimensions, present study revealed interesting observations. The study indicated that the mean birth weight of the fetuses exposed for the first time during embryonic period was reduced significantly to those who were exposed in the fetal period. It was also reduced in neonates who were exposed for 6 or more times in utero than those who were exposed less often. The study also revealed that the neonates who were exposed in embryonic period were more prone to have lesser length than unexposed group. Minor neonatal problems also noted more in more than 6 exposed group than less than 3 times exposed group. Moore et al 1982 using birth weight as an end point found a small, yet significant difference in the number of low birth weight babies in the exposed group. However, our study showed significant differences in birth weight and minor neonatal problems between heavy exposed group when compared with exposed group as well as highly significantly difference noted in birthweight between embryonic and fetal exposed group. This study also showed that embryonic exposed newborns had lesser mean crown heel length than unexposed group. Though our study population is small it suggests that it is better to avoid embryonic exposure and heavy exposure unless it is very essential. However no difference was noted in period of gestation at the time of delivery, one and five minute Apgar score, head circumference, fetal distress, neonatal hyperbilirubinemia, infections, mean placental weight, pregnancy complications like PIH, gestational diabetes and other obstetric problems in two groups. Though ultrasonography is a very informative, non-invasive, simple, readily available technique it may have subtle biological effects on the fetus when exposed in embryonic period, used very frequently and for prolonged period of time. Large multicentric well controlled studies are advocated in human fetuses exposed in utero to diagnostic US for any effects.

REFERENCES

1. *Bernstine R. L. : 34, 704, 1969.*
2. *Cartwright R. A., McKinney P. A., Hopton P. A., Birch J. M., Mann J. R. and Stiller C. : Lancet : 2, 999, 1984.*
3. *Falus M., Koranyi G. and Sobel M. : Dry. Hetilao : 13, 2119, 1972.*
4. *Hellman L. M., Duffus G. M., Donald I. and Sunden B. I. : 1133, 1970.*
5. *Kinner Wilson L. M. and Water House J. A. H. : 21, 997, 1984.*
6. *Kohorn E. I., Pritchard J. W., Hobbins J. C. : Obstet. Gynec. : 29, 272, 1967.*
7. *Moore, R. J., Barick M. and Hamilton P. : Am. J. Epidemio : 116, 571, 1982.*
8. *Scheidt P. C., Stanley F. and Bryla D. A. : Am. J. Obstet & Gynec. : 131, 743, 1978.*
9. *Shozi R., Murakami U. and Shimizu T. : Teratology : 12, 227, 1975.*