Intrauterine Growth Rate in Relation to Anorectal and Oesophageal Anomalies

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It has been widely, though not universally, accepted that a baby who is born before the end of 37 weeks' (259 days) gestation is premature and that one who weighs less than 2500 g. at birth has a low birthweight. Many recent studies have drawn attention to the importance of intrauterine growth rate as judged by the difference between actual and expected weight at birth in relation to gestational age. The Perinatal Mortality Survey (Butler and Bonham, 1963) showed that 35% of babies who weighed less than 2500 g. at birth were born after the end of 37 weeks' gestation and thus were not premature. The infant who, when born, is small for the length of gestation, small-for-dates, may be small because of retardation of intrauterine growth, though Walker (1967) found that both the height of the mother and the sex of the baby may also affect the weight of the baby. However, the small-for-dates baby differs from the true premature infant in several ways, one being a higher incidence of congenital malformation (Van den Berg and Yerushalmy, 1966).

Most reports of congenital anomalies in infants have recorded only the incidence of low birthweight, but have not distinguished between those who were premature by gestational age from those who, being small-for-dates, might have suffered intrauterine retardation of growth. We have used the stated weight at birth and length of gestation in 168 babies with oesophageal and anorectal anomalies as a basis for assessing the association between these anomalies and intrauterine development. We have considered as premature any baby who was born following a gestation of less than 38 weeks, and as small-for-dates any baby who weighed 2500 g. or less but who was born after a gestation of 38 weeks or more.

The Infants

Between September 1958 and June 1967, 168 babies less than 1 month old, with oesophageal or anorectal anomalies, or both, were admitted to the professorial surgical unit at The Hospital for Sick Children, Great Ormond Street, London. They were divided into three groups: 75 (50 boys and 25 girls) had anorectal anomalies alone (Group AR), 76 (39 boys and 37 girls) had oesophageal anomalies alone (Group OA), and 17 (9 boys and 8 girls) had combined oesophageal and anorectal anomalies (Group AR and OA).

Results

Birthweight (Fig.). In general babies with AR weighed more at birth than those with OA or AR and OA. Because of the preponderance of boys with AR alone, the mean weights of each group have not been compared. Instead the infants have been subdivided into those having a low birthweight (2500 g. or less) and those having birthweights above the accepted normal mean (3400 g., Ellis, 1966).

Gestation period. The incidence of prematurity was 6.6% in babies with AR, and 10.5% in those with OA (Table I). But in those with both anomalies, the incidence of prematurity was 47%, which is a significantly higher rate than that for either single anomaly ($\chi^2 = 20.6$; $p < 0.001$). Of 13 cases with an anorectal anomaly born before 37 weeks' gestation, 8 (61%) had associated oesophageal anomalies. The mean gestational age of premature infants was 33.2 weeks for AR, 35 weeks for OA, and 33.3 weeks for AR and OA.

Intrauterine growth rate. An analysis of the full-term birthweights by sex, and the comparison with normal birthweights (Ellis, 1966) is shown in

FIG.—Gestational age and birthweight of 75 cases with anorectal (AR) anomalies, 76 cases with oesophageal (OA) anomalies, and 17 cases with AR and OA.

Table II. Both boys and girls with AR weighed more at birth than those with OA, but in both groups the weights were below normal and the difference between the mean weight of the normals and those with OA or AR was significant.

Nine out of 75 babies (12%) with AR, 16 out of 76 babies (21%) with OA, and 2 out of 17 babies (11%) with AR and OA showed retardation of intrauterine growth with a low birthweight (2500 g. or less after 37 weeks' gestation (Table III)).

Comparing these small-for-dates with premature infants (Table IV), the former had a higher mean weight, a lower mortality rate ($\chi^2 = 17.5$; $0.01 > p < 0.001$), a lower incidence of other severe anomalies ($\chi^2 = 4.6$; $0.05 > p < 0.01$), and a higher incidence of twinning and hydramnios. No relevant differences of these factors were found in each group in relation to the type of anomaly.

Discussion

In Great Britain about 7% of all live-born infants weigh 2500 g. or less at birth, but 35% of these are born after 37 weeks of gestation (Butler and Bonham, 1963). Thus, of normal births, 4.5% are prematures, while 2.5% are small-for-dates.

In our series, apart from the 11 babies whose exact gestation period was not known, 109 infants were by our definitions neither small-for-dates nor premature, but nevertheless had a lower than normal birthweight (Table III)).

In Table V we have compared the figures for normal babies with those of the present series and also with others for two types of duodenal obstruction: meconium obstruction and neonatal Hirschsprung's disease. With OA or AR alone, the baby is more likely to be small-for-dates,

TABLE I
Gestational Age and Mean Weights of 75 Cases with Anorectal (AR) Anomalies, 76 Cases with Oesophageal (OA) Anomalies, and 17 Cases with AR and OA

Gestational Age (wk.)	AR			OA			AR and OA		
	No.	%	Mean Weight (g.)	No.	%	Mean Weight (g.)	No.	%	Mean Weight (g.)
<37	5	6.6	1560	8	10.5	1927	8	47	2041
38-40	60	80	3118	58	76.3	2863	7	41	2608
>40	5	6.6	3317	5	6.5	2835	1	6	3090
Unknown	5	6.6	3175	5	6.5	1956	1	6	2268
Total	75			76			17		

but when they are combined prematurity is more likely. In babies with intrinsic duodenal obstruction the pattern is similar but even more marked than in OA or AR alone, whereas in extrinsic duodenal obstruction, meconium obstruction and neonatal Hirschsprung's disease it is much nearer the normal. Mechanical factors may play some part in producing intrauterine growth retardation, since in the present series twinning and hydramnios were more common in the small-for-dates babies (Table IV). There is also good experimental correlation between intrauterine growth retardation and congenital malformation induced by radiation (Warkany and Schraffenberger, 1947; Russell and Russell, 1954; Wilson, 1954).

The precise relation of congenital anomalies with intrauterine growth rate is not understood, nor is it obvious why in some congenital anomalies the rate of prenatal growth is much slower than in others. In spite of this, it is obvious that clinically an appreciation of the importance of such variations in intrauterine growth rate may be of value in the assessment of babies presenting with congenital anomalies. Knowledge of gestational age may be of assistance in diagnosis; of 92 babies with AR, 17 (18%) also had OA, but of the 13 premature

TABLE II

Mean Weights of Full-Term Babies with Anorectal (AR) or Oesophageal (OA) Anomalies Compared with Mean Weight of Normal Full-Term Infants (Ellis, 1966)

	No.	Mean Weight (g.)	Standard Deviation (g.)
Male { Normal	243	3430	510
AR	39	3230	567
OA	31	2948	567
Female { Normal	209	3288	425
AR	21	2948	425
OA	27	2748	481

Males

AR against normal $t = 3.25$ ($F_{2,320}$) $0.05 > p > 0.01$

OA against normal $t = 12.66$ ($F_{2,310}$) $p < 0.001$

AR against OA $t = 1.86$ ($_{2,310}$) $p < 0.05$

Females

AR against normal $t = 5.42$ ($_{2,234}$) $0.01 > p > 0.001$

OA against normal $t = 16.0$ ($F_{2,254}$) $p < 0.001$

OA against AR $t = 1.36$ ($F_{2,245}$) $p < 0.05$

babies with AR, 8 (61%) also had OA ($\chi^2 = 10.0$; $0.01 > p > 0.001$). Amongst babies of low birth-weight (Table IV) the mortality rate was higher in those who were premature than in those who

TABLE III

Mean Birthweight of 75 Cases with Anorectal (AR) Anomalies, 76 Cases with Oesophageal (OA) Anomalies, and 17 Cases with AR and OA

	AR			OA			AR and OA		
	No.	%	Mean Weight (g.)	No.	%	Mean Weight (g.)	No.	%	Mean Weight (g.)
Premature (37 weeks or less)	5	6.6	1560	8	10.5	1927	8	47	2041
Small-for-dates (> 37 weeks)	9	12	2268	16	21	2268	2	11.7	1824
2500 g. or less)	56	74.7	3288	47	61.8	3061	6	35.3	2948
> 37 weeks, > 2500 g.	5	6.6	3175	5	6.5	1956	1	6	2268
Unknown gestation	75			76			17		
Total									

TABLE IV

Comparison Between Small-for-dates and Prematures (excluding 11 cases whose exact gestational period was not known)

	No. of Cases	Mean Weight (g.)	No. of Deaths	Associated Anomalies			Twins	Hydramnios
				Severe	Mild	None		
Premature (37 weeks or less)	21	1871	17	11	2	7	1	3.
Small-for-dates (> 37 weeks)	27	2239	9	6	6	15	6	8
2500 g. or less)	109	3147	22	20	23	66	1	9
> 37 weeks, > 2500 g.								

TABLE V

Incidence of Small-For-Dates and Prematures in Some Congenital Malformations

	2500 g. or less (%)	Small-for-dates (%)	Premature (%)	Unknown Gestation (%)
Normal (Butler and Bonham, 1963)	7	2.5	4.5	—
Anorectal anomalies (present series)	18	12	6	—
Oesophageal anomalies (present series)	38	21	10	7
Anorectal anomalies and oesophageal anomalies (present series)	64	11	47	6
Meconium ileus (Holsclaw, Eckstein, and Nixon, 1965)	9	—	—	—
Duodenal intrinsic obstruction (Young and Wilkinson, 1966)	54	35	19	—
Duodenal extrinsic obstruction (Young and Wilkinson, 1966)	12	3	9	—
Neonatal Hirschsprung's disease (Fraser and Wilkinson, 1967)	5.5	—	—	—

were small-for-dates, but severe associated anomalies were twice as common in those who were premature as in those who were normal or small-for-dates. It is known that respiratory distress syndrome is a problem of the premature baby, that oxygen and calorie requirements are related to intrauterine growth rate (Sinclair and Silverman, 1966), and that blood volume may be relatively increased in small-for-dates babies (Cassady, 1966). So many factors are related to the length of gestation and weight at birth that accurate information about these factors is becoming increasingly important in the diagnosis, management, and prognosis of neonatal anomalies.

Summary

Of 168 babies, of whom 75 had anorectal anomalies, 76 had oesophageal atresia, and 17 had both anorectal and oesophageal anomalies, 54 (32%) weighed 2500 g. or less at birth, 4 times as many as normal; and of these, 27 were born after gestations of 38 weeks or more.

Gestation was significantly shorter when oesophageal and anorectal anomalies were combined than when either existed alone.

Though birthweight was significantly lower than normal in babies with either oesophageal or anorectal anomalies, this reduction was more marked in both sexes with oesophageal anomalies.

Babies small-for-dates showed a higher mean weight, a lower mortality rate, a lower incidence of other anomalies, and a higher incidence of twinning and hydramnios than premature infants.

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