ABC of 1 to 7

H B VALMAN

THE SEVERELY ILL CHILD

There is no precise definition of the severely ill child, but there are several conditions that need urgent treatment if he is to survive. In most cases the treatment will be started in the ambulance or the accident and emergency department. A glance at a child will show that he is desperately ill and that a rapid history and examination are needed. The time of onset and duration of the symptoms should be noted. Questions must include the presence of rash, occurrence of diarrhoea, vomiting, cough, or fast breathing. The child may be receiving drugs or have had access to tablets or household fluids. Recent loss of weight should be noted.

Examination

The first priority is to ensure a clear airway and adequate ventilation and circulation. The child needs to be nursed on his side as vomiting and aspiration are constant hazards. A suction pump with a catheter of adequate bore—for example, FG 14—should be kept next to the patient and turned on before examination begins. If the child is not breathing spontaneously 100% oxygen should be given with a closely fitting mask and Ambu, Penlon, or similar inflating bag. The child may usually be ventilated satisfactorily by this method and intubation can wait until an anaesthetist or member of the paediatric unit arrives. If he is breathing spontaneously 100% oxygen should be given by rubber funnel or a mask if the child can tolerate it.

Clinical signs of gross dehydration or a femoral pulse of poor volume indicates that the circulating blood volume is reduced and that intravenous fluids are required urgently. A low blood pressure indicates a severe reduction in plasma volume, but in children it is a late sign. Severe hypovolaemia may occur with no fall in the blood pressure. The child should be completely undressed and observed with good lighting.

Urgent investigations

Diabetes mellitus	Dextrostix, plasma glucose, urea, sodium, potassium bicarbonate
Drowsiness after fit	
Head injury	
Poisons (including lead)	Dextrostix, analysis of vomitus, urine, blood
Septicaemia with meningitis or osteomyelitis	Blood culture, lumbar puncture
Gastroenteritis	Dextrostix, plasma sodium, potassium, bicarbonate
Continuous convulsions	
Upper airway obstruction	
Branchopneumonia	Chest x-ray
Bronchial asthma	
Bronchiolitis	Chest x-ray
Paroxysmal tachycardia	ECG
Peritonitis	Radiographs of abdomen

Dextrostix test

A Dextrostix or similar strip test should be carried out before the physical examination. If the blood glucose concentration is more than 15 mmol/l (270 mg/100 ml) the child probably has diabetic ketoacidosis. If the blood glucose value is below 2.5 mmol/l (45 mg/100 ml) hypoglycaemia due to insulin overdose, salicylate poisoning, or Reye's fatty liver syndrome should be considered.

The Dextrostix test must be done carefully to produce reliable results: if the strips are not fresh the results will be low. A complete drop of blood should be placed on the strip rather than smeared on; it does not have to cover the whole of the reagent area. After exactly 60 seconds the blood is washed off gently with drops of cold water, preferably from a wash-bottle, and the colour compared with the key on the bottle.

Drowsiness and loss of consciousness

If the child is drowsy or unconscious his parents should be questioned about the possibility of a recent fit, head injury, or drug ingestion. When urine from a child who has taken salicylates is tested with Phenistix the strip becomes brownish-red. If the tablets were swallowed at least six hours earlier the absence of this colour change excludes salicylate poisoning. If there is any doubt plasma salicylate and barbiturate concentrations may need to be measured. Septicaemia does not produce specific signs, just a generally ill child, and there may be associated meningitis or osteomyelitis. Neck stiffness is often absent in infants with meningitis who are less than 2 years old. Urine should be kept for drug analysis.

The stomach contents should be aspirated to prevent accidental inhalation of gastric contents but an anaesthetist must be present during the procedure.

A severely dehydrated child has sunken eyes, a dry tongue, and inelastic skin and has usually not passed urine for several hours. The extent of recent weight loss may be known.

Acute gastroenteritis

Maintenance water requirements for 24 hours

Age	Amount (ml/kg body weight)
1 week - 6 months	150 ml
6 months - 1 year	120 ml
1 - 3 years	100 ml
3 - 9 years	85 ml
9 - 12 years	70 ml
> 12 years	60 ml

Acute gastroenteritis should be considered if there has been diarrhoea or vomiting. Infants may become severely ill before passing many loose stools, as there may be pooling of fluid in the gut. Rectal examination often produces a large amount of fluid stool. Intravenous fluids are needed urgently, preferably 0.45% sodium chloride with 2.5% glucose solution. The rate is 40 to 80 ml/kg body weight given over two to four hours. When urine has been passed the rate can be reduced and the solution changed to 0.18% sodium chloride with 4% glucose supplemented by potassium chloride 20 mmol/l. The aim is to complete rehydration 24 hours after admission. The total volume required is the amount needed to make up the deficit plus the maintenance volumes. Severely dehydrated infants have a deficit of 10% of their body weight and moderately dehydrated infants 5% of the body weight.

In a severely shocked infant 10 ml of 0.9% sodium chloride solution or plasma for each kg of body weight can be given quickly by syringe intravenously using any large vein but preferably not the femoral vein.

Diabetic ketoacidosis

If diabetic ketoacidosis is present (blood glucose concentration over 15 mmol/l (270 mg/100 ml)) intravenous 0.9% sodium chloride solution is needed urgently together with intravenous or intramuscular insulin. A senior member of the paediatric unit should be informed immediately but the intravenous fluid should be started in the accident and emergency department. There are often deep frequent respiratory movements due to metabolic acidosis. A 21-gauge butterfly needle can usually be inserted into a peripheral vein.

Plasma glucose, potassium, sodium, urea, and bicarbonate concentrations should be estimated on admission and at least at two and six hours after the beginning of treatment.

The initial intravenous fluid is 0.9% sodium chloride solution, which is given at a rate of 20 ml/kg body weight in the first 30 to 50 minutes. Many units no longer use sodium bicarbonate solution as the metabolic acidosis is corrected without it. Provided the plasma potassium concentration is not raised potassium chloride may be added to the bag of solution (20 mmol potassium chloride to every 500 ml of intravenous fluid) and the bag shaken thoroughly. The rate of infusing potassium chloride should be 0.1-0.2 mmol/kg/hour. Oral potassium supplements are given when the child can drink; a suitable dose is 0.5 g every eight hours. When the blood glucose concentration falls below 10 mmol/l (180 mg/100 ml) the fluid is changed to 0.18% sodium chloride with 4% glucose and supplementary potassium.

Insulin for initial treatment should always be the short-acting type, either soluble or neutral insulin. After a loading dose of 0.2 units/kg, 0.1 units/kg is given every hour until the blood glucose concentration, as shown by hourly Dextrostix tests, is less than 10 mmol/l (180 mg/100 ml). The dose of insulin is then reduced. The same dose may be given as a continuous intravenous infusion using a syringe pump or by deep intramuscular injection.

Acute gastric dilatation is common in severe ketosis and the stomach contents should be aspirated in a drowsy or unconscious patient to avoid aspiration pneumonia.

Convulsions

Convulsions associated with fever occur in 3% of children aged 6 months to 5 years. Often there is no warning and the fever is not obvious to the mother. The child's clothes should be taken off and he should not be covered with a blanket. If the convulsions persist or start again, paraldehyde with hyaluronidase should be given intramuscularly. A glass syringe is ideal, but if only a plastic syringe is available the paraldehyde should be injected within two minutes of filling the syringe. If the convulsions do not stop within 10 minutes, the duty anaesthetist should be present while another drug is given intravenously. Diazepam must be given slowly over several minutes as there is a risk of respiratory arrest.

Early transfer to the intensive care unit should be considered if a second dose of anticonvulsant is needed. Diazepam is extremely effective but it has been associated with respiratory arrest, especially when the patient has previously received barbiturate or the drug has been given too quickly. Standard solutions of diazepam cannot be diluted, which may lead to inaccuracy in measuring small doses. Inserting and holding the needle in the vein of a convulsing, fat toddler is often a difficult task. Diazepam is best used only by those experienced in intubating infants.

Stridor

Stridor with drowsiness is a dangerous combination of signs, and the duty anaesthetist should be called to the child immediately. Cyanosis is a terminal sign in these infants. The throat and mouth must not be examined nor a throat swab taken except by a skilled anaesthetist prepared to perform immediate intubation or tracheostomy if necessary. Although most patients with stridor have laryngitis, a few have epiglottitis or an inhaled foreign body, and an examination of the throat in these last two conditions may cause complete obstruction of the respiratory tract followed by cardiac arrest. The child should be admitted to the intensive care unit or taken directly to the operating theatre as urgent intubation by a skilled anaesthetist may be required.

Raised respiratory rate

A raised respiratory rate at rest in a child aged over 2 years suggests pneumonia or peritonitis. Staphylococcal pneumonia may make the child extremely ill because of the associated septicaemia. Pneumonia causes the alae nasi to move actively and there may be a cough, indrawing of the chest wall, and adventitious sounds in the chest.

Infants with bronchiolitis may deteriorate suddenly and a rasping cough and recession of the chest wall may be the main features.

If there was choking just before the dyspnoea began the possibility of an inhaled foreign body must be considered.

When an enlarged liver accompanies a raised respiratory rate congestive cardiac failure is present. If there is no cardiac murmur, paroxysmal supraventricular tachycardia should be considered.

Abdominal tenderness

Generalised abdominal tenderness suggests peritonitis, which may be due to perforation of the appendix or of the small gut after intestinal obstruction. An obstructed inguinal hernia is a form of intestinal obstruction which is easily missed. In suspected intestinal obstruction urgent radiographs should be taken in the supine and erect positions to show fluid levels in distended loops of small gut. Fluid levels are also found in children with gastroenteritis. If the patient cannot stand erect similar information can be obtained from radiographs taken using a horizontal beam with the patient lying on his side.

Rash

If there is a generalised purpuric rash—on the trunk as well as the neck (which does not disappear when pressure is applied)—a presumptive diagnosis of meningococcal septicaemia should be made.

Blood should be taken for culture, and, using the same needle in the vein, 0.5 megaunits (300 mg) of benzylpenicillin is given slowly intravenously. The same dose is given irrespective of age. Children may die within a few hours of the onset of this disease and urgent treatment is necessary.

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