

A STUDY OF ELECTROLYTE CONTENTS IN MATERNAL AND NEONATAL BLOOD IN NORMAL AND TOXAEMIA OF PREGNANCY*

by

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Introduction

Pregnancy is an altered physiological condition and in it we find the growth and development of the foetus, and this growth, if it be normal, must be associated with the maintenance of normal stability of the internal environment which is composed of water and electrolytes. Sodium is the chief extracellular ion whereas potassium is the intracellular ion. The functions of these two electrolytes are concerned with the maintenance of water content in the respective zones, excitabilities of the tissues, acid-base equilibrium and other manifestations associated with life.

Survey of the literature (Chesley, 1950; Dieckmann, 1952; McCance and Young, 1941) clearly points out the derangement in sodium and potassium metabolism of the body associated with pregnancy, but literature is inadequate regarding the electrolyte contents in the foetal blood in normal and abnormal pregnancies. As has been stated previously the importance of electrolytes in the maintenance of water in the different compartments, particularly in the cells for their growth, was considered worth while to study the electrolytic changes in maternal and neonatal blood in normal and toxæmia of pregnancy with particular attention to

correlate the gross abnormalities in the sodium and potassium contents in the blood, so as to assess the degree of prematurity of the newborn.

Material and Methods

The total number of cases investigated was 100 out of which 50 belonged to normal pregnancy, 20 to mild pre-eclampsia, 20 to severe pre-eclampsia and 10 to eclampsia groups. All these cases were selected from the Department of Obstetrics and Gynaecology, Medical College, Calcutta, India, during the period from 1966 to 1968. Blood was collected simultaneously from the maternal end of the severed umbilical cord as soon after the birth of the baby as possible and also from the mother. Again on the 6th day of puerperium, fasting blood samples were taken both from the mother and the newborn baby. The flame photometric measurement in Zeiss Flame Photometer was used for the quantitative determination of sodium and potassium contents in blood.

Results

Sodium Content: The sodium content of maternal and foetal blood in normal pregnancy immediately after delivery and six days after confinement were 333.94 ± 0.8129 and 328.82 ± 0.9198 ; 327.30 ± 1.0122 and 322.68 ± 1.0128 mg. per 100 ml. respectively (Tables 1 and 2).

In mild and severe pre-eclampsia and eclampsia (Tables I and II) the values for

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TABLE I
Sodium Content of Maternal and Foetal Blood Immediately after Confinement

	Mg. per 100 ml.	
	Mean	Standard error
(a) Normal pregnancy:		
Maternal blood	333.94	0.8129
Foetal blood	327.30	1.0122
Difference between means	6.64	
't'	9.223	(Highly significant)
(b) Toxaemic pregnancy:		
(i) Mild pre-eclampsia:		
Maternal blood	348.6	1.7035
Foetal blood	344.70	1.7713
Difference between means	3.90	
't'	3.322	(Significant)
(ii) Severe pre-eclampsia:		
Maternal blood	356.45	0.7487
Foetal blood	347.15	0.8054
Difference between means	9.30	
't'	11.602	(Highly significant)
(iii) Eclampsia:		
Maternal blood	359.5	0.9804
Foetal blood	350.8	0.8054
Difference between means	8.7	
't'	9.109	(Highly significant)

the maternal blood were 348.6 ± 1.7035 and 338.45 ± 2.6818 ; 356.45 ± 0.7487 and 349.55 ± 0.9954 ; 359.5 ± 0.9804 and 350.6 ± 1.1566 mg per 100 ml. respectively.

In foetal blood the sodium content under the similar conditions (Tables I and II) were 344.70 ± 1.7713 and 337.05 ± 2.2425 ; 347.15 ± 0.8054 and 340.30 ± 0.7951 ; 350.8 ± 0.5538 and 342.5 ± 0.5217 mg per 100 ml. respectively.

Potassium Content: The potassium content of maternal blood in normal pregnancy immediately after confinement and six days after confinement (Tables III and IV) were 19.336 ± 0.0963 and $20.406 \pm$

0.1269 mg per 100 ml. respectively. In mild and severe pre-eclampsia and eclampsia the potassium content of maternal blood immediately after confinement and six days after confinement (Tables III and IV) were 21.22 ± 0.3462 and 22.805 ± 0.3434 ; 23.61 ± 0.3209 and 22.745 ± 0.1979 ; 23.47 ± 0.5984 and 22.79 ± 0.4886 mg. per 100 ml. respectively.

In foetal blood under similar conditions (Tables III and IV) the potassium contents were 38.925 ± 0.6216 and 36.13 ± 0.4785 ; 40.77 ± 0.3332 and 37.55 ± 0.4341 ; 41.88 ± 0.4886 and 39.57 ± 0.4138 mg. per 100 ml. respectively.

TABLE II
Sodium Content in mg. per 100 ml. of Maternal and Foetal Blood 6 days after Confinement

	Mg. per 100 ml.	
	Mean	Standard error
(a) <i>Normal pregnancy:</i>		
Maternal blood	328.82	0.9198
Foetal blood	322.68	1.0228
Difference between means	6.14	
't'	6.528	(Highly significant)
(b) <i>Toxaemic pregnancy:</i>		
(i) <i>Mild pre-eclampsia:</i>		
Maternal blood	338.45	2.6818
Foetal blood	337.05	2.2425
Difference between means	1.40	
't'	0.4357	(Insignificant)
(ii) <i>Severe pre-eclampsia:</i>		
Maternal blood	349.55	0.9954
Foetal blood	340.30	0.7951
Difference between means	9.25	
't'	8.332	(Highly significant)
(iii) <i>Eclampsia:</i>		
Maternal blood	350.6	1.1566
Foetal blood	342.5	0.5217
Difference between means	8.1	
't'	7.297	(Significant)

TABLE III
Potassium Content of Maternal and Foetal Blood Immediately after Confinement

	Mg. per 100 ml.	
	Mean	Standard error
(a) <i>Normal pregnancy:</i>		
Maternal blood	19.36	0.0963
Foetal blood	33.62	0.2629
Difference between means	14.26	
't'	57.161	(Highly significant)
(b) <i>Toxaemic pregnancy:</i>		
(i) <i>Mild pre-eclampsia:</i>		
Maternal blood	21.22	0.3462
Foetal blood	38.925	0.6216
Difference between means	17.705	
't'	-37.981	(Highly significant)
(ii) <i>Severe pre-eclampsia:</i>		
Maternal blood	23.61	0.3209
Foetal blood	40.77	0.3332
Difference between means	17.16	
't'	-39.596	(Highly significant)

TABLE IV
Potassium Content of Maternal and Foetal Blood six days after Confinement

	Mg. per 100 ml.	
	Mean	Standard error
(a) <i>Normal pregnancy:</i>		
Maternal blood	20.406	0.1269
Foetal blood	30.85	0.2668
Difference between means	10.444	
‘t’	-43.056	(Highly significant)
(b) <i>Toxaemic pregnancy:</i>		
(i) <i>Mild pre-eclampsia:</i>		
Maternal blood	22.805	0.3434
Foetal blood	36.13	0.4785
Difference between means	13.325	
‘t’	-24.936	(Highly significant)
(ii) <i>Severe pre-eclampsia:</i>		
Maternal blood	22.745	0.1979
Foetal blood	37.55	0.4341
Difference between means	14.805	
‘t’	-33.187	(Highly significant)
(iii) <i>Eclampsia:</i>		
Maternal blood	22.79	0.4886
Foetal blood	39.57	0.4138
Difference between means	16.78	
‘t’	-32.673	(Highly significant)

Discussion

From the analysis of the above figures the sodium content of maternal and foetal blood immediately after confinement and six days after confinement was found to have significantly increased in different grades of toxæmia of pregnancy than in normal pregnancy. Six days after confinement, the sodium contents of maternal and foetal blood were found to be lowered in toxæmia of pregnancy but still the figures were higher than those found in normal pregnancy. The reported findings of increased sodium content of foetal blood in toxæmia of pregnancy and in eclampsia may inhibit the anterior pituitary according to Selye's (1943) "Push-pull doctrine" of endocrine function from

liberating the factors necessary for growth of such babies. This cumulated sodium produces accumulation of extracellular fluid with the tendency of interfering with the process of growth.

Six days after birth the sodium contents of maternal and foetal blood diminish significantly in toxæmia of pregnancy with significant loss of weight in babies born of toxæmic mothers. This reduction in the sodium content may be due to withdrawal of the inhibitory states of the anterior pituitary (Salye and Hall 1943) a few days after confinement.

The potassium content in maternal blood of normal pregnancy, on the other hand, is within the physiological limit whereas in toxæmia of pregnancy and

eclampsia the figures are slightly increased depending upon the severity of toxæmia. In case of foetal blood, the potassium content is very high immediately after birth and becomes still higher in different grades of toxæmia of pregnancy.

Six days after birth, the potassium content of foetal blood in toxæmia of pregnancy shows lowered value though it is still higher than the adult standard.

The reported significant higher figures of the potassium content of foetal blood than that of maternal blood in normal and toxæmia of pregnancy is a curious phenomenon. It is a paradox how the observed high potassium level which is lethal to adults is compatible to the newborn babies.

The maintenance of potassium content inside the cells depends upon the presence of adequate amount of glucose (Harris, 1941; Darowaski, 1941). The findings of significant lowered glucose content of foetal blood in toxæmia of pregnancy (Roy Chowdhury *et al* 1962) may interfere with retention of potassium in the cells leading to increase in potassium in the cells and thus leading to increase in potassium content of the foetal blood.

The concomitant sodium and water retention tend to displace potassium from the cells (Darrow, 1948) resulting in higher level of potassium in foetal blood. The hyperpotassaemia in foetal blood may again be due to haemolysis of the immature erythrocytes (Smith, 1945), which are found in excess in foetal blood. Possibly hyperpotassaemia is physiological due to heavy demand made by the foetal tissues for the formation and growth of the cells.

Whatever may be the cause of hyperpotassaemia in the newborn babies of toxæmic mothers further investigations should be carried out to elucidate how

these babies can continue their existence with such higher values of potassium in blood during neonatal life.

Summary

1. A careful analysis of electrolytic changes has been made in maternal and neonatal blood immediately after confinement and six days after confinement. The selection of this interval was made in the light of high incidence of neonatal deaths during this period.

2. The present observation was made on one hundred cases involving fifty normal pregnancies, twenty mild pre-eclampsia, twenty severe pre-eclampsia and ten eclampsia.

3. Analysis of electrolytic changes clearly elucidated significant increase of the sodium content in the maternal and neonatal blood in different grades of toxæmia of pregnancy pointing to the high incidence of prematurity in such conditions.

4. Analysis of potassium concentration, both in maternal and neonatal blood, points to the higher concentration of potassium in the neonatal blood in normal as well as toxæmia of pregnancy. Such a high concentration of potassium in neonatal blood which is known to be lethal even in adults does not seem to produce appreciable adverse effect on the newborn baby.

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