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FOETAL ACID-BASE STATUS
and
FOETAL ELECTROCARDIOGRAPHY

by

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SUMMARY

A study has been made of foetal and maternal acid-base balance and of the foetal electrocardiogram in 108 women in labour. 102 subjects were selected where the foetus was considered to be clinically at risk from foetal asphyxia and six apparently normal subjects were included.

Foetal blood samples were obtained from the foetal scalp during labour and from the umbilical cord at delivery. The foetal electrocardiogram was recorded throughout labour from scalp electrodes attached directly to the foetal scalp, and the neonatal electrocardiogram was recorded within 24 hours of delivery. The clinical condition of the infant was assessed immediately following delivery, at 24 hours and at six weeks following delivery. Foetal and maternal venous blood samples were analysed for pH, $p\text{CO}_2$, standard bicarbonate, plasma electrolytes and glucose where sufficient sample was available. Samples of the foetal electrocardiogram were analysed for configuration and time constants and were subsequently studied in relationship to foetal biochemical parameters and to the neonatal electrocardiogram.

A comprehensive analysis of the interrelationship between maternal and foetal biochemical measurement has been included. This section of the study has confirmed the work of previous authors in establishing that a significant

relationship occurs between maternal and foetal acid-base status, and between foetal acid-base status during labour and the clinical condition of the infant at birth and 24 hours after delivery. Electrolyte values in foetal and maternal plasma were studied in relation to foetal and maternal acid-base values and a significant negative linear relationship was established between foetal and maternal blood pH values and plasma potassium levels. The mean values and standard errors of all variants have been recorded where appropriate. Time constants for the foetal electrocardiogram have been considered as whole group mean data in relationship to the time of sampling and in data grouped according to the acid-base and electrolyte values of the foetus. Mean values for electrocardiographic data were defined in relation to known normal acid-base values and it is considered that these values represent normal foetal E.C.G. time constants. Significant prolongation of electrical systole (Q-T interval) was seen to occur at the time of delivery in relation to low pH values in cord venous blood, provided the Q-T values were corrected for heart rate. Q-T prolongation was related to hyperkalaemia in cord venous blood with a higher degree of significance.

Hyperkalaemia was also shown to be related to T wave depression and inversion, changes which resemble those of hypokalaemia in the adult. On the evidence available, it is

suggested that the changes seen in the foetal electrocardiogram resemble those of hypokalaemia because, despite the apparent hyperkalaemia, a condition of cellular potassium depletion exists in states of chronic foetal acidosis.

Foetal acidosis, as demonstrated by low scalp blood pH values, was also shown to be associated with increased right axis deviation of the heart following delivery.

Foetal cardiac axis has been estimated using the technique of Larks for estimating foetal cardiac axis from abdominal electrodes. The mean values obtained using this method are similar to those reported from abdominal lead recordings although the relationship between the cardiac axes of foetal E.C.G. complexes obtained early and late in labour showed differing relations with the subsequent post-delivery leads.

An attempt has been made to define the critical limits of the time constants of the foetal electrocardiogram. The overlap of values between normal and abnormal groups suggests there are limitations on the application of these measurements for clinical usage.