

Problems of the Newborn

The Pre-term Baby

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Babies who weigh 2,500 g (5 lb 8 oz) or less at birth present special problems in the newborn period, and though (in the United Kingdom) these babies constitute only 7% of all newborns, about half the total neonatal deaths occur in this group. It used to be an internationally agreed convention to classify all babies weighing 2,500 g or less at birth as "premature." Nevertheless, it has been increasingly recognized in the past 10 years that not all of them are born prematurely—that is, after an abnormally short gestation. There are, in fact, two major categories of low-birth weight baby—the pre-term baby and the small-for-dates baby—and they differ not only in the cause of their low birth weight but also in the clinical problems they encounter in the perinatal period.

Pre-term babies are those born before 37 completed weeks from the first day of the mother's last menstrual period. In the United Kingdom they comprise about two-thirds of low-birth weight babies and their clinical problems may largely be accounted for by immaturity and unreadiness to adapt to life outside the uterus. Small-for-dates babies are those whose birth weight is abnormally low for the gestational age at which they are born. The definition of low birth weight for gestation is necessarily an arbitrary one, but there is now a fair measure of agreement for describing babies whose birth

weight is below the 10th centile of birth weight for their gestational age as small for dates. These babies constitute about one-third of low birth weight babies in the United Kingdom. Many of their problems, which differ from those of the pre-term babies, may be explained by intrauterine undernutrition. It is, of course, possible for a low birth weight baby to be both pre-term *and* small-for-dates. Table I summarizes the differences between these two classes of low birth weight babies. The remainder of this article describes the problems of the pre-term baby; the second article describes those of the small-for-dates baby and discusses the present day outlook for low birth weight babies.

True Premature Babies

Pre-term, or true premature babies are those born before 37 weeks' gestation. In most cases the cause of the early onset of labour is unknown—which is perhaps not surprising since the mechanism of onset of normal labour at term is not fully understood. Nevertheless, premature labour may sometimes be associated with cervical incompetence, multiple pregnancy, antepartum haemorrhage, or premature rupture of the membranes. In modern obstetric practice labour is often induced prematurely in cases of Rhesus incompatibility, toxæmia, and failure of intrauterine growth.

The problems of the pre-term baby are largely those resulting from its immaturity and relative unreadiness to adapt

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Differences between Pre-term and Small-for-dates Babies

	Problems	Pre-term Baby	Small-for-dates Baby
Definition		Born before 37 weeks' gestation	Birth weight below 10th centile for gestational age
Aetiology		Cause of early birth usually unknown, but may be associated with cervical incompetence, multiple pregnancy, antepartum haemorrhage, or early induction of labour	1. Impaired fetal growth potential with or without congenital malformation. 2. Intrauterine undernutrition, possibly due to placental insufficiency
Cause of Problems		Immaturity	Often intrauterine undernutrition
Frequency of Occurrence of Problems	Intrauterine hypoxia Respiratory difficulties: Birth asphyxia Hyaline membrane disease Apnoeic attacks Feeding difficulties: Inability to suck or swallow Functional obstruction and enterocolitis Aspiration of feeds Intracranial haemorrhage: Intraventricular Subdural Jaundice (hyperbilirubinaemia) Liability to infection Difficulty in maintaining body temperature* Symptomatic hypoglycaemia†	+ + +++ +++ +++ +++ +++ ++ +++ +++ +++ +++ +++ +++ ++ +	+++ +++ 0 + 0 ++ + 0 + ++ ++ ++ ++ ++ ++ ++

The plus signs indicate the relative likelihood of developing particular problems in the two kinds of low birth weight baby.

+++ Very common.

++ Fairly common.

+ A little more common than in the normal term baby.

0 No more common than in the normal term baby.

*Both kinds of baby will be able to maintain body temperature if kept in a warm enough environment (see text).

†Despite the relative risks indicated in the Table, symptomatic hypoglycaemia is unlikely to develop if low birth weight babies are adequately fed (see text).

to extrauterine life. Naturally these problems are more severe the earlier the gestational age at which the baby is born. Those born after 35-36 weeks' gestation will commonly present few or no problems; those born before 28 weeks' gestation have a rather slender chance of survival and usually die of respiratory failure or intraventricular cerebral haemorrhage.

General Care

The need for special neonatal care greatly depends on the degree of the baby's immaturity and whether the problems described below occur, but the following generalizations apply to most babies born at less than, say, 36 weeks' gestation.

NURSING CARE

Skilled nursing is probably the most important factor determining the outcome for a pre-term baby. It includes attention to warmth and feeding; careful and continued observation for signs of respiratory difficulties, aspiration of stomach contents or any of the other problems listed below; and keeping handling of the baby to a minimum. Preventing infection is a special responsibility of the nursing staff, since they handle the baby more than anyone else.

FEEDING

Policies on feeding premature babies have changed greatly in the past 20 years. Much earlier and more liberal feeding is now the rule, and this has resulted in a fall in the incidence of certain neonatal problems such as jaundice, in improved growth, and probably in improved later neurological development. In Britain the most usual policy is to feed the baby from within a few hours of birth with milk, preferably expressed breast milk. V. A. Smallpiece and P. A. Davies¹ recommend daily amounts of 60, 90, 120, and 150 ml per kg body weight during the first four successive 24-hour periods.

Babies of less than 35 weeks' gestational age will generally have difficulty in taking feeds from a bottle. Their sucking and swallowing reflexes are present, but are not sufficiently well co-ordinated or sustained for feeding. The more immature babies are therefore usually fed by nasogastric tube, intermittently—at first as often as every hour—or by a continuous drip into the stomach. Gastric feeding has to be replaced by intravenous feeding if there is functional intestinal obstruction or enterocolitis.

Some centres, especially in the U.S.A., prefer intravenous feeding—either with dextrose or amino-acid containing mixtures—in the first few days of life for all the most immature babies. The ideal method of feeding, for preventing immediate problems and of promoting optimum growth, is still uncertain, but undoubtedly in most pre-term babies oral or gastric milk feeding is practicable and effective.

WARMTH

Pre-term infants need to be kept in a very warm environment—warm enough for them not only to maintain their body temperature at around 36.9°C but to do so without having to use extra oxygen and body fuels. Keeping the baby warm enough is one of the few parts of neonatal care would controlled trials have shown substantially reduces mortality in pre-term babies. A 1 kg baby nursed naked requires an incubator temperature of about 35°C in the first few days of life, and a 2 kg baby an incubator temperature of about

34°C. The baby should also be covered by a Perspex heat shield to prevent loss of radiant heat to the wall of the incubator, which is somewhat cooler than the air within it. (For a detailed discussion of this important subject, see Hey and colleagues.^{2, 3})

OXYGEN

It cannot be emphasized too strongly that giving extra oxygen is *not* a routine part of the care of the pre-term baby. It may be required in those with breathing difficulties but should not be given otherwise. Unnecessary or excessive administration of oxygen may cause retrolental fibroplasia—with later blindness—or may damage the lungs.

INCUBATOR OR COT?

Incubator nursing has the advantages that the baby can be observed easily, that he can be kept warm without the nursery itself being uncomfortably hot for his attendants, and that oxygen can easily be given in controlled and measured concentrations if it is needed. The disadvantages of an incubator—apart from expense—are that the wet parts of its interior may be a reservoir for Gram-negative organisms (especially *Pseudomonas aeruginosa*), and that the baby may be more restless in the incubator than wrapped snugly in a cot. (Temperature control is easier if the baby is clothed, but a baby in an incubator need not necessarily be naked.) Incubator nursing is probably best for babies with respiratory problems or other serious disorders requiring intensive care, as well as for the most immature babies who need especially careful observation. But we probably use incubators too much and cots too little for nursing pre-term babies.⁴

PREVENTION OF INFECTION

Infection remains a major hazard to the pre-term infant, and the most stringent measures must be taken to prevent it. Washing the hands with antibacterial agents before handling the baby is the most important. Gowns should be worn, and those parts of the environment which may harbour bacteria—especially wet apparatus—should be kept as clean and sterile as possible.

MOTHERS AND LOW BIRTH WEIGHT INFANTS

Paediatric departments which have encouraged unrestricted visiting in their children's wards, with mothers playing an important part in the care of their children, have generally been much slower to regard the mother as more than an onlooker in the care of her very small or ill low-birth-weight baby. There is little evidence whether the pre-term infant is himself directly affected by contact with his mother, or lack of it. But it seems likely, and there is now actual evidence, that the mother will find it easier to develop a relationship with her baby if she can make close and frequent contact with him from birth.^{5, 6} She should be encouraged to touch him and talk to him from the start, and to handle, feed, and change him as soon as he is over the serious neonatal problems.

Disorders

RESPIRATORY DISORDERS

*Hyaline Membrane Disease.*⁷—This is the major cause of death in pre-term infants. The disorder is strongly related

to immaturity of the lungs, being rare in term infants, and occurring with increasing frequency and severity at decreasing gestational ages. Other factors which probably predispose to hyaline membrane disease are intrauterine hypoxia or birth asphyxia, antepartum haemorrhage, maternal diabetes, and caesarian section. Though the aetiology of the condition is not fully understood it seems clear that absence from the lungs of surfactant (the normal phospholipid lining of the alveoli, which lowers surface tension and allows them to expand more readily) plays an important part. There is also increased pulmonary vascular resistance and reduced pulmonary blood flow, leading to right-to-left shunting of blood, arterial hypoxaemia, and cyanosis.

Within the first few hours of life the baby develops signs of respiratory distress—a respiratory rate above 60/min., indrawing of the intercostal spaces or of the whole of the lower part of the chest, expiratory grunting, and cyanosis. The condition has a substantial mortality, but there is a natural tendency to spontaneous recovery if the baby survives the first 2-3 days of the illness. In fatal cases death is due to respiratory failure, often with increasingly prolonged episodes of apnoea.

The baby should be kept in a warm environment, fed adequately, and handled as little as possible (handling may provoke apnoea). Added oxygen is almost invariably needed in the incubator, but to avoid the dangers of excess oxygen its use must be controlled by frequent measurement of the oxygen concentration in the incubator as well as the oxygen tension in the arterial blood, of which samples may be obtained from an indwelling umbilical artery catheter or by radial stab.⁸ Babies with hyaline membrane disease usually have a combined respiratory and metabolic acidosis, which may be corrected by continuous or intermittent intravenous injection of sodium bicarbonate.

A fair proportion of babies with this disorder will recover with this regimen. Others will show progressive respiratory distress, hypoxaemia, and apnoeic attacks, and of these more severely affected babies some may be saved by artificial ventilation. Nevertheless, this poses considerable technical problems, and carries several hazards to the baby. Its use should be reserved for babies who are unlikely to recover without it,⁹ and it should be given in neonatal intensive care units which are experienced in this form of therapy. A recent form of treatment which may help the more severely affected babies and reduce the need for ventilator therapy is artificially to maintain positive pressure of up to 12 mm mercury in the baby's airway throughout expiration, to prevent alveolar collapse (continuous positive airway pressure).¹⁰

Apnoeic Attacks.—Episodes of cessation of breathing commonly complicate hyaline membrane disease. They also occur without hyaline membrane disease, especially in the most immature babies—those below about 32-33 weeks' gestation. In severe apnoeic attacks the baby becomes cyanosed and the heart slows; cardiac arrest may occur. Apnoeic attacks may be a sign of infection, intracranial haemorrhage, or hypoglycaemia; but frequently there is no obvious cause. Enrichment of the air with oxygen (with stringent precautions to prevent over-use) may diminish the frequency of apnoeic attacks; prolonged apnoea may make artificial ventilation necessary.

INTRAVENTRICULAR HAEMORRHAGE

The second commonest cause of death in pre-term infants is haemorrhage into the lateral cerebral ventricles, usually originating from a haemorrhage into the germinal layer adjacent to the ependyma of the ventricle. It is not clear why very immature infants are so liable to this form of haemorrhage. It may complicate hyaline membrane disease, or occur in the first few days of life in a pre-term infant who has previously done well. The commonest clinical signs

are apnoeic attacks, fits, or unexpected deterioration. There is no effective treatment, and the condition is probably fatal in most cases. Nevertheless, some babies survive intra-ventricular haemorrhage, and they may subsequently develop obstructive hydrocephalus. The first evidence of this will be unduly rapid expansion of the head, and this is one reason why head circumference should be measured regularly in the follow-up of low-birth-weight babies.

JAUNDICE

Jaundice due to raised levels of unconjugated bilirubin is much commoner in pre-term than term infants. There is a serious risk of kernicterus, causing death or permanent brain damage, if the serum bilirubin level rises above 20 mg/100 ml. Kernicterus is more likely to occur if the baby is hypoxic or acidotic; in very ill babies it may occur at lower serum bilirubin levels. If the serum bilirubin is reaching dangerous levels, exchange transfusion(s) will be necessary. Babies are certainly less likely to develop serious hyperbilirubinaemia if they are given adequate fluid and calories from the start. Other methods of keeping serum bilirubin levels lower than they would otherwise become are phototherapy—shining white or blue light on the baby's skin, to convert bilirubin into water soluble and harmless biliverdin and other products—and giving phenobarbitone, which induces the formation of the conjugating enzyme, glucuronyl transferase, in the liver. It is still not clear what unwanted effects these methods of preventing hyperbilirubinaemia may have, or what their place in routine management should be.

INFECTION

The susceptibility of the premature infant to infection¹¹ is far greater even than that of the term infant. In most neonatal units in the United Kingdom, Gram-negative organisms have displaced the staphylococcus as the commonest pathogens. *Ps. aeruginosa*—which flourishes in wet apparatus such as incubators, resuscitation equipment, and ventilators—is a particularly serious hazard to the pre-term infant. Since the signs of Gram-negative infection in the newborn are often non-specific, such infections should be suspected whenever a pre-term infant becomes ill, deteriorates, or has apnoeic attacks without any other obvious cause. Under these circumstances it is usually best to obtain cultures of blood, cerebrospinal fluid, and urine, and of nose, throat, and umbilical swabs, and then to start systemic antibiotic treatment without waiting for the results of the cultures.

GASTROINTESTINAL PROBLEMS

Functional Intestinal Obstruction is a not uncommon complication in pre-term infants, especially those with other illnesses such as hyaline membrane disease. The abdomen becomes distended; there is delay in the passage of meconium, or failure to pass changing stools; and bile-stained material pools in the stomach or is vomited. Usually the problem settles after 24-48 hours of intravenous feeding and aspiration or failure to pass changing stools; and bile-stained material of stomach contents.

Necrotizing enterocolitis¹² is a more serious condition associated with signs of intestinal obstruction. In addition there may be passage of blood per rectum; tenderness and possibly a palpable mass on abdominal palpation; and linear streaks of gas in the intestinal wall on plain abdominal x-ray films. Pathologically there is a haemorrhagic necrosis of bowel wall,

which may lead to perforation. The condition will frequently recover with treatment by intravenous drip and gastric aspiration combined with systemic antibiotics; laparotomy is indicated if there are signs of perforation.

ANAEMIA

Pre-term babies very commonly develop a normochromic anaemia, with the haemoglobin falling as low as 7-8 g/100 ml. around 4-6 weeks after birth, then slowly rising. Transfusion is rarely required. Iron supplements may be given from the age of 2 weeks and are absorbed satisfactorily. They make little difference to this early "anaemia of prematurity" but may prevent the baby becoming anaemic later in the first year.

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Therapeutic Conferences

Supraventricular Tachycardia—II

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PROFESSOR A. G. MACGREGOR: We have seen that supraventricular tachycardia in a young person is usually benign. The next patient is older and has had to stop her work.

Case 3, Recurrent Supraventricular Tachycardia with Angina

HOUSE PHYSICIAN: This 53-year-old woman (A.B.), was admitted, as on many previous occasions, with central chest pain after the onset of palpitations. She was pale and had a regular pulse of 154 per minute and a blood pressure of 90/60 mm Hg. There were no murmurs and she was not in heart failure. The E.C.G. showed a supraventricular tachycardia (Fig. 1) with ischaemic changes. Serial electrocardiogram tracings and enzyme studies have not supported a diagnosis of myocardial infarction.

DR. J. C. PETRIE: The previous medical history is complicated. She first had angina in 1960 and has had ST and T wave changes in leads 3 and AVF ever since. In 1963 she was clearly myxoedematous. She was treated with L-thyroxine, but whenever adequate doses were reached to treat the subthyroidism she tended to have episodes of supraventricular tachycardia.

PROFESSOR MACGREGOR: Unless the dosage of L-thyroxine is carefully controlled it may provoke angina pectoris in older patients. Supraventricular tachycardia undoubtedly occurs in people with thyrotoxicosis but it is unlikely that physiological doses of L-thyroxine are alone enough to account for the arrhythmia. She also has intrinsic heart disease and this may

have developed before she was first recognized to have myxoedema. What drugs have been given over the years to control her arrhythmia?

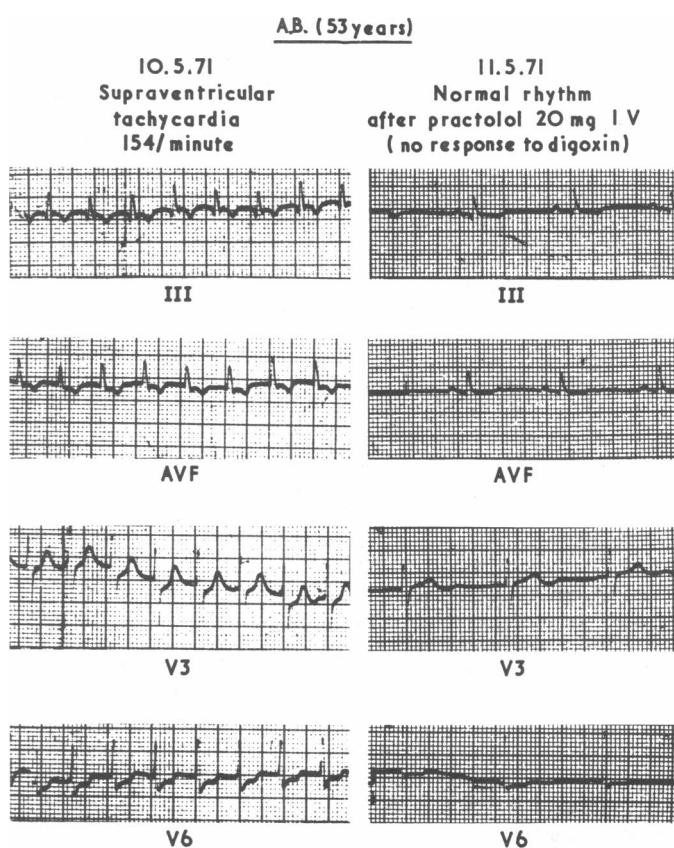


FIG. 1

Appointments of Speakers

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J. C. PETRIE, M.B., M.R.C.P., Senior Lecturer in Therapeutics
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