

Intrauterine growth of infants with chorioamnionitis

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The relationship between chorioamnionitis and fetal growth was examined by analysing the data of 299 infants with chorioamnionitis and the data of 296 infants with normal placentas. Six parameters were used for estimation of fetal growth: birth weight, length, head circumference, ponderal index, the ratio of length to head circumference and gestational age. Chorioamnionitis was identified, when at least 10 neutrophils per microscopic high-power field were present in the plate of placenta. There was no significant difference between the two groups at full term infants. The comparison could not be made under 37 weeks of gestation.

It was concluded that chorioamnionitis probably did not impair particularly the fetal growth.

A number of factors influence the rate of growth in utero. Conditions that are particularly likely to impair fetal growth are maternal, placental and fetal factors. The placenta is regarded by some as a primary regulator of fetal growth and placental abnormalities are thought to be a frequent cause of growth retardation. Placental lesions may be secondary to primary maternal or fetal factors impairing fetal growth [1]. Acute inflammations of the fetal membranes (chorioamnionitis) often have no adverse effects on the mother, or fetus, but in some cases they are associated with congenital pneumonia, early onset of labor and clinical evidence of maternal infection [10]. There are few papers in the literature on the relationship between chorioamnionitis and intra-

uterine growth of fetus. According to Russel, chorioamnionitis as a single element is not associated with retarded intrauterine growth [12]. However, in Russel's study, the diagnosis of impaired fetal growth was made by using two parameters—birth weight and gestational age. It is well known that birth weight and gestational age have considerable limitations in the evaluation of fetal growth [8, 9].

In the present study six parameters were used for examination of fetal growth: birth weight, length, head circumference, ponderal index, the ratio of length to head circumference and the gestational age. The parameters of infants with chorioamnionitis were compared with the similar parameters of infants with normal placentas.

MATERIALS AND METHODS

All placentas of infants delivered in Municipal Hospital Szentes in two years period were examined macroscopically and histologically according to Benirschke.

Chorioamnionitis was identified when at least 10 neutrophils per microscopic high-power field were present in the plate of

the placenta, or they were attached to the underside of the placental plate.

The placenta was taken as normal, if no abnormalities were found by macroscopic and histologic examinations. Since the placenta may reflect many of the intrauterine events that affect the infant's growth [1], the data of newborn with normal placentas were taken as controls.

TABLE I
Premature infants

a. Boys

GA (wk) Groups Number of infants	L 28		28-30		31-33		34-36	
	cha. 8	con. 0	cha. 7	con. 2	cha. 4	con. 2	cha. 12	con. 8
Mean weight g	886	—	1411	1310	1965	2245	2348	2867
SD	150	—	288	—	185	—	780	752
SE	5.09	—	7.71	—	4.70	—	9.46	9.27
Mean length cm	35.8	—	39.7	40.5	45.0	44.5	45.9	47.6
SD	2.6	—	2.4	—	2.6	—	4.2	2.7
SE	2.57	—	2.26	—	2.86	—	2.62	2.02
Mean head c.	25.4	—	28.8	27.5	29.6	31.0	32.7	33.2
SD	1.6	—	2.1	—	3.1	—	1.5	2.3
SE	2.78	—	2.77	—	5.19	—	1.63	2.47
Ponderal ind.	2.05	—	2.23	2.24	2.16	2.54	2.38	2.60
SD	0.29	—	0.25	—	0.20	—	0.39	0.34
SE	5.00	—	4.23	—	4.62	—	4.79	4.69
L/head c.	1.41	—	1.37	1.40	1.50	1.43	1.44	1.43
SD	0.06	—	0.04	—	0.10	—	0.08	0.05
SE	1.90	—	1.10	—	3.33	—	2.06	1.32

b. Girls

Number of infants	5		5		8		18	
	5	0	5	0	8	0	18	6
Mean weight g	890	—	1276	—	1748	—	2330	2408
SD	243	—	398	—	316	—	422	505
SE	12.2	—	13.9	—	6.39	—	4.26	8.57
Mean length cm	35.6	—	39.6	—	41.8	—	46.4	44.6
SD	3.9	—	4.1	—	3.5	—	1.9	3.6
SE	4.94	—	4.58	—	2.93	—	0.97	3.27
Mean head c.	24.3	—	29.2	—	29.1	—	32.1	33.0
SD	1.9	—	1.9	—	1.6	—	1.5	1.7
SE	3.89	—	2.95	—	2.12	—	1.21	2.07
Ponderal ind.	1.95	—	2.01	—	2.36	—	2.29	2.68
SD	0.19	—	0.18	—	0.30	—	0.19	0.32
SE	4.35	—	4.01	—	4.49	—	2.05	5.01
L/head c.	1.45	—	1.35	—	1.41	—	1.44	1.35
SD	0.09	—	0.10	—	0.07	—	0.06	0.12
SE	3.10	—	3.31	—	1.87	—	1.00	3.47

GA: gestational age, cha.: chorioamnionitis, con.: control, SD: standard deviation, SE: standard error, head c.: head circumference, L/head c.: ratio of length to head circumference

TABLE II
Full-term boys

GA (wk) Groups Number of infants	37		38		39	
	cha. 12	con. 6	cha. 16	con. 17	cha. 18	con. 26
Mean weight g	2751	2970	3347	3287	3511	3296
SD	398	367	522	628	589	339
SE	4.17	5.04	3.89	4.60	3.95	2.03
		NS				
Mean length cm.	47.6	48.5	50.2	49.5	50.2	49.3
SD	2.5	2.9	2.1	2.6	2.5	1.7
SE	1.49	2.44	1.06	1.25	1.18	0.67
		NS				
Mean head c. cm.	33.2	34.0	34.8	34.5	35.1	34.8
SD	1.9	1.7	1.7	1.2	1.7	1.1
SE	1.85	1.67	1.18	1.15	1.17	0.60
		NS				
Ponderal ind.	2.52	2.71	2.62	2.67	2.75	2.71
SD	0.31	0.22	0.21	0.28	0.26	0.22
SE	3.27	3.50	2.00	2.53	2.29	1.63
		NS		NS		
L/head c.	1.42	1.41	1.43	1.43	1.42	1.41
SD	0.08	0.08	0.06	0.05	0.07	0.04
SE	1.69	2.42	1.13	0.82	1.34	0.55

GA (wk) Groups Number of infants	40		41		42-43	
	cha. 45	con. 63	cha. 23	con. 16	cha. 6	con. 6
Mean weight g	3663	3351	3719	3526	3753	3600
SD	445	399	484	467	227	475
SE	1.80	1.49	2.71	3.31	2.47	5.93
Mean length cm.	51.5	49.8	51.7	50.5	52.7	51.0
SD	1.8	2.1	1.9	2.6	1.8	2.0
SE	0.52	0.54	0.75	1.29	1.38	1.60
Mean head c. cm.	35.2	35.0	35.2	35.0	36.0	34.7
SD	1.4	1.7	1.4	1.2	1.1	0.9
SE	0.61	0.64	0.81	0.87	1.36	1.05
Ponderal ind.	2.70	2.72	2.68	2.73	2.41	2.68
SD	0.27	0.27	0.24	0.29	0.31	0.27
SE	1.52	1.28	1.86	2.65	2.25	4.11
		NS		NS		NS
L/head c.	1.46	1.42	1.46	1.43	1.44	1.46
SD	0.06	0.07	0.05	0.05	0.07	0.07
SE	0.78	0.64	0.73	1.07	2.17	1.95
						NS

GA: gestational age, cha.: chorioamnionitis, con.: control, SD: standard deviation, SE: standard error, head c.: head circumference, L/head c.: ratio of length to head circumference, NS: not significant.

The mean values are generally higher in the groups of chorioamnionitis. In those control groups where the mean values are higher, the difference is not significant.

TABLE III
Full-term girls

GA (wk) Groups Number of infants	37		38		39	
	cha. 17	con. 8	cha. 13	con. 15	cha. 20	con. 29
Mean weight g	2946	2818	3058	3183	3027	3206
SD	278	286	395	338	416	339
SE	2.28	3.59	3.58	2.74	3.07	1.96
			NS		NS	
Mean length cm.	48.4	47.3	48.5	48.4	48.9	48.6
SD	2.1	1.7	2.3	1.5	2.1	1.8
SE	1.05	1.26	1.29	0.78	0.96	0.67
Mean head c. cm.	34.1	32.8	33.6	33.7	33.9	33.9
SD	1.8	1.7	1.6	1.5	1.5	1.3
SE	1.28	1.82	1.34	1.23	1.11	0.70
			NS			
Ponderal ind.	2.59	2.79	2.90	2.81	2.57	2.77
SD	0.27	0.24	0.35	0.37	0.25	0.33
SE	2.26	3.11	3.43	3.42	2.15	2.04
	NS				NS	
L/head c.	1.41	1.44	1.44	1.43	1.45	1.43
SD	0.09	0.06	0.05	0.08	0.07	0.06
SE	1.59	1.60	1.10	1.50	1.27	0.77
	NS					

GA (wk) Groups Number of infants	40		41		42-43	
	cha. 35	con. 58	cha. 23	con. 29	cha. 4	con. 5
Mean weight g	3257	3283	3401	3532	3225	3376
SD	329	385	514	425	606	398
SE	1.70	1.53	3.15	2.23	9.39	5.28
	NS		NS		NS	
Mean length cm.	49.7	49.7	49.9	50.4	49.3	50.2
SD	1.7	2.2	2.5	1.9	1.5	1.9
SE	0.56	0.57	1.04	0.68	1.55	1.72
			NS		NS	
Mean head c. cm.	33.9	34.1	34.4	34.8	33.0	34.8
SD	1.2	1.2	1.8	1.3	2.0	1.3
SE	0.59	0.47	1.18	0.70	3.03	1.69
	NS		NS		NS	
Ponderal ind.	2.65	2.68	2.72	2.75	2.68	2.66
SD	0.29	0.28	0.31	0.21	0.36	0.32
SE	1.85	1.38	2.37	1.45	6.71	5.26
	NS		NS		NS	
L/head c.	1.46	1.45	1.44	1.45	1.49	1.44
SD	0.06	0.06	0.07	0.06	0.11	0.07
SE	0.78	0.56	1.11	0.87	3.95	2.23
			NS			

GA: gestational age, cha.: chorioamnionitis, con.: control, SD: standard deviation, SE: standard error, head c.: head circumference, L/head c.: ratio of length to head circumference, NS: not significant.

The mean values are generally higher in the groups of chorioamnionitis. In those control groups, where the mean values are higher, the differences are not significant.

Birth weights were obtained by using gram scale with capacity of 5 kg.

Crown-heel length was taken by holding the soles of the feet firmly against a fixed upright placed at the zero mark. A movable upright was brought firmly against the vertex.

Head circumference was measured by applying the tape firmly over the glabella at anterior and that part of occiput. The maximal circumference was measured.

The nutritional status of the infants was assessed using Rohrer's ponderal index [11]. The index was calculated as follows: birth weight (g) $\times 100 \times \text{length (cm)}^{-3}$.

For the examination of disproportionate skeletal growth we used the ratio of length to head circumference [13].

Gestational age was calculated in completed weeks on all infants from the day of onset of the mother's last menstrual period. Infants whose mothers were uncertain about their menstrual dates were excluded.

All the infants in this study were single born. Neonates with major congenital malformations were excluded.

The level of significance was determined by application of the *t* test. The values of -2 standard deviation were calculated

from the data of control groups and applied both in the group of infants with chorioamnionitis and control group.

The examination was made retrospectively, the data of boys and girls were examined separately.

RESULTS

Within the study period 299 placentas were found with chorioamnionitis and 296 placentas with no abnormalities.

Under 34 weeks of gestation only four premature infants were found with normal placentas (Table I). There is an association between prematurity and chorioamnionitis. The low number of normal placentas under 34 weeks of gestation made the comparison impossible between the groups of chorioamnionitis and control. At 34–36 weeks of gestation the standard errors were too high for making reliable comparison.

TABLE IV

The ponderal index and the ratio of length to head circumference (37–42 weeks of gestation)

	Boys		Girls	
	chorioamn.	control	chorioamn.	control
Number of infants	120	134	112	144
Mean ponderal index	2.66	2.71	2.65	2.72
SD	0.26	0.26	0.28	0.29
SE	0.91	0.82	0.99	0.88
Number of infants under -2 SD*	5	4	3	2
Mean L/Hc	1.45	1.42	1.45	1.44
SD	0.06	0.06	0.07	0.06
SE	0.37	0.36	0.45	0.34
Number of infants under -2 SD*	2	2	4	4

* The values of -2 SD are calculated from the control group. Chorioamn. = chorioamnionitis, SD = standard deviation, SE = standard error, L/Hc = ratio of length to head circumference.

With full-term boys and girls the mean values of body measurements, ponderal indices and the ratios of length to head circumference were generally higher in the group of chorioamnionitis. In the control group, where the mean values were higher, the differences were not significant (Tables II and III).

The number of infants with excessive reduction of soft tissue mass and with disproportionate skeletal growth is nearly the same in the group with chorioamnionitis and in the control group (Table IV).

We failed to prove any relationship between chorioamnionitis and intrauterine growth retardation. This fact led us to the conclusion that chorioamnionitis probably did not impair particularly the fetal growth.

DISCUSSION

Benirschke and Driscoll wrote of acute chorioamnionitis: "Its frequent occurrence in placentas of premature labours and of premature rupture of the membranes may indicate, that membranous placentitis is a factor in pathogenesis of both these conditions." [3]. The high number of placentas with chorioamnionitis under 37 weeks of gestation supports this statement (Table I).

Intrauterine growth retardation can result from a variety of environmental or genetic influences on fetal growth [6, 7]. One of the major categories is chronic intrauterine infection [1]. Rubella is frequently associated with

intrauterine growth retardation. Similarly cytomegalic inclusion disease, herpes infections, toxoplasmosis and syphilis may impair growth in the infected fetus [1]. The morphological characteristics of the placenta in viral diseases are the vasculitis, ranging from endothelial necrosis to obliterative lesions or the actual disappearance of vessels [5]. The extensive vascular damage can explain the fetal growth retardation.

Pathogenic bacteria and T mycoplasmas are cultured from many placentas with chorioamnionitis [10]. The placenta, the cord and membranes are infiltrated with polymorphonuclear leukocytes. Villitis and extensive vascular damage occur rarely [5].

Bejar et al postulate that premature labour may be initiated by microorganisms with phospholipase A₂ activity from intrauterine infection. Phospholipase A₂ deacylating arachidonic acid from amniotic phospholipids increases prostaglandin synthesis, which triggers labour [2]. Growth retardation occurs, when fetal growth is limited by maternal, fetal and placental factors. If the labour is initiated by infection, there is no time for limitation of fetal growth and growth retardation is not possible.

Scammon and Calkins demonstrated that increments in most external body dimensions of the fetus bear a straightline relationship to increments in crown-heel length. They demonstrated, that for every increment of 10 mm length of the fetus, there was an increment of 6.5 mm in the head circumference. In the typical newborn

with nutritionally induced intrauterine growth retardation, brain growth and head circumference are spared at the expense of birth weight and linear growth. It is thought that blood flow is redistributed in favour of brain growth at the expense of blood flow to the viscera and skeletal muscle [14]. According to Miller, the mean ratios of length to head circumference of infants of different gestational ages were remarkably similar and no statistically significant differences were found among the means [8].

It is concluded that intrauterine growth of infants with chorioamnionitis is similar to that of infants with normal placentas. This can be explained morphologically and pathophysiologically. In chorioamnionitis caused by pathogenic bacteria—unlike in viral placentitis—villositis and extensive vascular damage occur rarely. In addition, there is no time for limitation of fetal growth, because labour may be initiated by microorganisms.

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