Arteriovenous Crossings on the Chorial Surface of the Human Placenta in Abnormal Pregnancy and Development

On the chorial surface of the placenta, the arteries cross superficial to the veins, more or less regularly[1-7]. Isolated, infrequent reversals of this crossing, i.e. vein crossing superficial to the artery, have been reported[5-7]. A high incidence of such reversed crossings, arteriovenous reversal, has been observed in multiple pregnancies, abnormalities of development[8] and some abnormal states of pregnancy[9]. Such arteriovenous reversal has been recognized as one of the 'Parameters of stress' of the foetal blood vessels of the placenta, which contributes towards slowing of the blood stream[10]. A quantitative assessment of the manifestations of this reversal, in relation to its level of occurrence and degree of severity, has been made and their significance in normal and abnormal states of pregnancy and development assessed[11]. Presence of this parameter at continuous levels to a marked or severe degree has been regarded as an abnormal quantum of its manifestation. The present communication is directed towards elaborating the manifestations of this parameter and assessing its significance in relation to abnormal states of pregnancy and development.

Injection corrosion preparations, using a continuous injection of a 10–15% solution of cellulose acetate buterite in acetone, have been made on 509 placentae belonging to cases with abnormalities of pregnancy and development (prematurity 53, placenta previa 27, multiple pregnancy 149, hydramnios 116, abnormalities of development 118 and coexisting hydramnios and abnormalities of development 46). The data regarding incidence, level of occurrence, degree of severity of arteriovenous reversal in each condition was analyzed singly and collectively, in relation to similar observations on 167 placentae belonging to normal cases, by means of Chi square test, with Yate's correction as indicated. The respective percentage values in each category were represented in a composite bar diagram and the lines of abnormalcy and severity were plotted in relation to the level and the degree of the parameter, by joining the upper limits of the normal quantum and intermediate levels of the abnormal quantum respectively.

The incidence of arteriovenous reversal is significantly increased in abnormalities of development only (Table I). The level of occurrence (Table II) and degree of severity (Table III) of the parameter are significantly accentuated to varying grades in the abnormal states as a whole and

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Table I. Incidence of arteriovenous reversal

Entity	Present	Absent	Total	Individual X^2 value	Interpretation
Normal	145 (86.83)	22 (13.17)	167 (100.00)	–	–
Prematurity	45 (84.90)	8 (15.10)	23 (100.00)	0.16 d.f.1	–
Placenta previa	26 (96.30)	1 (3.70)	27 (100.00)	1.19 d.f.1	–
Twins	134 (83.22)	15 (16.78)	149 (100.00)	0.46 d.f.1	–
Hydramnios	108 (93.10)	8 (6.90)	116 (100.00)	0.22 d.f.1	–
Abnormal development	113 (95.76)	5 (4.24)	118 (100.00)	5.44 d.f.1	P 0.05
Hydramnios and abnormal development	43 (93.48)	3 (6.52)	46 (100.00)	1.13 d.f.1	–
Total	614	62	676		

Chi square value 10.72 with d.f.6. Insignificant.

Table II. Level of arteriovenous reversal

Entity	Single	2 discontinuous	2 continuous	3 continuous	Total	Individual X^2 value	Interpretation
Normal	108 (74.48)	12 (8.28)	10 (6.90)	15 (10.34)	145 (100.00)	–	–
Prematurity	32 (71.11)	2 (4.44)	8 (17.88)	3 (6.67)	45 (100.00)	5.92 d.f.1	P 0.05
Placenta previa	18 (69.23)	3 (11.54)	4 (15.38)	1 (3.85)	26 (100.00)	2.86 d.f.3	–
Twins	76 (56.72)	12 (8.95)	27 (20.15)	19 (14.18)	134 (100.00)	10.28 d.f.3	P 0.01
Hydramnios	52 (48.15)	7 (6.48)	31 (28.70)	18 (16.67)	108 (100.00)	22.24 d.f.3	P 0.001
Abnormal development	49 (43.37)	11 (9.73)	32 (28.32)	21 (18.58)	113 (100.00)	32.36 d.f.3	P 0.001
Hydramnios and abnormal development	19 (44.19)	2 (4.65)	11 (25.58)	11 (25.58)	43 (100.00)	34.05 d.f.2	P 0.001
Total	354	49	123	88	614		

Chi square value 52.77 d.f.18. P 0.001.

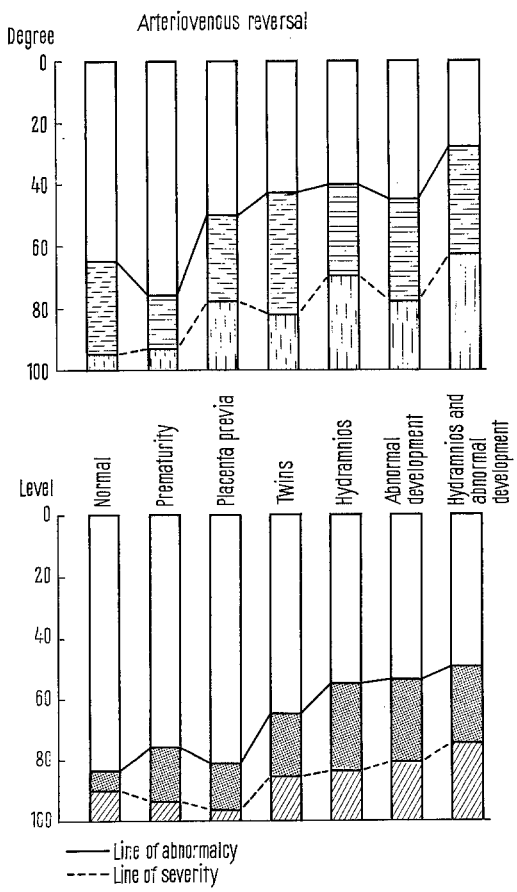
Table III. Degree of arteriovenous reversal

Entity	Mild	Moderate	Marked	Severe	Total	Individual X^2 value	Interpretation
Normal	58 (40.00)	37 (25.52)	43 (29.66)	7 (4.82)	145 (100.00)	–	–
Prematurity	17 (37.78)	17 (37.78)	8 (17.78)	3 (6.66)	45 (100.00)	2.50 d.f.2	–
Placenta previa	3 (11.54)	10 (38.46)	7 (26.92)	6 (23.08)	26 (100.00)	7.26 d.f.2	P 0.05
Twins	23 (17.15)	33 (24.41)	54 (40.28)	24 (17.90)	134 (100.00)	25.82 d.f.3	P 0.001
Hydramnios	18 (16.57)	25 (23.15)	33 (30.55)	32 (29.63)	108 (100.00)	23.36 d.f.3	P 0.001
Abnormal development	16 (14.16)	34 (30.09)	39 (34.51)	24 (21.24)	113 (100.00)	28.08 d.f.3	P 0.001
Hydramnios and abnormal development	3 (6.98)	9 (20.93)	15 (34.88)	16 (37.21)	43 (100.00)	41.28 d.f.3	P 0.001
Total	138	165	199	112	614		

Chi square value 75.54 d.f.18. P 0.001.

multiple pregnancies, hydramnios and abnormalities of development individually.

The lines of abnormalcy and severity in relation to the degree of the parameter show a positive gradient, similar in pattern but different in magnitude in the abnormal states with prematurity at the lowest level and hydramnios at the highest (Figure). The lines of abnormalcy and severity in relation to the level of the parameter also show a gradient, similar in pattern but different in magnitude in the abnormal states, with maximal manifestations in abnormalities of development (Figure).



Composite bar diagram showing percentage values of the manifestations of the level and degree of the arteriovenous reversal and corresponding lines of abnormalcy and severity.

The manifestations of the parameter are more marked in relation to the level of the parameter than its degree. The maximal effects are seen in hydramnios, in relation to the degree, and in abnormalities of development in relation to the level of the parameter. With coexisting hydramnios and abnormalities of development, the degree of the parameter shows some manifestations in addition to simple summation of those in individual states.

Reversal of arteriovenous relationship has been regarded as a manifestation of a common factor or combination of factors affecting foetal blood vessels in these states[8]. Presence of a gradient and similarity in the pattern of the lines of abnormalcy and severity of this parameter further support this postulate. The level of occurrence and the degree of the parameter appear to complement the effects of each other, in relation to slowing of the blood stream. Accentuation of the level and degree of the parameter in different clinical states to different extents shows that arteriovenous reversal is present in normal cases, at discontinuous levels to a mild or moderate degree. This helps in slowing the blood stream for an optimal exchange across the placental barrier. With normal crossings, the arterial pulse is utilized in propelling the blood in venous channels, since a tense amniotic sac does not allow a dissipation of this energy on the superficial aspect. In reversed crossing, the arterial pulse will be dissipated over the soft yielding placental tissue. In the abnormal states, the reversal is seen at continuous levels, to a marked or severe degree, its precise effects being dependent upon its quantum, other parameters and the foetus as a whole[12].

Zusammenfassung. Wenn auf der Membrana chorii die Arterien gehäuft von den Venen überkreuzt werden, treten auch vermehrt Missbildungen und Hydramnion auf. Die Plazenten von Zwillingen scheinen sich gleich zu verhalten wie diejenigen von Missbildungen.

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