INTER-RELATIONSHIP OF THE FREE AMINOACIDS AND ALPHA AMINOACID NITROGEN IN AMNIOTIC FLUID WITH THE MATERNAL AND CORD SERA AND THE URINE OF NEWBORN

by

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The mechanism of formation of the amniotic fluid has not been clearly elucidated and the origin of the proteins of human amniotic fluid is the subject of much conjecture. In early pregnancy the liquor is similar to plasma in composition while in later pregnancy its protein composition differs from that of plasma due to the changes in concentration of the free aminoacids. (Bangham 1960; McKay, *et al* 1968)) suggested that amniotic fluid of early pregnancy has a general protein structure of maternal interstitial fluids and this they presumed was a dilute dialysate of maternal serum. Seeds (1965) observed that the composition of the fluid at eight weeks of gestation was quite similar to the maternal interstitial fluid except for a slighly higher chloride and lower protein concentration.

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Abbas and Tovey (1960) demonstrated the similarity of electrophoretic patterns of amniotic fluid proteins and those of maternal serum.

An absence of large protein molecules in amniotic fluid indicates that the proteins of amniotic fluid have undergone sequestration, perhaps by filtration or by diffusion. In this respect the amniotic proteins appeared similar in composition to other interstitial fluids. The sequestered components of amniotic fluid nevertheless showed much resemblance in distribution to that of foetal serum. This fact led some support to a proposition of macro-molecular transudation of proteins from various foetal tissues rather than by secretion or filtration from maternal circulation (Bangham, 1960).

Brezezinski, Sadobsky and Shaffir (1961), on the other hand, have observed that the general electrophoretic pattern of human amniotic fluid proteins resembled that of cord serum rather than the maternal serum and hence they postulated that the proteins in amniotic fluid are derived from the foetus and not the mother.

It is believed that some part of the amniotic fluid is a product of selective secretion by the amnion but there has been no direct experimental evidence (Dancis *et al* 1957).

The role of micturition in the formation of amniotic fluid was suggested by some

authors (Brew, 1957; Hutchinson, 1967; Seeds, 1965). Enhorning and Adams (1965) have reported that 0.026-0.13 ml. per kg. per minute of amniotic fluid is produced in the respiratory tree of foetus.

There are a few reports (Abbas and Tovey 1960; Bangham, 1960; Brezezinski, Sadoubsky and Shaffir, 1961; McKay, Richardson and Hertig, 1958; and Stander, Mcnutt, Barton and Werts, 1964) on the protein electrophoresis of amniotic fluid but hardly any work has been reported on the aminoacid pattern in the human amniotic fluid. Wirtschafter (1958) observed lower concentration of specific free aminoacids in amniotic fluid than in foetal and maternal sera in seven subjects. The specific aminoacids and alpha amino nitrogen in amniotic fluid, maternal and cord sera and in baby's urine may show some inter-relationship and present a clue regarding the origin and role of amniotic fluid.

Material and Methods

This study was a part of the logitudinal project on quantitative and qualitative serum and urinary aminoacids, alpha aminoacids nitrogen and serum proteins fractions in newborns and their mothers, and a follow-up for a period of one year, (Panvalkar, Parekh, Shah and Udani (1970); Shah, Panvalkar and Udani) carried out during July 1966 to April 1968 at the Institute of Child Health and Obstetric Department of Grant Medical College and J. J. Group of Government Hospitals, Bombay.

Thirty-one normally delivered newborns and their fairly nourished healthy mothers where the free aminoacids and alpha aminoacid nitrogen of amniotic fluid, maternal and cord sera and baby's urine could be estimated were taken up for this study. The mothers of these babies were thoroughly examined and their weights, heights and nutritional status were recorded. Their diet and socio-economic status were enquired in details. The period of pregnancy was determined by the history, obstetrician's independent opinion and by the clinical assessment of maturity of the newborns (Bhatia, Shah, Shah and Udani). The cases with administration of anaesthesia, toxaemia of pregnancy, chronic renal disease, severe anaemia or malnutrition were not taken up.

Amniotic fluid was collected by aspiration through intact membranes at the time of labour by the obstetrician. After birth of a baby umbilical cord was cleaned and clamped on cessation of pulsations and cut. Ten ml. of blood was collected from the placental end of the cord directly into the sterile test tube. The mother's blood was taken within a few minutes of the delivery. Later on the serum samples were separated and a sample was discarded if there was any evidence of haemolysis. The placenta was examined for any abnormality like infarct, haemorrhage, calcification or low weight.

The newborns were examined after birth and those who had any signs of asphyxia neonatorum or any other gross abnormalities were not included in the study. These babies were re-examined on the next day and based on various measurements, neuro-motor signs and other findings, their maturity was assessed (Bhatia, Shah, Shah and Udani). The weight of these babies was taken on specified baby weighing scale and length was measured on infanto-meter.

Just for sake of comparison the babies were divided into three groups according to their birth weights and period of gestation. Group I consisted of twenty-one full-term babies who were weighing above 2500 gms. There were seven newborns in the group II which was formed

of small-for-dates but otherwise full-terms. Three immatures whose gestation period was less than 37 weeks were put in the group III.

Random specimens of 10 ml. of urine of newborns were collected by using condoms in case of male and plastic funnel for female babies. In some subjects mid-stream urine was collected. It was not possible to collect twenty-four hours' urine due to various technical difficulties. However, this was done before any feed was offered. The urine samples were desalted by electric desalting equipment of Baird and Tatlock. The serum and urine samples were then submitted for two dimensional paper chromatography. The quantitative analysis of aminoacids was carried out with modification of Iyer's (1954) technique. The alpha aminoacid nitrogen in serum and urine was estimated by Russel's method (1944).

Observations

In all, thirty-one newborns and their mothers were studied. The Table 1 gives the mean values of the alpha amino-acid nitrogen in amniotic fluid, maternal and cord sera and in baby's urine. The levels were highest in the babies' urine (16.14-53.33 mg%) and lowest in the amniotic fluid (4.18-5.60 mg%). The alpha aminoacid nitrogen was more in the cord serum as compared to the maternal serum. The values for amniotic fluid cord serum and baby's urine were raised in the immature babies (group III).

All the aminoacids were not traced in all the subjects. The percentage of the subjects in whom individual aminoacids were present is depicted in Table 2. In amniotic fluid, not a single aminioacid was traced in all the cases. Greater number of aminoacid spots were present in larger number of mature babies weighing above 2500 gms. Glutamic acid, cystine and lysine were traced in higher percentage of small-for-dates babies as compared with the groups I and III. Tyrosine and asparagine were absent in the amniotic fluid of all the groups. Histidine, aspartic acid, valine area and leucine area in the groups II and III and taurine in the group III were not detected. Glycine, serine, alanine, lysine glutamic acid, glutamine and cystine were traced in more than 50% of the cases in the groups I and II.

All aminoacids which were traceable with present methods were detected in maternal and cord sera in all the cases except for tyrosine and asparagine, which were present only in the group I. There seems to be some similarity in the observations of these two sera. Alanine, glycine, glutamic acid, serine and cystine were traced in the sera of more than 90% of the subjects of the three groups.

In babies' urine, leucine, tyrosine and asparagine were not seen in all the cases and valine and histidine were not spotted in the groups II and III. Likewise in the amniotic fluid none of the aminoacid was

TABLE I

Mean Alpha Aminoacid Nitrogen in Amniotic Fluid, Maternal and Cord Sera and in Baby's Urine expressed in mgm.

Groups	No. of cases	Amniotic & fluid	Mother's serum.	Cord serum	Baby's urine
I	21	4.35	5.47	6.84	17.10
II	7	4.18	5.85	7.06	16.14
III	3	5.60	5.70	11.75	53.33

seen in all the cases. Glutamic acid and glycine were traced in more than 50% subjects in three groups.

The Table 3, 4 and 5 present the means

TABLE II

The Percentage of Subjects in whom Specific Aminoacids were Detected

Aminoacids	Presence of Aminoacid in Percentage of subjects.											
	Amniotic fluid			Mother's serum			Cord serum			Baby's urine		
	I	II	III	I	II	III	I	II	III	I	II	III
Alanine	76.1	71.4	33.3	100%	100	100	100	100	100	80.9	42.3	33.3
Glycine	90.4	85.7	66.6	100	100	100	100	100	100	80.9	85.7	66.6
Lysine	61.8	71.4	..	90.4	71.4	100	100	85.7	100	38.1	—	33.3
Taurine	28.5	28.6	—	76.1	57.1	66.6	90.4	100	100	38.1	57.1	66.6
Glutamine	71.4	57.1	53.3	95.2	100	100	71.4	85.7	100	28.5	11.3	—
Glutamic acid	38.1	85.7	33.3	95.2	100	100	100	100	100	76.1	71.4	66.6
Serine	80.9	57.1	33.3	95.2	100	100	90.4	100	100	57.1	42.8	66.6
Threonine	42.8	28.6	33.3	57.1	85.7	100	71.4	85.7	66.6	28.5	28.6	—
Histidine	9.5	—	—	42.8	43.9	33.3	52.3	14.3	33.3	23.8	—	—
Aspartic acid	19.0	—	—	47.6	43.9	100	66.6	57.1	33.3	42.8	28.6	33.3
Cystine	42.8	71.4	33.3	95.2	100	100	96.4	100	100	61.8	42.8	66.6
Cystic acid	42.8	28.6	33.3	76.1	85.7	100	76.1	71.4	66.6	38.1	14.3	33.3
Valine area	14.3	—	—	61.9	71.4	100	61.8	57.1	33.3	4.76	—	—
Leucine area	9.5	—	—	33.3	71.4	100	28.6	42.8	33.3	—	—	—
Tyrosine	—	—	—	14.3	14.3	—	9.5	—	—	—	—	—
Asparagine	—	—	—	47.6	—	—	—	—	—	—	—	—

TABLE III

The Free Aminoacids in Amniotic Fluid, Maternal & Cord Sera and in Baby's Urine of the Group I Subjects

Aminoacid	Mean and Range of Aminoacids in Mgs.							
	Amniotic fluid		Mother's serum		Cord serum		Baby's urine.	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Alanine	2.71	0.50—5.0	3.11	0.50—7.50	4.17	0.50—8.60	1.69	0.15—3.90
Glycine	1.29	0.23—3.00	1.31	0.23—3.91	1.93	0.23—5.40	2.34	0.10—7.00
Lysine	1.19	0.50—2.5	2.54	0.50—8.00	3.62	0.52—8.50	1.48	0.37—6.20
Taurine	1.65	0.90—4.00	1.67	0.30—3.90	1.95	0.30—4.20	1.79	0.60—4.60
Glutamine	3.00	0.36 9.00	2.75	0.36—8.00	3.06	0.36—7.20	0.74	0.15—2.15
Glutamic acid	1.43	0.36—5.00	3.61	0.36—9.00	3.59	0.36—9.80	0.62	0.10—1.50
Serine	1.29	0.36—3.60	1.81	0.12—4.90	2.37	0.36—4.90	1.27	0.08—2.88
Threonine	1.52	0.30—4.50	1.29	0.30—3.90	1.23	0.30—3.00	0.68	0.18—1.80
Histidine.	2.00	—	1.01	0.33—2.31	1.16	0.30—2.21	1.19	0.43—2.20
Aspartic acid	1.30	0.50—1.20	1.50	0.50—2.50	1.22	0.50—2.50	0.85	0.24—1.50
Cystine	0.61	0.50—1.00	1.69	0.50—4.50	2.59	0.50—5.50	0.77	0.30—2.32
Cystic acid	2.33	0.50—7.00	0.96	0.50—1.50	1.20	0.50—2.50	0.86	0.15—1.80
Valine area	3.16	2.50—3.50	1.58	0.50—5.00	1.67	0.50—4.00	1.80	—
Leucine area	1.00	—	1.34	0.50—3.00	1.08	0.50—1.50	—	—
Tyrosine	—	—	1.28	0.60—2.04	0.90	0.60—1.20	—	—
Asparagine	—	—	0.50	—	0—50	—	—	—
Total tracable aminoacids.	24.48		27.95		32.24		16.08	

TABLE IV

The Free Aminoacids in Aminotic Fluid, Maternal & Cord Sera and in Baby's Urine of the Group II Subjects

Aminoacids	Mean and Range of Amioacids in Mgs.							
	Amniotic fluid		Mother's serum		Cord serum		Baby's urine.	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Alanine	2.72	0.30—5.00	5.32	1.00—9.00	4.76	2.50—8.50	0.93	0.15—1.40
Glycine	1.14	0.23 2.25	1.72	0.23—4.20	2.54	0.92—3.46	2.62	0.20—5.00
Lysine	2.40	0.50—4.50	1.00	0.50—2.50	4.25	2.50.6.00	—	—
Taurine	0.70	0.50—0.90	1.88	0.33—4.50	3.09	1.80—5.80	0.47	0.35—1.00
Glutamine	1.35	0.72—1.80	4.88	0.36—8.00	5.13	1.53—9.72	1.26	—
Glutamic acid	4.80	0.36—7.20	2.24	0.36—5.40	6.12	1.08—12.96	0.32	0.11—0.56
Serine	0.84	0.12—2.16	1.85	0.36—3.60	2.62	0.72—5.04	1.18	0.80—1.60
Threonine	2.10	1.20—3.00	0.70	0.30—1.50	1.83	0.60—3.20	0.67	0.15—1.20
Histidine	—	—	0.43	0.30—0.66	1.80	—	—	—
Aspartic acid	—	—	1.83	0.50—4.00	4.00	2.00—5.00	1.29	0.90—1.68
Cystine	1.50	0.50—5.00	1.57	0.50—4.90	4.57	1.00—6.00	0.83	0.55—1.86
Cystic acid	0.50	—	1.22	0.50—3.50	2.10	0.50—4.50	0.20	—
Valine area	—	—	0.30	0.50—1.00	0.87	0.50—1.50	—	—
Leucine area	—	—	1.00	0.50—3.30	0.50	—	—	—
Tyrosine	—	—	0.60	—	—	—	—	—
Asparagine	—	—	—	—	—	—	—	—
Total traceable aminoacids.	18.05		26.84		44.18		9.77	

TABLE V

The Free Aminoacids in Amniotic Fluid, Maternal & Cord Sera and in Baby's Urine of the Group III Subjects

Aminoacids	Mean and Range of Aminoacids in Mgs.							
	Amniotic fluid		Mother's Serum		Cord Serum		Baby's urine.	
	Mean	Range	Mean	Range	Maen	Range	Mean	Range
Alanine	1.00	—	6.16	2.00 9.00	6.16	1.00—5.50	0.15	—
Glycine	1.03	0.23—1.84	1.06	0.46—1.61	1.84	0.23—2.99	1.22	0.20—2.25
Lysine	—	—	2.66	0.50—5.00	2.73	0.50—4.00	0.15	—
Taurine	—	—	1.65	1.50—1.80	1.20	0.30—2.40	1.86	0.23—1.43
Glutamine	0.72	—	1.67	0.36—3.60	4.61	1.08—9.52	—	—
Glutamic acid	5.40	—	4.38	1.80—6.84	3.56	1.08—6.00	0.20	0.10—0.31
Serine	3.24	—	1.62	1.36—2.52	1.68	0.36—3.12	0.56	0.33—0.80
Threonine	0.50	—	1.36	0.60—2.00	0.43	0.37—0.50	—	—
Histidine	—	—	0.66	—	0.90	—	—	—
Aspartic	—	—	2.17	0.50—5.00	0.72	—	.03	—
Cystine	0.50	—	3.50	0.50—5.00	3.56	0.50—6.50	0.40	0.15—0.72
Cystic acid	0.50	—	1.75	0.50—1.25	0.75	0.50—1.00	0.15	—
Valine area	—	—	1.83	0.50—1.50	—	—	—	—
Leucine area	—	—	1.33	0.50—3.00	—	—	—	—
Tyrosine	—	—	—	—	—	—	—	—
Asparagine	—	—	—	—	—	—	—	—
Total Traceable aminoacids	12.89		31.80		28.14		5.72	

and ranges of specific aminoacids in the amniotic fluid, maternal and cord sera and in babies' urine from the groups I, II and III, respectively. The aminoacids shown below the dotted lines in the tables could better be determined by other methods. The total valine area included tryptophen methionine and valine and leucine area consisted of leucine, isoleucine and phenylalanine as these aminoacids occupy the same place in the paper chromatography.

The total traceable aminoacids were minimum, varying from 5.72 to 16.08 mgm% in babies' urine in these three groups. Similarly values were also lower in an amniotic fluid as compared to the levels in the maternal and cord sera. The cord sera had highest values in the groups I and II.

The values of specific aminoacids were highest in the cord serum and these were relatively comparable with that of mother's serum. These data are discussed elsewhere (Shah, Udani, Panvalkar, Srikhande and Shah). Similarly the observations on the inter-relationship between cord serum and baby's urine aminoacids are also reported by us (Shah, Udani and Panvalkar). In the present study, there was a wide range in the values and some of the specific aminoacids which were traced in higher quantity in one group did not show the same patterns in other group and hence no significant interpretations could be offered.

Threonine was highest in the amniotic fluid of three groups as compared to maternal and cord sera, and baby's urine. Valine and cystic acid were highest in the groups II and III.

The ratios of aminoacids in the amniotic fluid, cord serum and baby's urine to the aminoacids of the maternal serum are presented in the Table 6. The

TABLE VI

Ratios of Aminoacids of (i) Amniotic Fluid, (ii) Cord Serum and (iii) Baby's Urine to the Maternal Serum

Aminoacids	Ratios of Aminoacid								
	Amniotic fluid			Cord serum			Baby's urine		
	Groups			Groups			Groups		
	I	II	III	I	II	III	I	II	III
Alanine	0.87	0.51	0.16	.134	0.89	1.00	0.54	1.17	0.02
Glycine	0.98	0.66	0.97	1.47	1.48	1.73	1.78	1.52	1.15
Lysine	0.46	2.40	—	1.46	4.25	1.02	0.58	—	0.06
Taurine	0.92	0.37	—	1.16	1.64	0.75	1.07	0.25	1.12
Glutamine	1.09	0.27	0.43	1.11	1.05	2.76	0.28	0.26	—
Glutamic acid	0.39	2.14	1.23	0.97	2.73	0.81	0.17	0.14	0.05
Serine	0.71	0.45	2.00	1.31	1.41	1.03	0.70	0.64	0.34
Threonine	1.17	3.00	0.37	0.95	2.61	0.32	0.53	0.96	—
Histidine	1.72	—	—	0.87	4.18	1.36	1.02	—	—
Aspartic acid	1.06	—	—	1.23	2.18	0.33	0.69	0.70	0.47
Cystine	0.36	0.95	0.14	1.53	2.91	1.02	0.41	0.53	0.11
Cystic acid	2.42	0.41	0.28	1.25	1.72	0.43	0.89	0.16	0.08
Valine area	2.00	—	—	1.06	1.45	—	1.14	—	—
Leucine area	0.74	—	—	0.80	0.50	—	—	—	—
Tyrosine	—	—	—	0.70	—	—	—	—	—
Asparagine	—	—	—	1.00	—	—	—	—	—

amniotic fluid/maternal serum ratio for lysine was 2.40 in small-for-dates while it was only 0.46 in full-terms, and lysine was absent in immature baby's amniotic fluid. Similarly, the ratios of glutamic acid and threonine in amniotic fluid were higher in the small-for-dates. There was a similarity in the pattern of cystic acid, cystine, histidine and valine ratios in amniotic fluid and baby's urine.

Table 7 gives the data on the essential, babys' urine. The essential aminoacids were highest in the mature infants and lowest in the immatures, except in the cord blood where the essential aminoacids were highest in the small-for-dates. Semi-essential and non-essential aminoacids were elevated in the group II than in the gronp I and these were lowest in the immatures. The ratio of essential amino-acids to non-essential in the full term babies was above one i.e. 1.63 and 1.90

TABLE VII

The Essential, Semi-Essential and Non-Essential Aminoacids in Amniotic Fluid Cord & Maternal Sera and in Baby's Urine

Aminoacids	Amniotic fluid			Cord serum			Maternal serum			Baby's urine		
	Groups			Groups			Groups			Groups		
	I	II	III	I	II	III	I	II	III	I	II	III
Essentials												
(Histidine, Lysine, Leu-- cine area, Valine area and Threonine).	8.87	4.50	0.50	7.07	9.25	4.06	7.76	3.73	7.84	6.01	0.67	0.15
Semi-essential												
(Cystine, Glycine and Tyrosine).	1.90	2.64	1.53	5.42	7.14	5.40	4.28	3.89	4.56	3.11	3.45	1.62
Non-essential												
(Aspartic acid, Alanine and Glutamic acid).	5.44	7.52	6.40	8.98	14.88	10.44	8.22	9.39	12.71	3.16	2.54	1.38
Ratio of Essential A. A. to Non-essential A. A.	1.63	0.59	0.78	0.079	0.62	0.39	0.94	0.39	0.62	1.90	0.26	0.11

semi-essential and non-essential amino-acids in amniotic fluid, cord and maternal sera and baby's urine. Histidine, lysine, leucine, valine and threonine were includded in the essential aminoacids while semi-essential group consisted of cystine, glycine and tyrosine. Alanine, glutamic acid and aspartic acid were grouped as non-essential (Block and Bolling, 1944).

The levels of the aminoacids were higher in the cord and maternal sera, in that sequence, and lowest in babies' urine. Essential and non-essential amino-acids were more in amniotic fluid than in for amniotic fluid and baby's urine, respectively as compared to 0.079 and 0.94 in the cord and maternal sera, respectively.

Discussion

For over a century, investigators are trying to trace the origin of amniotic fluid. Rosa (1950) observed some evidence of secretory potentialities in the amniotic epithelium. The electron microscopic studies of the human amnion have shown that there are microvilli of the type seen in the gut. The cytoplasm in these cells

have many mitochondria and Golgi apparatus. Histochemically they have been shown to contain a number of enzymes in high concentration and seems to appear highly active. However, it is difficult to explain how one litre of amniotic fluid in a full-term baby weighing 3.4 Kg. is replaced every 2.9 hours as shown by isotopic study (Plent and Hutchinson, 1953). Other investigators have referred this fluid in part to foetal micturition (Brews, 1957; Hutchinson, 1967, Seeds 1965). Many have referred to amniotic fluid in terms of a 'transudate' and still others (Mckay, Richardson and Hertig, 1958) as dialysate. Hutchinson, Gray, Plentl, Alvarez, Caldeyro-Barcia, Kaplan and Lind, (1959) by using isotopes could not prove these hypotheses. As described earlier, some authors have postulated maternal blood (Abbas and Tovey, 1960), foetal blood (Brezeziniski, Sadobsky and Staffir, 1961) or mixed maternal and foetal origin (Brews, 1957) or secretion from foetal respiratory tree (Enhorning and Adams, 1965) as the source of amniotic fluid. In the present study, the alpha aminoacids nitrogen was substantially raised in the urine of newborns than in amniotic fluid, maternal and cord sera. It was lowest in amniotic fluid. The immature kidney of the newborns and particularly so of the immature babies excrete large quantity of the alpha aminoacid nitrogen.

All the aminoacids were not detected in the amniotic fluid, maternal and cord sera and in babies' urine in all the subjects. In amniotic fluid and babies' urine not a single aminoacid was traced in cent per cent of cases. The more number of aminoacids were spotted in more number of subjects in cord blood, maternal serum, amniotic fluid and baby's urine, in that sequence. However, there was a good amount of variability. There seems to be some similarity in the presence of aminoacid spots in the amniotic fluid and the baby's urine on one hand and maternal and cord sera on the other. The total traceable aminoacids were lowest in the baby's urine even though urinary alpha aminoacid nitrogen was highest. This may be due to some other aminoacids which could not be spotted with the present methods. There was a wide range in the values of the aminoacids. The foetal traceable aminoacids were highest in the cord blood. Many authors (Gadimi and Pecora, 1964; Lindblad and Baldesten, 1967; Shah, Udani, Panvalkar, Shrikhande, and Shah; Wirtschafter, 1958, and Wirtschafter and Williams, 1957) have reported raised values of aminoacids in the cord serum as compared to the maternal serum. The specific aminoacids were highest in the cord serum and were well comparable with that of the mother's serum. The individual aminoacid did not give any significant clue to understand the interrelationship of amniotic fluid with maternal and cord sera and baby's urine.

The ratio of aminoacids in the cord serum to the maternal serum were greater than one for many aminoacids, whereas the ratios of aminoacids in the urine of newborn to the maternal serum were less than one for good number of aminoacids. The findings similar to the latter were observed in cases of ratios of aminoacids in amniotic fluid to those in the maternal serum aminoacids and the ratio of the essential to non-essential aminoacids showed some interrelationship of the amniotic fluid and urinary aminoacids on one hand and those of maternal and cord sera on the other.

From the present observations it seems that specific aminoacids in amniotic fluid are not identically very similar to those in the maternal and cord sera and in the baby's urine. Some of the aminoacids were present in more percentage of sub-

jects in amniotic fliud as compared to urine. However, some similarity was observed between amniotic fluid and baby's urine when the ratios of amnioacids like cystine, cystic acid; histidine and valine in amniotic fluid and baby's urine to those aminoacids of the maternal serum. The ratio of essential to non-essential aminoacids of the amniotic fluid and baby's urine were also similar to some extent. It seems that the urine of the foetus contributes to the formation of the amniotic fluid. Seeds (1965) had studied urea, uric acid and creatinine in the amniotic fluid and has suggested that foetal urine is one of the main source of various electrolytes and metabolites in amniotic fluid during later half of pregnancy. The role played by the absorption of some of the aminoacids through gastrointestinal tract of the foetus was difficult to assess. We postulate that the aminoacids of amniotic fluid are first derived from the maternal side and later on during pregnancy they also come from the foetal urine.

Summary

1. The free aminoacids and alpha aminoacids nitrogen levels were studied in amniotic fluid, cord and maternal sera and in baby's urine of twenty-one full-term, seven small-for-dates, otherwise full term, and three immatures to observe the interrelationship of the amniotic fluid, baby's urine and maternal and cord sera.

2. The alpha aminoacid nitrogen was highest in the urine and was lowest in amniotic fluid.

3. Individual aminoacids were present in less percentage of the subjects in the amniotic fluid and in baby's urine as compared to cord and maternal sera.

4. Individual and total aminoacids were highest in the cord sera and minimum in the baby's urine.

5. The levels of individual aminoacids in amniotic fluid were not similar to those of the maternal and cord sera nor to those of baby's urine.

6. The ratios of cystine, cystic acid, histidine and valine in the amniotic fluid to those in the maternal serum, and the ratios of essential to non-essential aminoacids were similar in the newborns's urine and amniotic fluid.

7. It is postulated that the aminoacids of the amniotic fluid initially are formed from the maternal side and later on there is a significant contribution by the foetal micturition.

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