Fast-Bleeped: A to E Series – E: the acutely unwell paediatric patient

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A medical educational series comprising practical instructional pieces on how to approach undifferentiated clinical problems in the acute setting

CASE PRESENTATION

You are the Foundation Year 2 (FY2) doctor working at night in a busy Emergency Department (ED), covering the paediatric area. You are midway through your shift when the triage nurse asks you to review a new patient whom she is worried about. Oliver is a 2-year-old boy brought in by his father because he had been running a high temperature and had not been his usual self over the last two days.

As you arrive at the triage desk, you are met by Oliver, who is lying in his father's arms. He is silent and appears to be breathing quickly. You try to rouse Oliver, but he doesn't seem to respond to your voice and a gentle rub of his arms. On further inspection of his arms and legs, you notice he is mottled. You are very concerned, because you realise that these signs are urgent red flags in paediatric patients.[1] Calmly, you ask the father to carry Oliver into the paediatric resuscitation bay and ask the nurse to use the tannoy speakers to get a senior doctor to attend with you.

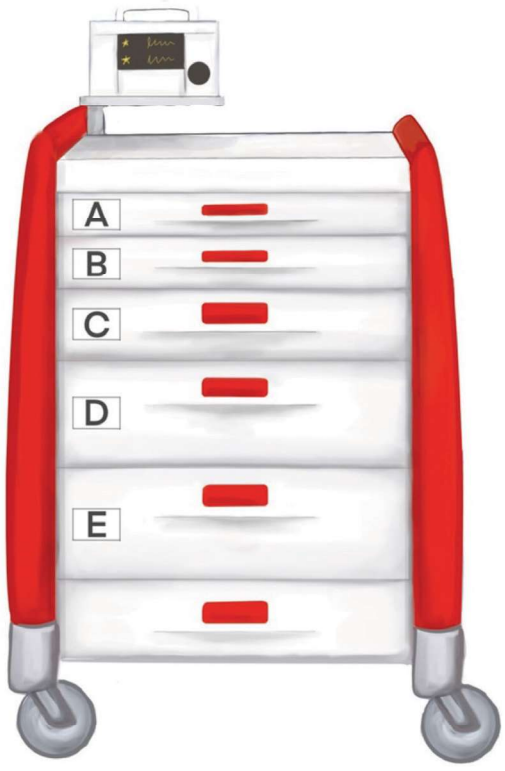

Figure 1: ABCDE crash trolley

HOW WOULD YOU APPROACH THIS CLINICAL SITUATION?

Dealing with acutely unwell paediatric patients is never an easy task. It is well known that even senior clinicians find these situations stressful. In this scenario, you have spotted this child needs urgent assessment. You have moved them to an appropriate clinical area (the paediatric resuscitation bay) and have called for senior support. As you wait for senior support, you should approach the paediatric patient with an ABCDE approach, just as you would an adult.[2, 3] You ask Oliver's father to put him on the trolley and you ask the nurse to take a full set of observations. The health-care assistant has begun calculating and writing up a 'WETFLAG' on the white board on the wall, which is shown in figure.[2, 4] You then begin your formal assessment as your registrar arrives to help.

Weight (Age + 4) x 2 = 12kg

Energy 4 J x Weight = 48J

Tube Internal Diameter = Age / 4 + 4 = 4.5

Fluids 10 ml x Weight = 120mls

Lorazepam 0.1mg x Weight = 1.2mg

Adrenaline = 0.1ml x Weight of 1:10,000 Adrenaline = 1.2mls

Glucose 2ml x Weight of 10% Dextrose = 24mls

Figure 2: WETFLAG calculations for Oliver's approximate weight

(A)irway: Assessing the airway in paediatric patients may prove harder than with adults. Small children may not be able to speak, which is normally a reassuring sign of airway patency in adults,[2] but they may make other vocal sounds. In this case, as Oliver was placed onto the trolley you heard him crying. You hear no additional abnormal airway sounds like stridor or stertor. Oliver's airway is patent. Your registrar is gaining intravenous (IV) access at this point and sends off his bloods, including a venous blood gas (VBG) and cultures.[1, 2]

(B)reathing: You begin by assessing the effort in Oliver's breathing and you ask the nurse to place a paediatric saturations probe around his finger. You count his respirations at 44 per minute and you notice he shows signs of increased work of breathing. He has intercostal recessions which you recognise as a worrying sign. His saturations are 87% on room air, which is also low.[5] You remind yourself that you do not normally deal with children and appreciate your boundaries in knowing normal paediatric observation values. You ask the nurse to get a paediatric observation chart to plot the values of his observations and recognise he is tachypnoeic, and hypoxic. You find the appropriately sized non-rebreathe mask and apply high-flow oxygen to Oliver's face. You continue to inspect his chest. There is equal, bilateral chest

rise. You auscultate his chest and hear normal breath sounds without any added sounds and good air entry bilaterally. His saturations climb to 97% on high flow oxygen.[1, 2]

(C)irculation: You begin by feeling Oliver's peripheral pulses which are fast and thready. The observation monitor tells you that his heart rate is 164 beats per minute (BPM) – meaning Oliver is tachycardic.[3, 6] You cycle the blood pressure (BP) which comes back as 65/25mmHg and perform a central capillary refill time (CRT), which is 4 seconds. You recognise his BP as low so you suggest to your registrar that a fluid bolus should be given.[6] You refer to the 'WETFLAG' that has been calculated on the white board (figure 2) and decide to administer 10mls/kg which, with Oliver's estimated weight, would be 120ml of a balanced crystalloid.[7,8] You auscultate Oliver's heart and decide that his heart sounds are normal and without additional sounds such as murmurs. You note his haemoglobin concentration on the VBG is within the normal reference range. His serum lactate level is elevated at 6 mmol/L, which worries you. Your registrar decides to bleep the on-call paediatrician to attend and help with the assessment. You find yourself unsure of the cause of his presentation, but you remember to continue with your assessment.[1, 2]

(D)isability: Although there is a paediatric version of the Glasgow Coma Scale (GCS), this patient needs a rapid assessment of his conscious level, so you decide to score him based on the Awake, Verbal, Pain, Unresponsive (AVPU) scale.[9, 10] You speak to Oliver and get no response, so you move to delivering a supraorbital painful stimulus to see whether he is responding to pain. He winces, cries out, and raises his hand to remove yours. You deem he is responsive and localising to pain and score him as 'P' on the AVPU scale.[10] Given he is poorly responsive, you double check the VBG to ensure that you have registered Oliver's blood glucose level. It is 6.5 mmol/L which is within the normal reference range so you can rule out hypoglycaemia from the differential diagnoses list. His pupils are equal and responsive to light bilaterally.

(E)xposure: The nurse tells you that Oliver's core body temperature is 38.3 degrees Celsius. You recognise this as a sign of inflammation, and you know that infection is the most common cause of inflammation. Your registrar points out that given the issues identified within 'B', 'C' and 'D' you should go further and include sepsis within your differential diagnoses. You remember the importance of early antibiotic treatment when managing a septic patient.[11] You check with Oliver's father whether he is allergic to any drugs, and you ask the nurse to prepare the antibiotics for sepsis of unclear source according to the local trust protocols.[1, 2] You remember the importance of fully exposing the patient and looking for any other clinical signs that may add to your differential diagnosis. As you do this, your registrar begins taking a collateral history from the father. You ask for the nurse to help undress Oliver. You palpate his abdomen which is soft and appears tender as Oliver winces during deep palpation. You inspect his limbs which are mottled. You roll Oliver over, and you are immediately struck by a large petechial rash that has spread over his back.[12] You palpate the rash and notice that it is non-blanching, which worries you, as you recognise this as a sign of a bleeding disorder such as disseminated intravascular coagulation (DIC), in particular you associate this clinical sign with this age group as potential meningococcal septicaemia.[1, 2, 12]

You begin re-assessing all your above interventions as the paediatric registrar arrives and your registrar begins delivering a Situation, Background, Assessment, and Recommendation (SBAR) handover.[13]

> *"This is Oliver, he is a 2-year-old who we are worried has sepsis, possibly meningococcal septicaemia, due to a petechial non-blanching rash and signs of septic shock. His medical background is unremarkable. He was born via vaginal delivery at 38 weeks with no issues, he is up to date with vaccinations and has been meeting all developmental milestones. He has been unwell over the last two days with poor feeding and hasn't been himself, according to his father. On clinical assessment he is tachypnoeic and hypoxic. He is hypotensive, tachycardic and mottled, so we have already administered a 10ml/kg of crystalloid bolus. He is currently responsive to pain only but has equal, reactive pupils bilaterally. He is pyrexial and has a normal blood glucose level. On full exposure he has a petechial rash over his trunk. We are worried he has meningococcal septicaemia, so we have administered IV antibiotics. I will organise a chest x-ray and ask the nurse to take a urine sample for culture. We have already sent a blood culture, but we will also send blood for meningococcal screening. We think his care should be escalated to a paediatric high dependency unit and the paediatric retrieval team needs be contacted for further advice"*

What is the paediatric traffic light system?

The paediatric traffic light system is a National Institute for Health and Care Excellence (NICE) guideline approach to evaluating children under five who are acutely unwell.[1] Alongside clinical judgment, it serves as an aid to health-care professionals in making appropriate escalation decisions. It is shown in table 1.

What are the manifestations of paediatric sepsis and how should you act on them?

Paediatric sepsis is described as 'a final common pathway for many decompensated infections' and is a life-threatening medical emergency.[14] Before thinking about the manifestations of paediatric sepsis in critically unwell children, it is vital to think about the pathophysiology of sepsis. It occurs when there is a dysregulated immune response from the host to an infection leading to organ dysfunction and failure. Consequences of this dysregulated immune response include hypotension, cardiac dysfunction and endothelial leak.[14, 15]

Recognising the clinical manifestations of paediatric sepsis early is vital if one is to implement rapid intervention and treatment. Important signs to look for in the paediatric population include fever or hypothermia, tachycardia, tachypnoea, hypoxia and altered consciousness. These are all red flags which should make you think of sepsis as a differential. Hypotension is often a late and worrying sign.[14, 15]

Any child who you suspect is septic should have a 'sepsis 6' bundle commenced. It is advised that within one hour, the child should have a senior clinician review, oxygen administered, IV access, antibiotics and consideration for IV fluids and vasopressors if indicated.[16, 17] Hypotension and other cardiovascular signs that do not seem to improve following fluid therapy is suggestive of a more serious syndrome called

	Green (low risk)	Amber (intermediate risk)	Red (high risk)
Colour (of skin, lips, or tongue)	• Normal colour	• Pallor reported by parent/ carer	• Pale/mottled/ashen/blue
Activity	• Responds normally to social cues • Content/smiles • Stays awake or awakens quickly • Strong normal cry/not crying	• Not responding to social cues • No smile • Wakes only with prolonged stimulation • Decreased activity	• No response to social cues • Appears ill to a healthcare professional • Does not wake or if roused does not stay awake • Weak, high-pitched, or continuous cry
Respiratory		• Nasal flaring • Tachypnoea: ○ RR >50 breaths/ minute, age 6–12 months ○ RR >40 breaths/ minute, age >12 months • Oxygen saturation ≤95% in air • Crackles in the chest	• Grunting • Tachypnoea: RR >60 breaths/ minute • Moderate or severe chest indrawing
Circulation and hydration	• Normal skin and eyes • Moist mucous membranes	• Tachycardia: ○ *>160 beats/minute age <12 months,* ○ *150 beats/minute, age 12–24 months* ○ *>140 beats/minute, age 2–5 years* • CRT ≥3 seconds • Dry mucous membranes • Poor feeding in infants • Reduced urine output	• Reduced skin turgor
Other	• None of the amber or red symptoms or signs	• Age 3–6 months, temperature ≥39°C • Fever for ≥5 days • Rigors • Swelling of a limb or joint • Non-weight bearing limb/not using an extremity	• Age <3 months, temperature ≥38°C • Non-blanching rash • Bulging fontanelle • Neck stiffness • Status epilepticus • Focal neurological signs • Focal seizures

Table 1: Traffic light system for assessing children under five years of age by NICE.[1]

septic shock and in all cases the treating clinician should involve the paediatric intensive care unit (PICU) team early to consider whether vasopressor support is needed.[1, 16, 17]

What is the paediatric WETFLAG acronym?

The WETFLAG acronym (detailed below) is used to estimate the weight of the child based on age, sizes of advanced airway adjuncts, doses of common resuscitation drugs and the energy dose for defibrillation.[4] It is normally used for acutely unwell children requiring resuscitation. It is common for this to be used in the ED when a child is pre-alerted as part of the team preparations. It is worthy to point out that the below calculations are just approximate values and senior clinicians should be consulted.

- **W**eight (kg): (age+4)x2
- **E**nergy (J): 4 joules/kg
- Endotracheal **T**ube (cm): internal diameter (age/4) + 4
- **F**luid bolus(ml): 10 ml/kg
- **L**orazepam (mg): 0.1 mg/kg
- **A**drenaline (ml): 0.1ml/kg of 1:10,000
- **G**lucose (ml): 2ml/kg of 10% dextrose solution

What are the logistics of managing the critically unwell child in a district general hospital?

Within the National Health Service (NHS) the provision of paediatric critical care tends to be centralised in tertiary centre hospitals.[18] Most district general hospitals (DGH) will have some capacity for high dependency unit paediatric patients, but these areas can only care for level two patients, and the number of these beds are often very limited. This means that, most of the time, any child presenting to a DGH who requires advanced respiratory support (level three) such as ventilation will require transfer to a tertiary centre via a retrieval team.[19] There are various retrieval teams across the United Kingdom (UK) covering different areas of the country. If you are working within acute paediatrics, it is important to familiarise yourself with your local team.

Any critically unwell child can be referred to the retrieval service for advice or to arrange transfer to a tertiary service. Normally, this involves a phone call where advice is given via the phone. Before referring to the retrieval service, a senior clinician from the local site should always be involved. If the retrieval team deem the child to fulfil their transfer requirements, then, arrangements will be made for transfer with the retrieval team travelling out to the DGH to retrieve the child.

Outcome of case

In our above case, there was a strong suspicion of septic shock. It is known that children tend to compensate well with critical illness, then "fall off a perch". The paediatric registrar was worried about deterioration so kept Oliver in resus and stayed by his bedside. The consultant paediatrician was also contacted and attended promptly.

Unfortunately, Oliver deteriorated over the course of the night with worsening blood pressure readings and increasing work of breathing. The retrieval team were contacted, and advice was given to start a vasopressor infusion. They advised involving the anaesthetic team to consider endotracheal intubation and ventilation to offload Oliver's respiratory muscles, thus, reducing metabolic demand. A retrieval team was dispatched, and Oliver was taken to a PICU bed at the tertiary referral centre. Oliver's blood cultures confirmed the clinical diagnosis of meningococcal septicaemia. He remained intubated and ventilated for a week with vasopressor support, whilst his antibiotics took effect. He improved and was eventually repatriated home for continued support leading up his discharge.

DISCLAIMER

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