"Big Head, Little Body" and Beyond: Emergency Paediatric Resuscitation and Stabilisation

Ella Scott
Clinical Nurse Consultant: Coordinator
GESCHN Paediatric Support Project
Sydney Children's Hospital
Sydney, Australia

Scott DeBoer
Founder: Peds-R-Us Medical Education
Dyer, IN USA

KEYWORDS
Paediatric, Resuscitation, Stabilisation, Assessment , Respiratory, Cardiovacular, Emergency Department

Introduction

If one asks what kinds of patients instill anxiety in even the most experienced of emergency nurses, burns and children are the typical answers. When confronted with the initial resuscitation and stabilisation of a critically ill or injured child, the acronyms of "sick or not sick", and "pink, warm, sweet, and safe" can easily summarize the assessment and treatment priorities. Using one's clinical assessment skills and instincts is imperative to quickly determine does the child look "sick or not sick?"

> *"That is all very fine but it won't do – anatomy, botany. Nonsense, Sir! I know an old woman in Covent Garden who understands botany better, and as for anatomy, my butcher can dissect a joint foll as well. No, young man, all this is stuff you must go to the bedside, it is there alone you can learn disease." Thomas Sydenham (1624-1689)*

Sick or Not Sick: Neurological Assessment

Crying or not crying – If the child is crying, this is actually a very reassuring sign. This means they are alive, breathing, and perfusing their brain well enough to scream. However, silence is not golden in children. If they are not crying, especially if painful interventions are being performed (ie placement of intravenous lines), this is a hallmark sign of a "sick" child. Crying, unless the child is actively being held and comforted, is a very appropriate response and quite the "music to our ears!"

Look at their faces – Babies and children should not look stressed. If they look stressed, are grimacing etcetera, something is wrong. Children, when feeling sick, should be unhappy and crying, especially if unpleasant interventions are being undertaken .Again, alert, active, and screaming are very good signs.

Fontanelles- These are otherwise known as the "soft spots" or the "windows to the brain" of babies and small children. The anterior fontanelle does not normally fuse until (on average) 18 months of age, but it can close as early as 9 months. Therefore, like the pupils, they can be the "windows to the brain." If the child is dehydrated, hypovolaemic, or "shocky", the fontanelles can be sunken. However, if intracranial haemorrhage (ICH) or meningitis is suspected, the fontanelles may no longer be soft, but full or even bulging, suggestive of increased intracranial pressure (Merenstein and Gardner, 2001).

Activity level/Muscle tone- Infants, like older children, should be actively moving their extremities and still continue to move them even when they are asleep. "Sick kids" are rag-doll floppy or even worse, minimally or non-responsive to painful interventions, ie venipuncture. Their arms and legs, even when asleep, should be in a flexed position. If they are flopped open exhibiting a positive "frog-leg" sign then there is a definite reason for concern (Merenstein and Gardner, 2001).

Parents/Caregivers- If present or able to be contacted by phone, parents can be an invaluable resource to shed light not only on the illness or injury that prompted the emergency department (ED) visit, but also on other issues such as medical conditions, medications, and allergies. This is especially so with children who are chronically ill, developmentally delayed, or have rare medical syndromes- these parents are often the "experts" on their children's condition therefore should be viewed and consulted as such.

Sick or Not Sick: Respiratory Assessment

Why do children arrest? Children can have primary cardiac events, but this is rare. Most of the time if the heart stops it is because a significant respiratory event occurred first (Ushay and Notterman, 1997; Brennan and Gupta, 2001).

Respiratory Rate – Children definitely can breathe faster than adults. Respiratory rates well over one hundred are not unheard of in critically ill infants. However, what is crucial is to assess the respiratory status as a whole, and not merely the rate. Other reasons, such as pain, acidosis, or fever can cause significant tachypnoea. Although tachypnoea can be an important early sign of respiratory distress or failure, assessing the respiratory rate along with effort and eli nical appearance is the key (Merenstein and Gardner, 2001; Brennan and Gupta, 2001).

Retractions – When children are retracting, they are simply trying to get more air in and out of their chest. It is important to recognise both the presence and severity of the retractions. The worst kind of retractions are called *sternum to spine.* If anyone in neonatology or paediatrics is told that "the baby's sternum is touching his spine", they should immediately recognise that the child is quite sick. Beyond sternum to spine are subcostal, intercostal, and supraclavicular retractions in their respective regions.

Grunting-With inspiration the alveoli open, and upon exhalation they close. However, when children have "bad lungs" for whatever reason, it can be quite difficult to open the alveoli up again once they close. Remember that if the alveoli do not open, air exchange does not occur. When sick children exhale, their epiglottis and vocal cords at the top of their airway slam shut like a trap door, and exhaled air is pushed against a greatly narrowed opening. This action actually creates PEEP (positive end expiratory pressure), which is physiologic, but markedly increased with grunting. Even though intubation is not warranted in every grunting child, preparations for emergent intubation should in place (Merenstein and Gardner, 2001).

Sick Or Not Sick: Cardiovascular Assessment

Feet- With cardiovascular assessment, simply feel their feet. The feet are the "windows to the heart" in sick kids, because when a child is in shock blood goes selectively to the heart, lungs, and brain. The body is saymg:

"What do I truly need to stay alive at this moment?" Answer: heart, lungs, and brain.

"What do I not need?"

Answer: everything else.

Therefore, children will vasoconstrict in an effort to keep the blood where it really needs to be. If the child has great peripheral pulses, and feet are pink, warm, and dry, is the child in shock? Probably not. In infants and children with normal vasculature, the feet, like the

fontanelle with neurologic assessment, are a reliable and non-invasive way to assess the cardiovascular status (Merenstein and Gardner, 2001).

Capillary Refill – The normal capillary refill is 2-3 seconds in a warm environment. The easiest way to remember this is to blanch the finger/toe/heel/chest and say "capillary refill". By the time one has finished saying "capillary refill", the blanched area should be pink again (Merenstein and Gardner, 2001).

Heart Rate and Rhythm -This is another significant physiologic difference between children and adults. Adults have "bad hearts" and therefore tend to present with cardiac events and multiple arrhythmias first. Children however are blessed with good hearts, and therefore for the most parr simply go "too fast, too slow, or not at all". If they go too fast one should attempt to slow it down with oxygen, adenosine (eg in cases of supraventricular tachycardia – SVT), or amiodarone (eg in cases of ventricular tachycardia-VT). If they go too slow one should try to speed it up with oxygen, atropine, or epinephrine (adrenaline).

If they "don't go at all" – do something fast! Most children in cardiac arrest present to ED with a terminal brady-systolic rhythm. However, more children (6-19%) are actually in VT/ventricular fibrillation (VF) than previously thought. This is especially important when one looks at the recent emphasis on public access defibrillation. The fact that more children are initially presenting in an electrically reversible rhythm, combined with the recent introduction of a paediatric adapter for adult automatic external defibrillators which decreases the delivered energy to a infant/paediatric level (Philips Medical Systems, Andover, MA, USA) means that automatic external defibrillation is no longer just an adult procedure.

A review of cardiac arrest in children showed that 30% of paediatric VT/VF patients survived to hospital discharge, compared with only 5% of asystolic patients. Think about how many adults actually revert to sinus rhythm from asystolic arrest. If we get them back, do we really get them back? You not only have to restart their hearts, but their heads as well. The chances of a child reverting to sinus rhythm from (presumed) asystole are certainly better than adults, but again, at what expense? (Ushay and Notterman, 1997; Young and Seidel, 1999; Kattwinkel, 2000; Sanders, 2001; Schleien and Todres, 2001).

Sick Or Not Sick: Abdominal Assessment

Is the belly big?- When children cry, or when they are subjected to bag-valve-mask (BVM) ventilation, their abdomens quickly become distended with air. This distension pushes on the diaphragm making breathing difficult due to compression of the lungs. Therefore, if BVM is being performed, or if the abdomen appears distended, a naso- or oro-gastric tube needs to be quickly inserted in an attempt decompress the stomach and allow the child's lungs room to breathe (Kattwinkel, 2000; Merenstein and Gardner, 2001).

Is there any urine output?- If the child is in shock blood goes to the heart, lungs, and brain. It does not go to the "butt or the gut". Therefore, one of the easiest ways to know if a baby is doing well or improving is to assess their urine output? This concept is summarized by understanding the idea that the body is now perfusing more than just the heart, lungs, and brain and is now also sending blood to the kidneys. Textbooks teach to look for 0.5-1.0ml/kg/hr of urine output in the inpatient critical care settings. In the ED however, just remember: "if they are peeing, they are doing well" (Merenstein and Gardner, 2001).

Sick Or Not Sick: Skin Assessment

Mottling- Mottling begins with "M" and it looks like marble. Patients whose skin looks like marble and acting like inanimate marble statues are in shock. Shock sends blood to the heart, lungs, and brain, and not to the skin, therefore sick children get this blotchy and marblesque look to their skin (Merenstein and Gardner, 2001).

Blue – Blue begins with "B" and is therefore bad. However, newborn babies and small children can be blue in one of two areas -either on the *inside* or on the *outside*. Blue on the *inside* is central cyanosis, which involves the face and torso turning purple. This is quite an ominous sign, occurring only with significant hypoxia, therefore supplemental oxygen should immediately be given.

Blood vs Dopamine -After "three strikes"of 2mllkg fluid boluses, something else should be done. If the child is presumed to be hypotensive from sepsis then think about dopamine or another pressor. If however the child needs blood, give them blood. Blood is thicker than water, so, water-like fluids (NS/LR) are administered based on the 20mllkg calculation, and blood (which is thicker) is administered using the 1Omllkg calculation . Whether you administer red blood cells, fresh frozen plasma, or platelets, *blood is thicker than water,* so use the 1Omllkg formula for any blood products.

If the child remains m shock despite several fluid boluses and blood products are not indicated, dopamine can be considered. However it is highly recommended that you consult with a paediatric critical care specialist before starting dopamine or any other vasopressor in a child (Abdelmoneim and DeNicola, 2001; Cote, 2001; DeNicola and McCrory, 2001; Sanders, 2001).

Keep them Pink, Warm, Sweet, and Safe: Warm

Make sure they are warm and kept warm. Children, as described earlier, have *big head, little body* syndrome. This is crucial to remember when the issue of thermoregulation is addressed as children will lose the majority of heat from their head. Therefore, cover up their bodies, and especially remember to cover their heads (woolly bonnets are good for babies). Check a temperature immediately on arrival, regularly monitor the temperature whilst in the ED, and again shortly before transport. Warming devices such as warm blankets, over head warmers, forced air warmers, and wrapped hot packs can be utilized in the effort to maintain normothermia (Bissonnette and Ryan, 200 1).

Keep them Pink, Warm, Sweet, and Safe: Sweet

This actually encompasses three concepts:

1. are they sweet?
2. keep them sweet, and
3. make them act sweet!

Are they sweet? -When infants and young children are stressed, their blood sugars can decrease dramatically. Therefore, performing a finger/heel stick blood sugar is crucial immediately upon arrival, regularly whilst in the ED, and again shortly before transport. If the blood sugar is low, then a slow IV bolus of 10-25% dextrose is indicated (Buser-Gills and Whitfield, 1995).

Keep them sweet- As indicated earlier, sick children can drop their blood sugar levels, therefore ensuring a continuous supply of glucose, via an IV dextrose infusion of some kind is indicated (Buser-Gills and Whitfield, 1995).

Make them act sweet-This simply means that children, just like adults, feel pain and anxiety. Utilization of parents or caregivers to calm and comfort the child, in addition to administration of appropriate sedatives and analgesics is essential for humane patient care (Cote, Lugo, and Ward, 2001; DeBoer and Petersen, 2001).

Keep them Pink,Warm,Sweet,and Safe: Safe

Sick children should be taken safely to a place accustomed to care for sick children. Emergency medical service paramedics can very appropriately transport non-critically ill children. However, when the child is being transported to a paediatric ICU or trauma center setting, then specialized transport teams should be utilized as available. A study by Barry and Ralston (1994) highlighted the dangers of non-specialized transport teams. 75% of patients transferred suffered serious clinical complications, nearlyaquarterofwhich were defined as life threatening. These alarming figures are not surprising considering blood pressure, temperature and blood sugar levels were not monitored in most patients, and 27% of patients had no monitoring of their oxygen saturation or electrocardiograph. Upon arrival to the paediatric ICU 11o/o required immediate endotracheal intubation and 9% were significantly hypotensive.

The risk of deterioration from the primary illness, complications from treatment, and the transfer process itself make the interhospital transfer potentially hazardous. There are several settings in which intervention by the retrieval team during stabilization could lead to a decrease in morbidity during transport (Britto, Nadel, Maconochie, Levin, and Habibi, 1995). Children who are sick enough to require a paediatric ICU should be transported to that ICU by a specialized team.

Table 1. Comparison of study and control groups.

Airway C-spine protection	**Breathing**	**Circulation**	**Disability Defibrillation**	**Exposure**	**Repeat full set of vital signs & obtain weight- Family presence**	**Give comfort measures**	**Head to toe assessment & history**	**Inspect posterior surfaces**
Assess For:	Efficacy of breathing	Recognition of circulatory failure	Recognition of potential CNS failure	Temperature/ Fever				
Retractions	Pulse oximetry	Heart rate	Conscious level	Prevent hypothermia				
Inspiratory & expiratory noises	Rate	Pulse volume	A Alert	Look for a rash				
Grunting	Chest expansion	Capillary refill	V Responds to voice					
	Auscultation	Blood pressure	p Responds to pain					
	Nasal flaring	Skin temperature & colour	U Unresponsive					
			Posture					
			Pupils					
			Don't ever forget glucose heater					

Adapted from Mackway, Jones, Molyneux, Phillips, eta/. 2007

Conclusion

Paediatric patients, especially those who are critically ill, are infrequently encountered in most ED settings. Remembering the concepts encompassed by *Sick or Not Sick; Pink, Warm, Sweet, and Safe,* or even just using an alphabet mnemonic (diagram 3) can help make these very stressful encounters a little "sweeter."

References

Abdelmoneim, T. and DeNicola, L. (2001) Vascular access in children.ln Harwood-N uss (Ed) *The ClinicaiPracticeofEmergency Medicine.* Lippincott, Williams, and Wilkins, Philadelphia. 1141-1144

Banayan, K. (2002) Personal conversation with Dr K. Banayan MD, Department of Anesthesiology, St. Catherine Hospital, East Chicago, Indiana, USA

Barry, P. and Ralston, C. (1994) Adverse events occurring during interhospital transfer of the critically ill. *Archives of Disease in Childhood,* 71, 8-11

Bissonnette, B. and Ryan, J. (2001) Temperature regulation. In Cote, C., Todres, D., Ryan,]. and Goudsouzian, N. (Eds) *A practice of anesthesia for infonts and children.* W.B. Saunders, Philadelphia. 610-635

Brennan, J. and Gupta, N. (2001) Pediatric Resuscitation. In Harwood-Nuss (Ed) *The Clinical Practice ofEmergency Medicine.* Lippincott, Williams, and Wilkins, Philadelphia. 1125-1133

Britto, J., Nadel, S., Maconochie, I., Levin, M. and Habibi, P. (1995) Morbidiry and severiry of illness during interhospital transfer: Impact of a specialised retrieval paediatric team. *British Medical Journal,* 311, 836-839

Buser-Gills, M. and Whitfield,]. (1995) Neonatal transport: Resuscitation and documentation. In McCloskey, K. and Orr, R. (Editors). *Pediatric transport medicine.* Mosby, St. Louis. 404-413

Cote, C., Lugo, R. and Ward, R. (2001) Pharmacokinetics and pharmacology of drugs in children. In Cote, C., Todres, D., Ryan, J. and Goudsouzian, N. (Eds) *A practice of anesthesia for infants and children.* W.B. Saunders, Philadelphia. 121-171

Cote, C. (2001) Pediatric equipment. In Cote, C., Todre, I., Ryan, J. and Goudsouzian, N. (Eds) *A practice of anesthesia for infonts and children.* (3rd ed.) W.B. Saunders, Philadelphia. 715-738

Cummins, R. (Ed) (2000) *Advanced Cardiac Life Support Provider Manual.* American Heart Association, Dallas, Texas

DeBoer, S. and Zeglin, D. (1999) Pediatric Rapid Sequence Intubation: Intraosseus Sryle. *Air-Med,* 5(5), 11-12

DeBoer, S. and Petersen, L. (2001) Sedation for Non-Emergent Neonatal Intubation. *Neonatal Network,* 20(7), 19-23

DeNicola, L. and McCrory, J. (2001) Shock. In Harwood-Nuss (Editor) *The Clinical Practice ofEmergency Medicine.* Lippincott, Williams and Wilkins, Philadelphia. 1137-1140

Emergency NursesAssociation. (1998) *Emergency Nursing Pediatric Course.* Emergency Nurses Association, Park Ridge, IL USA

Kattwinkel, J. (Ed) (2000) *Textbook of Neonatal Resuscitation.* (4th ed.) American Academy of Pediatrics: Elk Grove Village, IL

Mackway Jones, K., Molyneux, E., Phillips, B., et al. (2001) *Advanced Paediatric Life Support.* (3rd ed.) British Medical Journal Publishing, London

Merenstein, G. and Gardner, S. (Eds) (2001) *HandbookoJNeonatal Intensive Care.* Mosby-Year Book, St. Louis

Ragosta, K. and Kanter, R. (1995) Airway management. In McCloskey, K. and Orr, R. (Eds) *Pediatric transport medicine.* Mosby-Year Book, St. Louis. 167-185

Sanders, A. (2001). Cardiac arrest and resuscitation. In Harwood-Nuss (Ed). *TheClinicaiPracticeofEmergencyMedicine* .Lippincott, Williams and Wilkins, Philadelphia. 648-656

Schleien, C. and Todres, D. (2001) Cardiopulmonary resuscitation. In Cote, C., Todres, D., Ryan, J. and Goudsouzian, N. (Eds) *A practice of anesthesia for infants and children.* W.B. Saunders, Philadelphia. 265-293

Ushay, H. and Notterman, D. (1997) Pharmacology of pediatric resuscitation. *Pediatric Clinics ofNorthAmerica,* 44(1), 207-233

Wheeler, M., Cote, C., and Todres, D. (2001) Pediatric airway. In Cote, C., Todres, D., Ryan, J. and Goudsouzian, N. (Eds) *A practice of anesthesia for infants and children.* W.B. Saunders, Philadelphia. 79-120

Young, K. and Seidel, J. (1999) Pediatric cardiopulmonary resuscitation: A collective review. *Annals of Emergency Medicine,* 33(2), 195-205

Zarirsky, A., er al. (Ed) (2001) *Pediatric Advanced Life Support.* American Heart Association, Dallas, Texas