Great Ormond Street Hospital for Children NHS Trust

Resuscitation and Emergency Management

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Associated GOSH clinical guidelines/protocols see K drive, alphabetically listed:

- ***R***esuscitation algorithms 2006
- ***A***dmission policy to PICU & NICU and ***I***nternal collapse policy (GOSH)
- CATS guidelines

Fundamental Knowledge:

List of topics relevant to PIC that will have been covered in membership examinations.
They will not be repeated here.

- PALS/EPLS or APLS to provider level.
- Initial, immediate management of common paediatric emergencies: Asthma, Septic shock, Status Epilepticus, anaphylaxis, Trauma, Burns

Information for Year 1 ITU Training (basic):

Year 1 ITU curriculum

- Identification of the patient at risk of critical illness.
- Ability to initiate investigation and arrive at a differential diagnosis during and immediately after resuscitation.
- EGDT in septic shock

Curriculum Notes for Year 1:

The latest version of the Resuscitation guidelines is from Dec 2005. Since the guidelines form the basis for the uniform management of children with critical illness and/or cardiopulmonary arrest by the team, it is important to familiarise yourself with current guidelines (website 1). The rationale behind some the changes are described in the Circulation supplement reference (ref 1*).

Identification of at-risk patients:

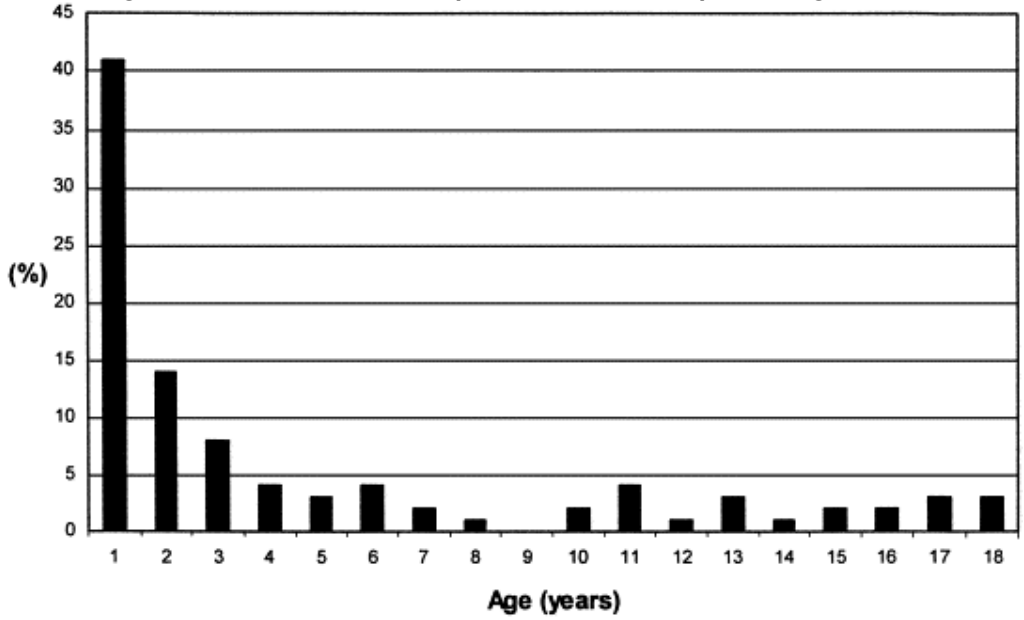
Critical illness and cardiopulmonary arrest are uncommon in the general paediatric population (102 children / 100 000 population are admitted to PICU annually; out of hospital cardiac arrest occurs at a rate of 10 / 100 000 child population annually). Even in-hospital, cardiac arrest is uncommon (1-2% of hospital admissions; 6-14% of ICU admissions). Despite this, a high proportion of arrests in hospital are among high-risk patients: witnessed (96%) and occurring on an ICU (65-75%).

The top 7 causes of out of hospital cardiac arrest presenting to the emergency department are: myocarditis, HOCM, airway disease, epilepsy, hypovolaemia and toxic ingestion (ref 2). The majority of arrests occur in infants (45%); however, respiratory causes predominate in

this age group (3). The etiology is different in in-hospital cardiac arrest (airway-related and congenital cardiac disease predominate).

Key messages:
- Expect to see a cardiac arrest in roughly 10% of PICU admissions
- Most in-hospital cardiac arrests are witnessed and occur in high risk populations (ICU, HDU)
- Respiratory compromise and cardiovascular compromise are the main preceding scenarios
- Most arrests occur in infancy
- The commonest presenting rhythms are non-shockable

Age distribution of out of hospital cardiac arrests presenting to ED



Engdahl J et al. Resuscitation 2003;58(2):131-8.

Investigation and differential diagnosis:

Most resuscitation situations involve standardised management (e.g. APLS). Identifying the etiology of the cardiac arrest is secondary, once resuscitation has been completed. The differential diagnosis during ongoing resuscitation is limited to conditions, which may contribute to the arrest:

- Tension pneumothorax: HYPOTENSION, DESATURATION, decreased air entry, hyperresonance on percussion, deviation of trachea and apex beat
- Haemothorax: HYPOTENSION, DESATURATION, decreased air entry, dull to percussion
- Cardiac tamponade: HYPOTENSION, SHOCK, muffled heart sounds, elevated JVP

Stabilisation of the sick child may proceed concurrently with investigations and identifying a diagnosis – airway compromise, respiratory failure and septic shock are the common scenarios. Baseline investigations such as blood gas, oxygen saturations, lactate, counts, cultures and coagulation screen are crucial. Identifying adequacy of stabilisation using blood gas, lactate, venous oximetry and cardiac output measurement is also important (website 2).

Early goal directed therapy

An imbalance between systemic oxygen delivery and demand occurs early in septic shock, and the resultant persistent global tissue hypoxia precedes multi-organ dysfunction and death (ref 4). A fall in mixed venous oxygen saturation level due to increased tissue extraction occurs earlier than a rise in serum lactate when oxygen demand outstrips supply. This correlates well with cardiac index and can serve as a target for haemodynamic therapy.

In a study conducted in the ED where patients in septic shock were randomised to either standard treatment (targets: CVP, MAP and urine output) or goal-directed therapy (additional target: SVC O2 >70%), Rivers et al showed highly significant reduction in mortality by 16% (ref 5*).

Implications of early goal-directed therapy study:

- Early correction of the imbalance between oxygen demand and supply reduced mortality in septic shock
- To maintain central venous sats >70%, inotropic agents were used to increase cardiac index; haematocrit was kept >30% to maximise oxygen content of blood
- Central venous sats from the SVC were used as a surrogate for true mixed venous sats from the PA

Websites:

[1]. www.resus.org.uk: Resuscitation Council UK – read up updated 2005 guidance
[2]. www.cats.nhs.uk: CATS website – read up guidelines on acute management of conditions

References:

[1]. **Circulation 2005 112 [Suppl I]: III-73-III-90**
(full text link: http://circ.ahajournals.org/content/vol112/22_suppl/)
[2]. Richman PB, Nashed AH. The etiology of cardiac arrest in children and young adults: special considerations for ED management. Am.J Emerg.Med. 1999;17(3):264-70.
[3]. Engdahl J, Axelsson A, Bang A, Karlson BW, Herlitz J. The epidemiology of cardiac arrest in children and young adults. Resuscitation 2003;58(2):131-8.
[4]. Bloos F, Reinhart K. Venous oximetry. Intensive Care Med. 2005 Jul;31(7):911-3.
[5]. **Rivers E., Nguyen B., Havstad S., Ressler J., Muzzin A., Knoblich B., Peterson E., Tomlanovich M., the Early Goal-Directed Therapy Collaborative Group. Early Goal-Directed Therapy in the Treatment of Severe Sepsis and Septic Shock. N Engl J Med 2001; 345:1368-1377.**

Information for Year 2 ITU Training (advanced):

Year 2 ITU curriculum

- Cardiopulmonary resuscitation to PALS/APLS team leader provider level
- Role of team leader in resuscitation attempts
- Guidelines for discontinuing resuscitation attempts.
- Knowledge of recent resuscitation research
- Ethics of resuscitation research

Curriculum Notes for Year 2:

Team Leader

There is evidence that the person in charge of the resuscitation is most effective when not involved in practical procedures, and that the most effective resuscitations are those with a clearly identified team leader (website 1).

Role of the team leader:

Team Leader Guidelines from the Resuscitation Council (UK)

1. Make it clear from the outset that you are the leader by stating it clearly - you must do most of the talking and make the final decisions.
2. By following recognised resuscitation guidelines the experienced team can anticipate the need for interventions. The team leader should provide a reason for any significant deviation from standard protocols.
3. Maintain a calm and positive attitude; encourage and support team members.
4. Make decisions confidently and quickly. If you are unsure consult with the team, be flexible but then give clear directions. Call for senior advice and assistance if appropriate.
5. Play to the strengths of team members and allow them some autonomy if their skills are adequate.
6. Allocate roles and tasks throughout the resuscitation and be specific. This avoids several people or no one attempting the task!
7. Give clear, precise directions throughout the resuscitation attempt.
8. Plan ahead and inform the team of anticipated requirements.
9. Maintain realistic performance standards without being critical.
10. Try to stand back, allocate tasks to team members and maintain an overview.
11. At the end of the resuscitation attempt, thank the team and ensure that staff and relatives are being supported. Complete all documentation and ensure an adequate handover.

Taken from www.resus.org.uk

Guidelines for discontinuing resuscitation attempts

There are no unequivocal universal guidelines as to when to discontinue resuscitation. Any decision to discontinue has to be made with team consensus and following consultant input (specialist and PICU).

Assuming the goal of resuscitation is to ensure a neurologically intact survival, two factors have been used to decide when to terminate resuscitation:

Duration of CPR: In out of hospital cardiac arrest, duration of CPR >20 minutes with no return of spontaneous cardiac output is associated with 100% mortality (ref 1*). There are occasional reports of survival following >60 min CPR, although most cases are due to icy water submersion, toxic ingestion and institution of extra-corporeal CPR.

Doses of adrenaline: No spontaneous cardiac output following >2 doses of adrenaline is considered to be predictive of 100% mortality. However, some studies show different results, and it is not clear whether number of adrenaline doses is an independent predictor of outcome.

Outcome of out of hospital paediatric cardiac arrest carries uniformly grave prognosis (ref 2*). 12% survive to hospital discharge, although the rate of neurologically intact survival is no more than 6%.

Recent resuscitation research

There are a number of ongoing strands of resuscitation research. Key themes are:

- Therapeutic hypothermia following cardiac arrest
- Use of vasopressin in resuscitation
- Public access defibrillation in adult out of hospital cardiac arrest
- Compression techniques

Two randomised studies in adult patients showed that when therapeutic hypothermia was instituted following VF cardiac arrest, survival to hospital discharge and neurological outcome at 6 months were significantly better (refs 3 and 4*). A similar study is ongoing in paediatric patients.

The traditional role of adrenaline in cardiac arrest was challenged by vasopressin in a recent randomised study in adults with cardiac arrest (any rhythm). Patients who presented in asystole were more likely to survive to hospital discharge (4.7 vs 1.5%). Outcome was similar with other initial rhythms (ref 5*). In a more recent multi-centre adult study, adrenaline and vasopressin in combination were compared with adrenaline alone – there was no additional benefit (ref 7).

Use of AEDs (automatic external defibrillators) was shown to double survival rate when compared to trained CPR alone in the community (ref 6).

Compression-only CPR and interposed abdominal compression-CPR are evolving techniques for CPR. Mechanical devices have also been used to deliver effective CPR.

Ethics of resuscitation research

Studies of interventions applied during cardiac arrest face difficulties when informed consent needs to be obtained from patients and or their carers in an acute situation. Situations in which exceptions to informed consent may be appropriate have been specified in the USA, although not used for children. This includes the need for community consultation.

The need to obtain informed consent and the delay that might entail in a highly emotional situation will need to be balanced against the potential benefits of the intervention and whether true informed consent can ever be obtained.

Key ethical issues in resuscitation research:

- Surveys indicate that patients value informed consent more than the chance of an improved outcome as part of a research study.
- Some interventions such as rapid cooling post-arrest within 30 min may not be possible unless waiver of informed consent is possible
- Reviews indicate that fewer research studies are being conducted in resuscitation over the past decade
- Prospective consent obtained at or before admission to hospital may be acceptable to patients; however, the fact that >100 patients may need to be consented for 1 resuscitation may itself raise other ethical and logistical questions.
- Other models of consent such as deferred consent, opt-out option and full waiver of consent have been tested and used in studies.

Websites

[1]. www.resus.org.uk

References

[1]. **Schindler MB, Bohn D, Cox PN, McCrindle BW, Jarvis A, Edmonds J, Barker G. Outcome of out-of-hospital cardiac or respiratory arrest in children. N Engl J Med. 1996 Nov 14;335(20):1473-9.**

[2]. **Donoghue AJ, Nadkarni V, Berg RA, Osmond MH, Wells G, Nesbitt L, Stiell IG; CanAm Pediatric Cardiac Arrest Investigators. Out-of-hospital pediatric cardiac arrest: an epidemiologic review and assessment of current knowledge. Ann Emerg Med. 2005 Dec;46(6):512-22.**

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[6]. Ornato JP, McBurnie MA, Nichol G, et al. The Public Access Defibrillation (PAD) Trial: study design and rationale. Resuscitation 2003; 56:135-147.

[7]. Gueugniaud PY, David JS, Chanzy E et al. Vasopressin and epinephrine vs. epinephrine alone in cardiopulmonary resuscitation. N Engl J Med. 2008 Jul 3;359(1):21-30.

