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ELECTROLYTES IN AMNIOTIC FLUID IN NORMAL AND TOXAEMIC PREGNANCY WITH ITS CO-RELATION TO FOETAL AND PLACENTAL WEIGHT

by

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Hellmann *et al* (1948) by injecting heavy water into the maternal circulation showed that it appears rapidly in the foetal blood as early as 12th week of gestation. They also found that permeability to the water increases with gestational age until 35 weeks, after which there is a sharp decline.

With the growth of foetus, the concentration of sodium and potassium increases, but the proportion of these two ions vary and each hour 13 mEq. of sodium and 0.6 mEq. of potassium is exchanged (Vosburgh *et al*, 1948). Potassium is exchanged less freely than sodium which in turn is exchanged freely between maternal and placental circulation (Flexnar *et al*, 1948), though at

a rate one-fifth as slowly as that of water (Vosburgh *et al*, 1948).

Makepeace *et al* (1931) reported the mean sodium values of maternal serum at term as 311 mgm. per cent while that of amniotic fluid as 291 mgm. per cent. The foetal urine, however, had a range of sodium concentration from 6.3 mgm per cent to 26 mgm per cent.

Battaglia *et al* (1959), however, found the maternal plasma sodium values beyond 37 weeks of pregnancy within a range of 133.6 to 141 mgm. per cent, with an average of 138 mgm. per cent, while the amniotic fluid in the same patients had the sodium content within the range of 119.5 to 133 mgm. per cent with a mean value of 125.3 mgm. per cent.

Lind and Cheyone (1969) found that the sodium concentration of the amniotic fluid was highly in correlation with osmolarity and they reported that the sodium content of the liquor falls with increasing

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gestation as much the same way as osmolarity.

The potassium concentration of the maternal plasma and amniotic fluid is much less than that of sodium. Battaglia *et al* (1959) found only a little difference between maternal plasma and the amniotic fluid potassium, the mean of amniotic fluid potassium was 0.5 mEq. higher than that of maternal plasma potassium which was 3.4 mEq./litre.

Gillibrand (1969) reported the mean value of maternal serum potassium level as 3.97 mEq. per litre, while he found the mean amniotic fluid level as 3.8 mEq. per litre. He found that the amniotic fluid potassium remained in approximate equilibrium with maternal serum throughout pregnancy.

Makepeace *et al* (1931) reported the average value of chloride content in amniotic fluid 620 mgm. per cent. Sozanskii (1961) found no fall in amniotic fluid chloride content with advancing pregnancy.

Gillibrand (1969) found no change in chloride content of the maternal serum during entire period of gestation, but as the pregnancy advanced there was a fall in amniotic fluid chloride along with sodium.

Electrolytes in Toxaemia of Pregnancy

Dieckmann and Pottinger (1956) reported that the mean values of sodium chloride and potassium were the same in pre-eclampsia and hypertensive diseases as that in normal pregnancy. The range of sodium was 127 to 142 mEq./litre and for potassium 3.9 to 5.6 mEq./litre, while at term in normal pregnancy the range was 132 to 137 mEq./litre for sodium and 4.6 to 5.2 mEq./litre for potassium.

Howard (1963) made a comparative study of electrolytes (sodium and potassium) concentration in serum and amniotic fluid and the results are given as below:

TABLE I
Mother's Serum and Amniotic Fluid Electrolytes in Normotensive Patients

Serum Electrolytes		Amniotic Fluid Electrolytes	
Na mEq./litre	K mEq./litre	Na mEq./litre	K mEq./litre
142	4.4	133	3.8
141	5.1	144	5.6
138	4.5	126	5.2
141	4.9	129	5.3
Mean	140	4.7	127
			5.0

TABLE II
Showing Maternal Serum and Amniotic Fluid Electrolytes in 21 Patients of Pre-eclamptic and Eclamptic Toxaemia

Serum Electrolytes		Amniotic Fluid Electrolytes	
Na mEq./litre	K mEq./litre	Na mEq./litre	K mEq./litre
141	4.8	126	4.4

Howard (1963) found that though the amniotic fluid sodium ion concentration was normal in toxæmia of pregnancy, the concentration of amniotic fluid potassium ion in pre-eclampsia was lower than that in normotensive patients.

Material and Method

The present study consists of estimation of electrolytes (sodium, potassium and chloride) of the amniotic fluid collected during labour from 15 normal pregnant and 20 cases suffering from toxæmia of pregnancy, admitted in Zenana Hospital, Jaipur from 6-7-1969 to 21-5-1970.

Normal cases were the women at full term pregnancy, of any gravida with haemoglobin not less than 10 gm. per cent. The toxæmic cases included pre-eclampsia and eclampsia. Severity of toxæmia was evaluated and cases were grouped according to criteria given by Eastman and Hellmann (1961). On admission each case was examined for evidence of anaemia. The general systemic and obstetric examinations were done. The amniotic fluid was taken directly by puncturing the membranes at the end of first stage of labour with 18 gauge B.D. type needle and preserved in dry autoclave vial. Determination of sodium and

potassium in amniotic fluid was done by Flame Photometry.

The new born and placental weights were recorded in gm.

Observations

The following table shows the average value of electrolytes (Na, K and Cl) in amniotic fluid amongst various groups of toxæmia and in normal cases.

The average sodium concentration in toxæmic cases was definitely higher (303.44 mgm. per cent) than that in normal cases (268.10 mgm. per cent).

The variations in the average potassium values of amniotic fluid were insignificant, though there was clear difference of about 2 (0.5 mEq./litre) to 3 mgm. per cent (0.75 mEq./litre) between severe pre-eclamptic toxæmia and eclampsia and normal and mild cases of pre-eclamptic toxæmia.

The average values of chloride in amniotic fluid of normal cases was 312.77 mgm per cent which is definitely lower than the mean average of toxæmia cases (339.84 mgm%).

The variations in the electrolytes of the amniotic fluid of normal and toxæmic cases with regard to the maturity is given in Table IV.

The variation in electrolytes of amnio-

TABLE III
Average Values of Electrolytes (Na, K, Cl)

Group of cases	No. of cases	Average Na in mg%	Average K in mg%	Average Cl in mg%
Normal	15	268.10	13.571	312.77
Mild P.E.T.*	7	299.11	13.70	333.53
Severe PET*	4	305.95	16.56	358.55
Eclampsia	9	305.64	15.46	336.45
Average of Total toxæmic cases	20	303.44	15.07	339.84

* PET. Pre-eclamptic toxæmia.

TABLE IV
Variations in Electrolytes of Amniotic Fluid According to Maturity of Foetus

Electrolytes	Mature		Premature less than 2500 gms.	
	Normal mg%	Toxaemia mg%	Normal mg%	Toxaemia mg%
Na	266.90	300.17	272.93	298.91
K	14.33	13.69	10.65	16.08
Cl	310.23	336.52	322.95	340.82

tic fluid in normal and toxaemic cases with regard to the maturity of foetus is given below in Table IV.

The above table shows that the average sodium concentration of amniotic fluid of normal cases differed from toxaemic cases by about 30 mgm. and there was no significant difference between the average values of mature and premature groups.

The amniotic fluid of normal mothers who had mature new born babies showed higher average potassium by 3.5 mg. than those who had premature babies, whereas in toxaemic mothers who had premature babies had about 2.5 mgm. potassium above that of toxaemic mothers of mature babies showing thereby a reversal from normal.

The average values of chlorides of amniotic fluid of normal cases showed a variation of about 12 mgm. between mature and premature groups, while in toxaemic cases it was about 4 mgm. However, the chloride of normal was lower by about 20 mg. than the average in toxaemic cases in both mature and premature groups.

The following table shows the average weight of placenta in normal and various groups of toxaemia of pregnancy.

It was observed that the average weight of the placenta decreased with the severity of the toxaemia. The maxi-

TABLE V
Weight of Placenta and Toxaemia of Pregnancy

Group of cases	Average weight of placenta in gm.
Normal	411.33
Mild PET*	357.10
Severe PET*	325.00
Eclampsia	252.70

*PET. Pre-eclamptic toxaemia.

mum average weight of placenta was 411.33 gm. in normal control cases and the minimum average weight was 252.70 gm. in eclampsia group, whereas mild pre-eclamptic toxaemia and severe pre-eclamptic toxaemia groups showed 357.10 gm. and 325.00 gm. respectively.

An attempt has been made to divide the normal and toxaemia cases into three groups depending upon the weight of the placenta. First group consists of cases in normal and toxaemia of pregnancy having a placental weight upto 200 gm. Second group runs from 201 to 400 gm. and third group comprises the cases having placental weight above 400 gms.

Table VI shows the variations in amniotic fluid electrolytes and placental weight.

The above table shows that the average sodium levels did not vary significantly in normal or toxaemic cases or with

TABLE VI
Variations in Amniotic Fluid Electrolytes and Weight of Placenta

Electrolytes of amniotic fluid.	Placental weight groups					
	Group I 0 — 200 gms.		Group II 201 — 400 gms.		Group III above 400 gms.	
	Normal mg%	Toxaemia mg%	Normal mg%	Toxaemia mg%	Normal mg%	Toxaemia mg%
Na	300.00	291.38	260.94	313.25	270.71	301.71
K	11.70	16.97	12.86	14.04	14.58	13.31
Cl	350.00	339.93	304.20	320.16	316.62	295.68

various placental groups. The average potassium concentrations showed increasing concentrations along with the increase in the placental weight in normal cases, whereas the toxaemia cases showed that there was a decrease in amniotic fluid potassium with the rise of placental weight. The average chloride concentrations of the amniotic fluid gradually decreased as the placental weight increased in toxaemia cases similar to potassium changes, though these changes were inconclusive in normal cases.

Discussion

Howard (1963) made a comparative study of electrolytes (Na, K) concentrations in serum and amniotic fluid. He observed that the average amniotic fluid sodium concentration in normotensive patients was 127 mEq./litre (292.10 mg. per cent) and the potassium 5 mEq./litre (19.5 mg. per cent); whereas, he found in amniotic fluid of toxaemia patients the average values of sodium as 126 mEq./litre (289.8 mgm. per cent) and potassium 4.4 mEq./litre (17.16 mgm. per cent). In our study we found that the average value of sodium in normal amniotic fluid was 268.1 mg. and the potassium as 13.5 mg. per cent; whereas, the average in toxaemia was 303.44 mgm. per cent for sodium and 15.07 mgm. per cent for potassium.

Hence, the average sodium concentration in toxaemic amniotic fluid was definitely higher than that in normal in the present series. However, the average sodium values did not change with severity of toxaemia, whereas the potassium values were higher (16.56 and 15.54 mg. per cent) in severe pre-eclamptic toxaemia and eclampsia as compared to normal and mild pre-eclamptic toxaemia (13.57 and 13.70 mgm. per cent).

The average chloride concentration of amniotic fluid in normal cases was 312.77 mg. per cent as compared to 339.84 mg. per cent in toxaemic amniotic fluid. We found a definite raised value in toxaemia cases as compared to normal, though chloride is supposed to be a passive ion for all practical purposes. It is evident that there is a clear difference of about 2 mg. (0.5 mEq./litre) to .3 mgm. (0.83 mEq./litre) present between severe pre-eclamptic toxaemia and eclampsia and normal and mild pre-eclamptic toxaemia.

The average sodium concentration of amniotic fluid of normal cases differs from the toxaemia cases by about 30 mg. in both mature and premature groups. There is no significant difference between average values of mature and premature.

The amniotic fluid from the normal mothers who had matured new born showed higher average potassium by 3.5 mg.

than those who had premature new born, whereas in toxæmic mothers who had premature baby had about 2.5 mgm. potassium above that of toxæmic mothers who had matured babies, showing thereby a reversal from the normal. The average values of chloride of amniotic fluid of normal cases showed variation of about 12 mg. between mature and premature groups, while in toxæmic cases it was about 4 mg. However, the chloride of normal was lower by about 20 mg. than the average in toxæmic cases in both mature and premature groups.

It was evident that the average weight of placenta decreased with the severity of toxæmia as the minimum average weight was 252.79 gm. in eclampsia group. The explanation for it might be improper growth during development of placenta or due to premature aging in toxæmia of pregnancy. An attempt was made to correlate the changes in the constituents of amniotic fluid to the weight of the placenta.

The average potassium concentration increased along with the increase in placental weight in normal cases, whereas in toxæmic cases it decreased with the increase in placental weight i.e. there was reversal of potassium pattern. The changes in the sodium and chloride were inconclusive.

Summary and Conclusion

Sodium

(1) The average sodium level in amniotic fluid was higher in toxæmia cases than in normal cases.

(2) The sodium concentration in amniotic fluid had no relation with maturity of new born.

(3) The variations in sodium concen-

tration in relation to placental weight were insignificant.

Potassium

(1) The average potassium concentration of amniotic fluid increased in toxæmia cases than in normal cases.

(2) In normal cases the average potassium concentration decreased with the prematurity, whereas in toxæmia it increased with prematurity "a reversal effect".

(3) In normal cases the average potassium concentration increased with the increase in placental weight, whereas in toxæmia it decreased with the increase in placental weight "a reversal effect".

Chloride

Being a passive ion the changes have been variable and inconclusive.

The average placental weight decreased with the severity of toxæmia. There was reversal of the potassium pattern i.e. potassium concentration increased with increase in placental weight in normal cases, whereas in toxæmic cases it decreased with the increase in placental weight.

The changes in potassium levels as reversal in toxæmia cases from normal cases can be explained on the basis of excessive breakdown of the amniotic cells or a primary derangement in its diffusion.

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