Neo-Natal Paediatrics

Edited By

W. R. F. COLLIS

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INTRODUCTION

THIS work, confined almost entirely to the neo-natal period, is designed to help those organizing neo-natal units in maternity hospitals, and as a guide to students and post-graduates studying the problems of the new-born baby, so that they may know what to do when confronted with the many different conditions of this period, from atresia of the oesophagus to haemolytic disease. Without being exhaustive or attempting to include everything and thus make the work too unwieldy and expensive we have attempted to cover the subject sufficiently for practical purposes.

I am aware that some of the methods advocated here are not universally accepted, and it is with diffidence that we present our own approach based on our experience in prematurity, pyloric stenosis, infant feeding and so on, but we think this better than trying to reach an agreed mean with many other centres and in the end leaving the student somewhat at a loss to know what we really advise.

Considerable space has been given to what may be called the surgical problems of the new-born, for the reason that they form a large proportion of the emergencies which arise in the neo-natal period, which if allowed to go undiagnosed and untreated lead rapidly to the death of the infant.

I have gathered together my colleagues, medical and surgical, both from the Rotunda hospital and from the other paediatric units attached to maternity hospitals in Ireland, asking each of them to write that section in which he is most interested and on which he has done most original work. We are also honoured by having among our contributors a number of distinguished people who have given us the benefit of their special knowledge. I am particularly indebted to Professor McCance and Dr. Widdowson of Cambridge for their contribution on the physiology of the new-born kidney ; to Mr. Peel for giving us some of his original work on the babies born of diabetic mothers, from the famous clinic at King's College Hospital ; and to Eirene Collis, whose original work on cerebral palsy is now being recognized as a real contribution to modern paediatrics, for her section on neurological diagnosis in the infant.

A certain selected number of references are given at the end of the sections where they may be of use to the student of the subject, but no complete bibliography is attempted, and in those chapters dealing with subjects such as prematurity where the bibliography is enormous, references are either omitted or cut to a minimum.

There is considerable difference of opinion in different centres as to what the scope and function neo-natal departments, attached to mater-

nity hospitals, should have. In some places they are referred to as " premature units ", a designation which in no way explains their full function, as prematurity is only one of the many vital problems which are present in the new-born and for which these departments must be equipped and organized to deal. It may not be out of place, therefore, to give a brief description here of the development of the neo-natal department in the Rotunda Hospital.

Some twenty-five years ago I was appointed paediatrician to the ancient Rotunda Hospital in Dublin. At that time the department was simply a nursery, consisting of seven cots looked after by three untrained little girls of eighteen, called nursery nurses. It was not surprising to find that the mortality in this ward was 60 per cent. Since then I have watched the department grow till now it consists of first a series of infant wards of up to twenty-five cots, serving the needs of the labour wards and operating theatre ; and secondly, a special neo-natal unit for babies born on the Rotunda district or referred to us by outside doctors for special neo-natal conditions such as haemolytic disease of the new-born. The latter consists of some 30–35 infant cots each in a single small self-contained ward, a breast milk bank, a milk kitchen, and an operating theatre designed for neo-natal surgery : the intestinal obstructions, pyloric stenosis, cranial and thoracic surgery.

At first we had our difficulties, the greatest being the lack of understanding in general medical circles of the place that neo-natal paediatrics should play. It cannot be separated from obstetrics and yet it must needs take the child beyond the care of the obstetrician, as in the very special conditions such as haemolytic disease and sub-dural haematoma occurring immediately after birth, and the problems of infant feeding and infection, which often occur towards the end of the neo-natal period but still before the infant passes out of the care of those surrounding it at its birth. For these reasons neo-natal units have sometimes found difficulty in establishing themselves in maternity hospitals.

Personally, I have been fortunate in having been associated with some of the leading obstetricians of the day, Dr. Ninian Falkiner being perhaps the one to whom Irish paediatricians owe most. It was he who conceived the idea with Dr. James Deeney of the Department of Health in Dublin, of getting the three maternity hospitals, which control the vast majority of confinements in the city, to enlarge the scope of their paediatric departments by supervising the health of all babies, well or sick, born on their services, up to six weeks of age or till such time as they might be considered to be thriving normally (a much longer period being necessary in such conditions as prematurity).

Indeed the Department of Health first asked us if we would look after all babies up to one year. But when this proposal was examined it was found beyond the scope of any maternity hospital service. Up to six weeks, however, it has worked admirably, having the great advantage of all owing continuity for the mother and baby before, during and after

her confinement in the same medical centre. For this purpose the Rotunda hospital erected a special out-patient department welfare centre for the infants on its service. Here both normal well babies are brought by their mothers for weighing, advice regarding feeding and hygiene, and sick babies whether suffering from neo-natal infection, the post-haemolytic disease state, prematurity, or orthopaedic, venereal or other special states are seen in special clinics at different hours. From here, also, the sister in charge has many of the babies visited in their homes by her specially trained nurses. This system, I hold, is far superior to the ordinary welfare centre where only advice and not treatment is given. It also serves as an excellent training ground for students and post-graduates.

At the end of the six-week period or at that time when the baby is considered thriving normally they are referred back to their family doctors, or sent on to the city welfare clinics, or both. We have very happy relations with the City Health Department, doctors from its Tuberculosis and V.D. sides working directly on our service. In future we hope to establish closer relations still with the city Child Welfare Department, whose nurses (health visitors) might benefit greatly by closer integration in our special welfare clinic in the hospital.

At first we found ourselves a little isolated from the rest of the hospital but recent staff changes have now brought about a very satisfactory position. Our staff arrangements in the paediatric department are as follows : Director of Paediatrics and Deputy Director (both consultant rank), Resident Paediatrician (junior registrar status, having previous paediatric experience), Resident Obstetrician (one of the junior obstetrical staff seconded to us for three months), besides usually a number of post-graduates attached to our department doing special work.

Teaching plays a very important role, consisting of ward rounds in the paediatric Units and clinical demonstrations in the out-patient department and a number of courses of didactic lectures covering the whole neo-natal period. I now set two paediatric questions in the final obstetrical and gynaecological paper for Trinity College students, designed to test their knowledge gained in these clinics. This seems a better plan than having a separate paediatric paper, as the new-born baby and his mother must always be considered together by the family doctor for whose training our teaching is primarily planned.

The most important factor, I think, has been the taking on to the paediatric staff for a time, of each member of the junior obstetrical staff. This has led to complete liaison and understanding between obstetrical and paediatric sides of the hospital. The paediatric staff now examine all new-born babies immediately after birth, take charge of all abnormal babies, and do a round daily in the puerperal wards. They do not, however, take the responsibility away from the obstetrical staff and their students for the first ten days of life but rather work beside them,

an experienced paediatric sister working with the obstetrical medical officer in charge of the district.

Such co-ordination of the paediatric and obstetrical sides of the hospital, as far as it has gone, is very satisfactory, but much remains to be done if this liaison is to bear full fruit. One has only to remember the immense subject of still-birth, with all its implications for the obstetrician, the general physician, the paediatrician and the pathologist, to realize how much is still left for the future.

April 1958

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CHAPTER I

THE NORMAL CHILD

WILLIAM KIDNEY

The Skin (also see p. 140)

THE skin of the new-born infant is red tinged with blue. This blueness gradually disappears in the first 24 hours, leaving him a " lobster pink " colour which gradually fades in 2–3 days. A blotchy or mottled appearance is quite usual.

Persistent, continuous cyanosis occurs in obstructive asphyxia, atelectasis, hyaline membrane disease, congenital heart disease with pulmonary stenosis and intracranial lesions.

Cyanotic attacks, which are more prevalent in prematures, suggest cerebral anoxia or haemorrhage. Such variations can be confirmed by estimating oxygen saturation, carbon dioxide saturation, and blood count for polycythaemia.

Jaundice may be physiological, or due to haemolytic disease, ABO incompatibility, biliary atresia, or severe infections. It may result from toxic substances, e.g. Vitamin K, Penicillin.

Oedema, when local, usually means pressure, or local infection. When general it may indicate severe infection, severe anaemia, subnormal temperature, incorrect electrolyte, or excessive glucose in the diet.

Dehydration shows itself in the skin by dryness, loss of elasticity and increased wrinkling of the skin.

The new-born infant is usually covered with vernix caseosa, which lubricates it, protects it and diminishes heat loss and the entry of infection.

The superficial layer of the epidermis is inelastic and easily cracks at folds. It is shed within the first five days and gives the appearance of desquamation.

Areas of pigmentation or naevi may be found on the skin. They are usually raised and have a deep port-wine colour. Paler naevi sometimes called spider naevi may be found on the back of the neck, forehead and mid line of the face or eyelids. Unlike the others, these usually dis appear in a few months.

The skin, besides being an organ of protection and sensation, is vitally concerned in heat loss and fluid excretion.

The skin area or body surface can be estimated from a nomogram pre pared from the patient's height and weight. A 7 lb. infant, twenty inches long, has a body surface area of 0·2 square metres.

Fluid requirements are directly proportional to body surface at all ages.

Measurements

The simplest measurement is the infant's weight. The average healthy new-born infant weighs 7 lb. 4 oz., but a normal infant may weigh anything between $5\frac{1}{2}$ lb. and 12 lb. Under $5\frac{1}{2}$ lb. constitutes prematurity or immaturity, irrespective of the period of gestation.

A previable infant is a title sometimes given to one who is less than $1\frac{1}{4}$ kg., i.e. 2 lb. 12 oz. Such an infant is usually of less than 28 weeks gestation.

Weight may be affected by heredity, toxaemia, diabetes, pressure oedema, multiple births and even by mode of delivery. The process of natural delivery involves first, the draining of the infant and his immediate environment, when the membranes rupture. Secondly the intermittent contraction of the uterus probably forces excessive interstitial fluid into the circulation and hence its ultimate elimination from the body. This explains why babies born by Caesarean Section tend to weigh more at birth than their fellows, and to lose so much weight in the first few days of life. They are losing what they should have lost during delivery.

Birth weight is important because it influences mortality. The death rate falls as the birth weight rises. In assessing the prognosis for a premature infant, the major factors are weight, gestation age, health of the mother and the presence of complications.

In these countries and in the United States weights are usually expressed as pounds and ounces. For classification however gram-grouping is advisable. For the convenience of those collecting series of cases the following groups are used.

1,500 grams or less equal	3 lb. 4 oz. or less.
1,501–2,000 grams equal	3 lb. 5 oz.–4 lb. 6 oz.
2,001–2,500 grams equal	4 lb. 7 oz.–5 lb. 8 oz.
2,501–3,000 grams equal	5 lb. 9 oz.–6 lb. 9 oz.
3,001–3,500 grams equal	6 lb. 10 oz.–7 lb. 11 oz.
3,501–4,000 grams equal	7 lb. 12 oz.–8 lb. 13 oz.
4,001–4,500 grams equal	8 lb. 14 oz.–9 lb. 14 oz.
4,501 grams or more equal	9 lb. 15 oz. or more.

About 91 per cent. of all births weigh over 2,500 grams and 9 per cent. weigh less than this weight and therefore are classified as immature or premature. This latter figure varies with many factors, but is considerably lower in wealthier and more educated groups than among the poor.

In the normal neonate it is usual to expect an initial weight loss of 4–6 oz. Relatively and actually there is a greater weight loss in smaller infants. Normal infants should have returned to their birth weight by

the tenth day and gain one pound by the end of the neo-natal period.

Height

The new-born infant averages 20 in. when measured from under the heel to the fontanelle. Variations between 18 and 22 in. are normal. Premature infants are usually under 18 in. and their length may give an indication of their maturity.

Diathesis

Diathesis is not obvious in the new-born, most infants appearing to be " hypersthenic " or " lateral " as distinct from hyposthenic or linear. The angle formed by the ribs at the lower end of the sternum is usually 75°–85°.

Pulse Rate

Pulse rate is variable ; between 100 and 160 per minute. There are wide variations in rate, rhythm. It may not be possible to detect murmurs, which become apparent later.

Respiration

Respiration is controlled by three medullary centres, which initiate (*a*) irregular gasps, (*b*) regular gasps, and (*c*) normal respiration rhythm. The normal rate may be anywhere between 30 and 60 respirations per minute and marked variations may be found in the same infant (see p. 107).

Respiration is almost all abdominal or diaphragmatic and the chest does not expand on inspiration, indeed the expanding abdomen may pull in the chest wall.

The Head

The circumference of the head at birth is about 13 inches. This measurement is made at the widest part, the tape passing around the forehead and over the occiput.

Another useful measurement is " Ear to Ear " measuring across the top of the parietal bones from the upper junction of the ear to the head of the corresponding point on the other side.

There are two fontanelles formed by the junction of sutures between the bones. The anterior fontanelle is large and diamond shaped, measuring about two fingers across, i.e. about $1\frac{1}{4}$ ins. It may however be almost closed at birth. Bulging of the fontanelles with separation of the sutures may be seen in intracranial haemorrhage, but it is possible to have intracranial haemorrhage (under the tentorium), which does not effect tension at the fontanelle.

The posterior fontanelle is smaller and may close during the neo-natal period.

The head constitutes almost one-third of the bulk of an infant. (The head of the adult is about one-tenth of the body.) It represents one-quarter the height of the newborn infant. Its growth is more rapid in early infancy than at any other time in life.

The face is small and nose situated higher than in the adult. There may be dark hair on the head, which does not indicate the infant's ultimate colouring. In all but very dark infants the iris of the eye is blue.

The Neck

The neck is relatively short, the chest is round and its circumference is always less than that of the head at birth. The limbs are relatively short, the legs being only equal to the trunk in the infant, but equal to the trunk and head in the adult.

Body Fluids

The normal infant's weight is about 77 per cent. water and 23 per cent. solids. In early infancy and in foetal life the proportion of water is even higher. The process of normal delivery causes a degree of dehydration by (*a*) drainage when the membranes rupture and fluid flows away and (*b*) expulsion of fluid from the tissues by the intermittent uterine contractions.

In a normal infant the process of dehydrating continues for a few days and is seen in the loss of a few ounces body weight.

In contrast the normal adult is about 60 per cent. fluid and 40 per cent. solid.

The infant's fluids are divided into cellular 48 per cent. and extracellular 29 per cent. The extracellular fluid is divided into vascular (plasma) and interstitial.

The total blood volume in mls. can be estimated by multiplying the body weight in pounds by 45, i.e. 45 mls. per lb. body weight.

Laboratory Findings

Urine

p.H. 4·5–8·2
S.G. 1,010–1,030.

Electrolytes (Plasma values)

Cations	*Average*	*Range*
Sodium	142 m.equ./l.	137–147 m.equ./l.
Potassium	5 m.equ./l.	4·0–5·6 m.equ./l.
Calcium	5 m.equ./l.	4·5–5·8 m.equ./l.
Anions		
Chloride	103 m.equ./l.	98–106 m.equ./l.
Bicarbonate	23 m.equ./l.	20–25 m.equ./l.
Phosphate	2 m.equ./l.	1·7–2·6 m.equ./l.

Total Proteins

The normal level of total proteins in the full term new-born infant lies between 5·0 and 6·4 gm. per 100 mls. of blood. This level falls slowly throughout the neo-natal period and usually reaches 5·4 gm. at about six weeks. Thereafter it gradually rises, the rate depending largely on dietetic intake.

The premature infant starts life with a slightly lower concentration (5 to 6 gm. per cent.), which falls more rapidly and to a lower level (4·0 to 4·7 gm. per cent.). Furthermore the return to normal may not commence until the infant is about three months old. Adult levels are reached at about one year.

A rise in total proteins usually means a rise in the total globulin. This is most likely to be caused by a reaction to infection or infestation, but it may also occur in dehydration and diseases of the reticulo endothelial system (such as leukaemia). In such cases serum protein levels over 20 gm. per cent. have been recorded.

In practice the only condition likely to produce an increase in serum proteins in the new-born is dehydration resulting from diarrhoea or vomiting.

A fall in serum proteins can be taken to mean a fall in serum albumin. In the new-born this is almost invariably due to dietetic disorders, insufficient protein intake or accumulation of fluid in the tissues (oedema, excess sugars, or excess fluids).

The albumin globulin-ratio is not of much value. It is better to consider each fraction separately.

	Premature Infants	*Full-Term*
Serum Albumin		
At birth	4 gm. %	4·8 gm. %
At 1 month	3 gm. %	3·5 gm. %
Serum Globulin (total)		
At birth	1·6 gm. %	1·75 gm. %
At 1 month	1·4 gm. %	1·7 gm. %
Alpha Globulin		
At birth	0·35 gm. %	0·5 gm. %
At 1 month	0·35 gm. %	0·5 gm. %
Beta Globulin		
At birth	0·5–0·8 gm. %	0·5–0·8 gm. %
At 1 month	0·5–0·8 gm. %	0·5–0·8 gm. %
Gamma Globulin		
At birth	0·7 gm. %	0·8 gm. %
At 1 month	0·2 gm. %	0·5 gm. %
Fibrinogen		
At birth At 1 month	Uncertain 130–250 mgm. per 100 mls.	