STUDY OF pH VALUE, CREATININE CONTENT AND ALKALINE PHOSPHATASE LEVEL OF LIQUOR AMNII IN FOETAL DISTRESS*

by

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It is very difficult to diagnose foetal distress in time. Various investigations have been suggested from time to time for determination of intrauterine foetal status. In recent years amnioscopic examination to see the physical character of liquor amnii is extensively practised. Saling's (1965) micro-sampling of foetal scalp blood and study of acid-base balance of the same have also raised the interest in this field.

Though the origin of liquor amnii is debated, its formation is dependent upon exchange of water and electrolytes between the mother, the foetus and the amniotic space (Plentl, 1959) and as such intrauterine status of the foetus is expected to be best reflcted in this medium. In case of foetal distress it is expected that a natural reflection of metabolic change may occur in the composition of amniotic fluid. Examination of amniotic fluid may in that case be of great help in the assessment of foetal hypoxia. The aim of the present investigation is to focus the importance of amniotic fluid examination in the assessment of degree of foetal distress. Estimation of oxygen (PO_2), carbon dioxide (PCO_2) tension, bicarbonate content (HCo_2) and pH value of amniotic fluid may be helpful in this respect (Raiha and Kauraniemi, 1961).

Suranyi (1968) is of the opinion that amniotic fluid pH value and creatinine content may be regarded as index of acid-base balance of the foetus in utero. Boyer (1961) observed increased enzymic activity in the form of elevated alkaline phosphatase level in amniotic fluid in cases of intrauterine foetal distress. As estimation of pH value, creatinine content and alkaline phosphatase level of liquor amnii is simple and bed-side procedure, the present study is limited to estimation of these factors in amniotic fluid.

Material and Methods

The present study is based on determination of pH value, creatinine content and alkaline phosphatase level of liquor amnii in 20 cases of foetal distress—both antenatal and intranatal and also in 20 control cases with clinically uncomplicat-

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ed pregnancy and labour admitted in the Department of Obstetrics and Gynaecology, R. G. Kar Medical College, Calcutta, during the period from January, 1971 to December, 1971. Amniotic fluid samples were collected by abdominal amniocentesis according to the method of De *et al*, (1969). The cord blood and maternal blood were collected for pH value, creatinine content and alkaline phosphatase level estimation immediately after birth of the baby for comparative study of the values in the amniotic fluid both in normal pregnancy and in foetal distress cases. The following signs were taken as criteria of foetal distress: (1) Foetal heart rate more than 160 beats or less than 100 beats per minute between uterine contractions; (2) gross irregularities in rhythm causing difficulty in counting the foetal heart sounds, and (3) passage of meconium in liquor amnii. The particular sign or signs must be present persistently in at least three examinations in between uterine contractions over a 15-minute period at 5-minute intervals to be considered a case of foetal distress. It was further corroborated by the Apgar Scores determination which was done one minute after birth of the baby.

Cord blood was collected via doubly clamped cord immediately after delivery and before the first breath was taken. Simultaneously, maternal blood was collected for estimation of pH value, creatinine content and alkaline phosphatase level. The samples of blood were collected and kept anaerobically until pH value was determined.

The pH value was determined at 38°C with the help of pH meter (Elico Model LL 1-10) by the glass electrode method (Wright, 1961). The creatinine content was estimated by Jaffi Picric acid method. The alkaline phosphatase activity was determined by Bodansky's (1932) method having no special reference to heat stable alkaline phosphatase.

Results

Table I shows the pH values of amniotic fluid, maternal blood and cord blood in normal pregnancy and in foetal distress cases.

The average amniotic fluid pH value

TABLE I

pH Value of Amniotic Fluid, Maternal Blood and Cord Blood in Normal Pregnancy and in Foetal Distress

		Amniotic Fluid	Maternal Blood	Cord Blood
Normal pregnancy (20 cases)	Range	7.60-7.80	7.10-7.35	7.0-7.35
	Mean	7.70	7.22	7.10
	S.D.	±0.2	±0.03	±0.22
Pregnancy Associated with Fetal Distress (20 cases)	Range	7.30-7.50	6.70-7.10	6.60-7.10
	Mean	7.35	7.02	6.83
	S.D.	±0.23	±0.32	±0.42
	"t"	*4.2	*3.5	*4.2

"t" values significant.

in normal pregnancy was 7.70 ± 0.2, whereas in foetal distress amniotic fluid pH value was 7.35 ± 0.23. This difference is statistically highly significant.

The cord blood pH value and maternal blood pH value in normal pregnancy were 7.10 ± 0.22 and 7.22 ± 0.03, respectively. The same figures in foetal distress cases were 6.83 ± 0.42 and 7.02 ± 0.32. The comparative alterations of pH value in cord blood and maternal blood are more evident than that in the amniotic fluid.

Table II shows the creatinine content of amniotic fluid, maternal blood and cord blood in normal pregnancy and in foetal distress cases.

The average creatinine content of amniotic fluid in normal pregnancy shows a value of 1.4 ± 0.02 mg. per cent. In cases of foetal distress, this value shows an elevation to 2.33 ± 0.63 mg. per cent. The cord blood creatinine content in normal pregnancy and in distressed newborn babies are 1.80 ± 0.01 mg. and 2.7 ± 0.10 mg. per cent, respectively. Variation in creatinine content in both amniotic fluid and in cord blood of distressed babies bears a close correlation.

Table III shows the alkaline phosphatase level in amniotic fluid, maternal blood and cord blood in normal pregnancy and in foetal distress cases.

TABLE II

Creatinine Content of Amniotic Fluid, Maternal Blood and Cord Blood in Normal Pregnancy and in Foetal Distress

		Amniotic Fluid mg%	Maternal Blood mg%	Cord Blood mg%
Normal pregnancy (20 cases)	Range*	0.9-1.8	1.64-1.82	1.72-1.92
	Mean	1.4	1.68	1.80
	S.D.	±0.02	±0.02	±0.01
Pregnancy associated with foetal distress	Range	1.9-2.73	1.78-1.98	2.29-2.95
	Mean	2.33	1.89	2.7
	S.D.	±0.63	±0.35	±0.10
	"t"	*2.5	*2.5	*2.3

* "t" values significant.

TABLE III

Alkaline Phosphatase Level in Amniotic Fluid, Maternal Blood and Cord Blood in Normal Pregnancy and in Foetal Distress (Bodansky Unit/100 ml.)

		Amniotic Fluid	Maternal Blood	Cord Blood
Normal pregnancy (20 cases)	Range	1.5-2.0	7.5-8.1	3.9-4.4
	Mean	1.7	7.8	4.1
	S.D.	±0.06	±0.04	±0.08
Pregnancy associated with foetal distress (20 cases)	Range	4.0-10.0*	7.5-8.4	3.4-4.8
	Mean	7.0	7.9	4.1
	S.D.	±0.5	±0.08	±0.08

* Significant change.

The average alkaline phosphatase level of amniotic fluid in normal pregnancy is 1.7 ± 0.06 Bodansky units per 100 ml. In cases of foetal distress, this value rises to 7.0 ± 0.5 Bodansky units per 100 ml. This variation in alkaline phosphatase level of amniotic fluid in foetal distress cases is statistically significant.

Quantitative variation in creatinine content and alkaline phosphatase level of maternal blood in normal pregnancy and in foetal distress cases are quite significant (Tables II and III) although a linear relationship could not be inferred.

Discussion

From the results it is evident that the variation in pH value of amniotic fluid in pregnancies associated with foetal distress is significant. These findings are in accordance to earlier observations of De *et al*, (1969a, b). It is definite in spite of inorganic buffer of amniotic fluid, pH value shifts to acidic side. pH value of maternal blood also alters with foetal distress. This finding is in agreement with the observation of Debdas and Roy Chowdhury (1970). The acidotic or metabolic change in the mother may initiate foetal distress which in turn produces mild degree of toxaemia associated with hypoxia. The latter perhaps produces further acidity and foetal distress. Thus a vicious cycle is established.

There is a rise in creatinine content of maternal blood associated with foetal distress resulting in increased chorionic vascular permeability. The increased creatinine content of liquor amnii may also be derived from placenta due to excess metabolism in foetal distress. The released creatinine in the liquor surpasses that of maternal blood. This is confirmed from the present finding in cord blood creatinine content of normal and distressed newborn babies.

Amniotic fluid contains fair number of cells like other cellular granules and there is definite alkaline phosphatase activity of these amniotic cells during normal pregnancy. In foetal distress, there is definitely increased tendency of alkaline phosphatase activity in amniotic fluid indicating an indirect reflection of enhanced amniotic cellular metabolism (Boyer 1961).

The maternal serum alkaline phosphatase activity in foetal distress remains unaltered which indicates that the enzyme activity in maternal serum is not related to foetal distress. It is interesting to note that cord blood alkaline phosphatase activity in foetal distress remains unaltered, whereas marked increase of amniotic fluid enzymic activity in foetal distress suggests an immediate change of metabolism in the foetus. As such, foetal distress is due to localised metabolic change rather than foeto-maternal generalised metabolic alteration.

Summary and Conclusion

The pH value, creatinine content and alkaline phosphatase level of amniotic fluid, maternal blood and cord blood were estimated in 20 cases of foetal distress and also in 20 control cases of normal pregnancy.

Considerable acidosis, elevated creatinine values and increased alkaline phosphatase activity were found in amniotic fluid in pregnancies associated with foetal distress. In the latter it was observed that the degree of acidosis, creatinine value and alkaline phosphatase activity ran a parallel course both in amniotic fluid and cord blood with the severity of foetal hypoxia.

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