

Renal, Hepatic and Endocrine Parameters in Normal Indian Foetuses in the Second Trimester of Pregnancy

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Summary: The aim of this study was to establish normal reference range for various biochemical parameters of the foetus. It was carried out in 15 different normal fetuses between 13 and 23 weeks of gestation. Serum uric acid and serum creatinine were found to increase with gestational age. Fetal serum electrolytes (sodium and potassium) were found to remain constant. Albumin also showed an increasing trend with gestational age. The foetus showed hyperbilirubinaemia as compared to the adult with an increase mainly in the direct fraction. Serum transaminases showed no particular trend with gestational age. Serum phosphate and alkaline phosphatase showed an increasing trend while calcium levels remained relatively constant.

Introduction:

Cordocentesis described in 1983 by Daffos et al combined the simplicity of earlier methods like placentocentesis with the efficacy of fetoscopy as a method of obtaining pure foetal blood.

With the advent of cordocentesis the need arose for obtaining normal reference ranges for various biochemical parameters of the foetus. This would allow detection of deviations from the normal in foetuses with anomalies like hydronephrosis, anaemia, infections, congenital adrenal hyperplasias etc. This pilot study was undertaken to obtain normal reference ranges in foetuses as very few studies are available in the literature and no studies are available from India.

Methods

This study was carried out in the Department of Obstetrics and Gynaecology at the All India Institute of Medical Sciences, New Delhi, India, from April 1993 to December 1994.

The study was carried out in 15 patients of which 11 were young, healthy, pregnant women attending the outpatients department of Obstetrics and Gynaecology of the All India Institute of Medical Sciences requesting termination of pregnancy for reasons other than an abnormal foetus. The remaining 4 women underwent cordocentesis during pregnancy for ruling out Down's

Syndrome in the foetus and were subsequently confirmed to be having foetuses with normal karyotypes. The renal, hepatic and endocrine functions were analysed according to gestational age.

The sample population was obtained on a non-random basis. The procedure was performed with the informed consent of the patients.

Foetal ultrasound was carried out with a real time scanner (General Electric RT.3000, Sector probe 3.5 MHz) to confirm the period of gestation and rule out gross congenital malformations. Following this, cordocentesis was performed under ultrasound guidance with a 22 gauge needle which was passed through the abdominal and uterine walls to directly puncture the foetal umbilical cord. Once an umbilical vessel was entered blood was aspirated and transferred to a heparinised vial for karyotypic studies (where indicated), a plain vial for biochemical estimations and a vial containing sodium fluoride for blood glucose estimations. The amount of blood aspirated ranged from 2 to 8 ml in cases of termination of pregnancy, and 3 ml in cases undergoing cordocentesis for diagnostic indications. Kleihauer Bethke test was performed on all blood samples to confirm their origin.

Throughout the procedure and for 30 minutes after sampling the foetal heart was continuously monitored for any abnormality.

Figure 1

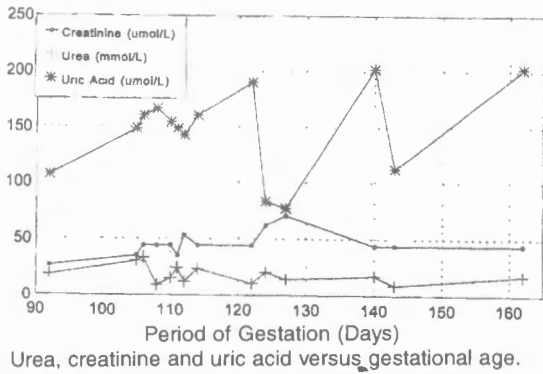


Figure 2

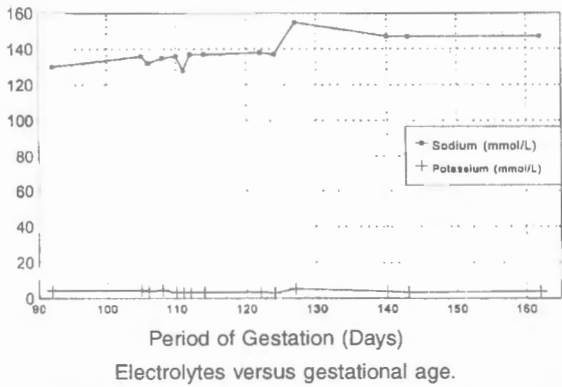


Figure 3

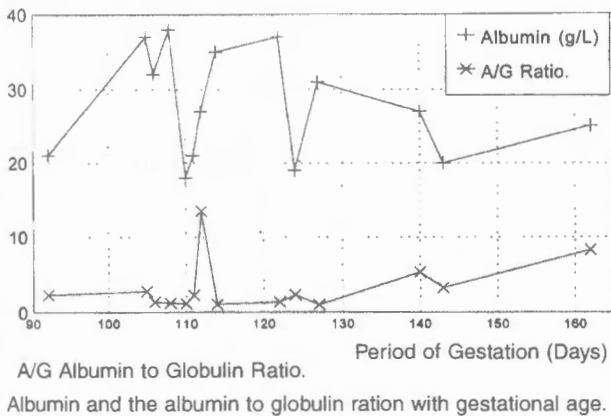


Figure 4

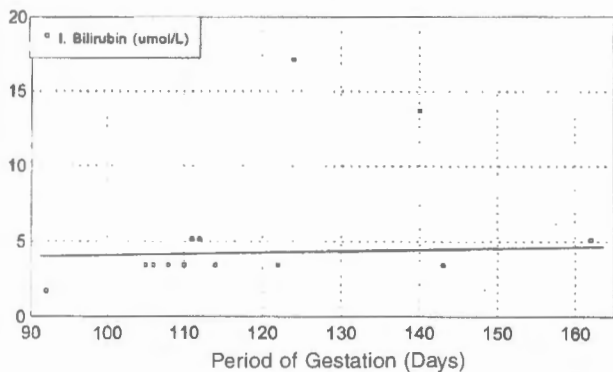


Figure 5

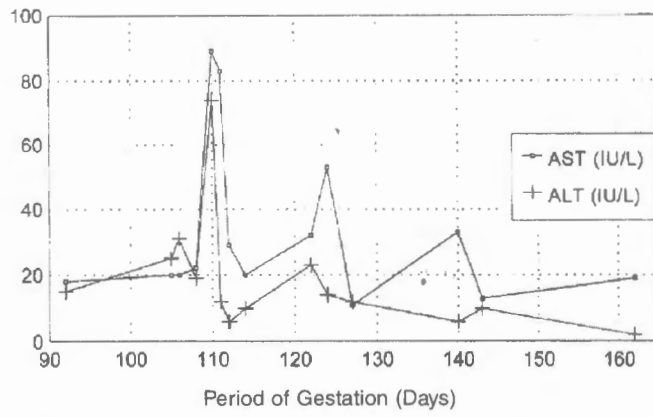


Figure 6

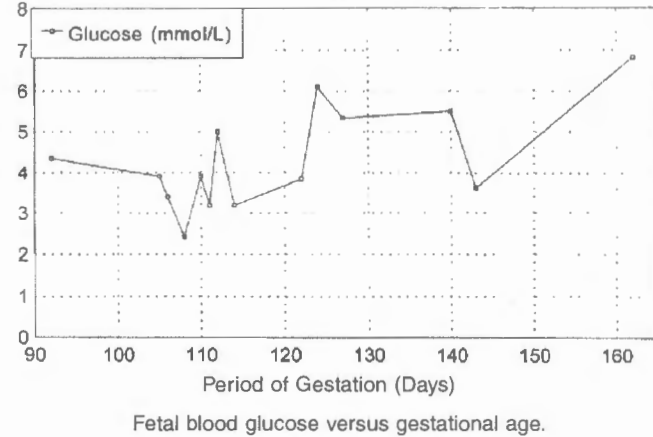
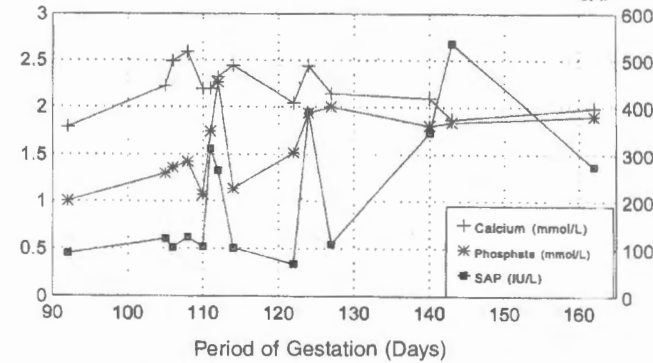


Figure 7



In the group desiring termination of pregnancy the pregnancy was terminated by either Ethacridine lactate administration (extra-amniotic) or instillation of intra-amniotic 15-methyl-prostaglandin F_{2α}. In the group of patients undergoing cordocentesis for diagnostic indications the patient was managed conservatively with antibiotics and tocolytics awaiting the results of tests on

the foetal blood.

Foetal blood was analysed on the BM Hitachi 717 Automatic analyser using Randox kits. Standardisation was done after every 60 samples. Serum electrolytes were analysed on a flame photometer.

Results

The period of gestation at which cordocentesis was performed ranged from 13 to 23 weeks with the majority falling in the 15 to 16 weeks gestational age group.

Renal function

The parameters analysed were urea, creatinine, uric acid and electrolytes i.e. sodium and potassium. Serum uric acid and creatinine increased with gestational age. Figures 1 and 2 show these parameters in relation to gestational age. Serum electrolytes show no significant change with gestational age.

Hepatic function

Figure 3 shows increase in albumin and albumin to globulin ratio with increasing gestational age. Figure 4 depicts indirect bilirubin which is seen to lie within a narrow range in most cases. Serum transaminases show no particular trend with gestational age (Figure 5).

Endocrine function

The parameters analysed in this group were blood glucose, serum amylase, calcium, phosphate and alkaline phosphatase (Figure 6 and 7). Serum phosphate and alkaline phosphatase increased with increasing gestation and serum calcium remained relatively constant. Blood glucose showed an increasing trend with gestational age.

Discussion

Foetal serum electrolytes show little change with gestational age demonstrating that the foetus is

remarkably efficient in maintaining the electrolyte concentration of its plasma constant. There is an increase in concentration of creatinine and uric acid, probably due to increasing muscle mass of the foetus. (Moniz et al.1985).

The foetus shows hyperbilirubinaemia relative to maternal values. This increase is mainly in the direct fraction with the indirect bilirubin being within the narrow range of 1.71 to 5.13 $\mu\text{mol/L}$ in most cases. This is probably due to the equilibration of indirect bilirubin with maternal blood. Foetal hyperbilirubinaemia is explained by the shorter life span of foetal red blood cells and the immature conjugating ability of the foetal liver. (Pearson 1971, Moniz et al 1985).

In contrast to previous studies which showed an increase in calcium and a decrease in phosphate in the foetal blood with gestation, our study shows an increase in phosphate and a relatively constant serum calcium. Since the foetal serum calcium is dependent on the placental calcium pump, the finding may reflect the delayed onset of the action of this pump in pregnancy, as majority of values in this study are at less than 20 weeks of gestation. (Reitz et al. 1977, Ramsey et al. 1973). Serum alkaline phosphatase shows an increase with gestational age. This enzyme has been earlier shown to be entirely of bone origin and is proposed to be increased due to increased osteoblastic activity in the foetal bones (Moniz et al 1985).

References

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