The First Year of Life

H B VALMAN

BACTERIAL INFECTION IN THE NEWBORN

Symptoms

Refusal of feeds

Lethargy

Hypotonia

Apnoea

Fever

Some infections are fulminating and the infant dies within a few hours. More commonly, however, the onset is insidious and the vague features may include the refusal of feeds by an infant who has fed normally, lethargy, hypotonia, apnoea, or fever. Fever is arbitrarily defined as a rectal temperature over 37.5°C , but newborn infants with infection often have a normal or even a subnormal temperature.

The most common pathogens are group B streptococci, *Escherichia coli*, *Staphylococcus aureus*, and *Pseudomonas*. The pathogens causing infection at a particular site can sometimes be predicted—for example *Staph aureus* in paronychia—but swabs for bacterial culture should still be taken before giving an antibiotic. Usually an antibiotic needs to be given before the organism has been isolated, but the treatment can be changed later once the sensitivity of the pathogen to antibiotics has been tested in vitro. The sensitivity of the pathogens in a particular unit is often known, which may give a guide to effective treatment. If septicaemia is suspected and there is no obvious site of entry of the pathogen both a penicillin and an aminoglycoside—for example, gentamicin—must be given.

Intestinal absorption is variable and regurgitation of antibiotics common, so that the intramuscular or intravenous route should always be used initially. Intramuscular injections should be given deeply into the upper lateral aspect of the thigh. Schemes for rotating the sites are essential to prevent local necrosis and to avoid further injections being given into a relatively avascular area. Intravenous antibiotics are given slowly by bolus injection rather than by adding them to the bottle of intravenous fluid.

Group B-streptococcal infections

Early onset

Raised respiratory rate

Peripheral cyanosis

End of 1st week

Insidious septicaemia

Meningitis

The group B *Streptococcus* is probably the commonest pathogen that causes severe infection in the first week of life. It is acquired during birth from the maternal vagina. Although about 10% of mothers are colonised and about 25% of their infants acquire this organism, only 1 in 2000 infants have symptoms, although about half of these die. In the early onset type of infection a raised respiratory rate accompanies peripheral cyanosis and septicaemia. The chest radiograph may show extensive areas of consolidation in both lungs or it may be normal. The same organism may cause a more insidious septicaemia and meningitis towards the end of the first week.

Escherichia coli infections

The use of an antibiotic or combination of antibiotics with a wide spectrum of action tends to eliminate all bacteria except *E coli* and *Pseudomonas*, which flourish especially in a warm moist environment. The preterm infant, who has a greater susceptibility to infection, nursed naked in an incubator with increased humidity and contaminating the air with faeces provides the ideal setting for these infections, especially if broad-spectrum antibiotics are being given. The umbilicus may become infected and this may be followed by septicaemia and later meningitis.

Early symptoms are ill defined, and the nurses may report that the infant appears vaguely unwell. He may have lethargy, anorexia, jaundice, and purpura. The early symptoms of meningitis are similar to those of septicaemia, but late features are vomiting, a high-pitched cry, convulsions, raised anterior fontanelle tension, but rarely neck stiffness.

A urinary tract infection may easily be missed if a specimen of urine is not examined in every infant with fever or who is unwell. Rarely, there are physical signs of an associated congenital abnormality of the urinary tract such as an enlarged kidney due to hydronephrosis or a persistently palpable bladder and poor urinary stream caused by obstruction from a urethral valve in a boy.

Outbreaks of acute gastroenteritis due to specific types of pathogenic *E coli* may occur in newborn nurseries.

Staphylococcal infections

Pustules

Pemphigus

Breast abscess

Osteomyelitis

Conjunctivitis—*Staphylococcus epidermidis* is often cultured from eye swabs of infants with conjunctivitis and it is impossible to determine whether this is the primary cause of the conjunctivitis or whether it is secondary to chemical inflammation. Chemicals such as chlorhexidine used in swabbing the mother's perineum may enter the infant's conjunctiva during delivery. Primary infection with *Staph aureus* may cause severe conjunctivitis. After taking an eye swab from an infant with conjunctivitis, chloramphenicol ointment should be applied to both eyes three times daily for a week.

If mild conjunctivitis persists longer than a week the possibility of infection with *Chlamydia trachomatis* should be considered. The laboratory may be able to isolate the organism using special techniques. The best treatment consists of a course of tetracycline eye ointment, which should be continued for at least six weeks.

Skin sepsis—Clusters of yellow pustules in the axilla or groin which first appear on the fourth day or later are usually due to staphylococci. They may resemble the lesions of neonatal urticaria, but those lesions appear earlier and resolve within 48 hours. If there is any doubt the lesions should be treated as staphylococcal pustules.

Pemphigus of the newborn is a rare bullous eruption which is rapidly fatal and very infectious if adequate antibiotics are not given.

Umbilical infection, shown by a localised red area and a serous exudate, may be due to *Staph aureus* or a wide variety of other pathogens.

Paronychia is an infection along the side of the nail of the fingers or toes. It often affects several digits together. The lesion appears trivial but it may lead to any of the more serious infections due to *Staphylococcus*. Surgery is not required.

A breast abscess is a red tender swelling which may not affect the whole breast; usually there are enlarged lymph nodes in the axilla on the same side. Physiological enlargement may be unilateral. Surgical drainage is usually required as well as antibiotics for a breast abscess.

Pneumonia—The signs are the same as those of other types of pneumonia—raised respiratory rate, recession, and sometimes focal or generalised signs in the lungs. The infant appears extremely ill because of the accompanying septicaemia. A chest radiograph may initially show generalised non-specific changes and later lobar consolidation with characteristic pneumatoceles, which are air-filled spaces. Complications are pneumothorax and empyema.

In **osteomyelitis** there are often no specific signs, just an ill infant who will not feed. Reluctance to move a limb and crying when the limb is moved or touched are valuable localising signs, but swelling at the site of the lesion is a late sign. A radiograph of the limb may show a soft tissue swelling or a raised and thickened periosteum at an early stage of neonatal osteomyelitis.

Gonococcal infection

Gonococcal conjunctivitis may be unilateral, usually does not respond to local chloramphenicol, and is often present within 48 hours of birth. In severe conjunctivitis, particularly when bilateral and associated with severe oedema, gonococcal infection should be suspected and special arrangements for taking swabs must be made with the laboratory. If the conjunctivitis does not respond rapidly to treatment the swabs should be re-examined for gonococcal infection. The paediatrician should be told as soon as the laboratory confirms the diagnosis in view of the medical and legal implications. A high vaginal swab should also be taken from the mother. If gonococcal infection is suspected, even if smears do not confirm it, penicillin eye drops should be given very frequently for the first six hours then every six hours. Intramuscular penicillin is also given and the diagnosis is reconsidered when the results of the cultures are available.

Candida infections

Candida infections are encouraged by the use of broad-spectrum antibiotics. Candida infection of the mouth produces white plaques (thrush) and may make the infant reluctant to feed. It also causes a fiery red scaly eruption in the perineum. A swab made damp with sterile sodium chloride solution should be used to obtain a specimen for laboratory confirmation of the cause of the perineal rash. Oral nystatin suspension should be given after feeds for at least a week for the oral lesions. Nystatin ointment should be applied to the perineal rash each time the napkin is changed for at least a week.

Management and treatment

Careful evaluation of the features noted above may enable a tentative diagnosis to be made and to be confirmed by a single investigation. In many infants, however, there are no specific signs and the following investigations should be carried out.

Urine microscopy and culture—Specimens must be collected carefully and examined promptly to produce reliable results. After preliminary washing with water a disposable adhesive plastic urinary bag is applied to the skin round the external genitalia and removed as soon as a small amount of urine has been passed. A fresh mid-stream clean catch specimen can often be obtained after gentle suprapubic stimulation, especially in boys. If the bag urine specimen contains more than 10×10^6 pus cells per litre or bacteria are seen in a fresh specimen or there is a growth of more than 100×10^6 organisms per litre a further bag urine specimen is taken if the child is not severely ill. If the infant is ill or the second bag specimen is abnormal a further urine specimen is obtained by suprapubic bladder puncture. Bacteria cultured from this specimen confirm a urinary tract infection.

Other investigations that may need to be performed are (a) gastric aspirate, ear swab, and umbilical swab; (b) chest radiograph; (c) blood culture from a peripheral vein, avoiding the femoral vein; and (d) lumbar puncture.

After the age of 2 days a neutrophil polymorph count higher than $10 \times 10^9/l$ suggests infection. A very low neutrophil polymorph count also suggests overwhelming infection.

Intravenous pyelography should be performed in all infants with a confirmed urinary tract infection at the age of a few months, and some units also perform a micturating cystogram in girls. Inadequately treated neonatal urinary infections may cause permanent renal scars and later renal failure.

As infants may deteriorate rapidly treatment is started immediately for the most likely organisms involved if the child is ill. If the infant appears ill antibiotics suitable for septicaemia should be given intravenously or intramuscularly after all the specimens have been taken. If the diagnosis is

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uncertain after physical examination, investigation of the urine, chest radiograph, and examination of the cerebrospinal fluid (CSF) and the infant appears well it is better to withhold antibiotics until a paediatrician has been consulted.

Suitable antibiotics are: intramuscular or intravenous cloxacillin for staphylococcal infections; intravenous penicillin for group B streptococcal infections; intramuscular gentamicin for *E coli* septicaemia; intravenous chloramphenicol for *E coli* meningitis. (Blood and CSF levels must be measured within a few hours of starting treatment with chloramphenicol); the alternative is intravenous ampicillin at high dosage and intramuscular and intraventricular gentamicin.

To treat urinary tract infection intramuscular gentamicin and ampicillin should be given, and once the sensitivities are established it may be possible to continue treatment with one antibiotic such as ampicillin. In any case gentamicin should not be given for longer than a week as eighth nerve damage may occur. Every infant who has had a confirmed urinary tract infection should have a repeat examination of the urine for the presence of infection every three months for two years.

The serum concentrations of gentamicin should be between 5 and 10 mg/l one hour after the previous dose. The trough blood level, taken just before the next dose is due, should be less than 2.5 mg/l.

Gentamicin should not be given for longer than seven days for a urinary tract infection but a longer course is needed for meningitis.

Dr H B Valman, MD, FRCP, is consultant paediatrician, Northwick Park Hospital and Clinical Research Centre, Harrow.

Non-accidental injury

Non-accidental injury inflicted by adults on children is often hard to detect. Symptoms that are difficult to explain may be the result of inflicted injury. In Britain as many as 100 children a year may die from non-accidental injuries.

Non-accidental injury should be suspected, especially in a child aged under 3, whenever: (a) there has been a delay between the accident occurring and the parents seeking medical help; (b) the explanation of the injury is inadequate, discrepant, or too plausible; (c) the child or sibling has a history of non-accidental or suspicious injury; (d) there is evidence of earlier injury; (e) the child has often been brought to the family doctor or accident department for little apparent reason; (f) the parents show disturbed behaviour or unusual reactions to the child's injuries or have a history of psychiatric illness; (g) the child shows obvious neglect or failure to thrive.

Typical initial injuries are: (a) burns, abrasions, or small bruises on the face; (b) injuries to the mouth or torn fraenum of the lip; (c) bruises caused by shaking or rough handling, including finger-shaped bruises; (d) subconjunctival haemorrhages. If the doctor suspects non-accidental injury he should undress the child completely and examine him fully, noting all signs of injury. If his suspicions are not allayed he should secure the immediate admission of the child under the care of a consultant paediatrician. He should, if possible, not mention his suspicions to the parents as they may refuse to allow admission and it may impair his relationship with them.

If parents refuse to allow their child to be admitted or want to remove him from hospital too soon the social services department or National Society for the Prevention of Cruelty to Children may seek a place of safety order, which allows the child to be kept in hospital for 28 days. In an emergency the police can secure an immediate place of safety order but this lasts only eight days.

The fact that children with genuinely accidental injuries will occasionally be admitted unnecessarily should not deter any doctor from admitting a child when there is reasonable doubt about the cause of an injury.