Fluid Resuscitation for Children

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Paediatric Fluid Resuscitation

- Recognition of circulatory compromise
- Vascular access in children
- Choice of resuscitation fluid
- Post resuscitation fluids
Recognition of compromise

- Intervention before circulatory collapse is key to achieving good outcomes
- Shock is a common end state from multiple different pathologies in children
- Mortality in children most commonly due to
  - Trauma
  - Sepsis
Recognition of compromise

- In retrospect, abnormal physiology often clearly recorded in the hours leading up to in-hospital paediatric collapse.
  - Tachycardia
  - Tachypnoea
  - Change in behaviour
- Signs may be attributed to other causes
- Overlap with benign conditions
- Final deterioration frighteningly rapid
Recognition of compromise

- Heart rate
- Best clinical sign for
  - Early recognition
  - Tracking change in condition
- Interpretation in context of global appearance
  - Colour
  - Interaction & behaviour
  - Peripheral warmth/capillary refill
Recognition of compromise

Some conditions routinely fool even experienced paediatric staff

- Congenital heart disease, single ventricle anatomy
- Occult sepsis (e.g. Primary peritonitis)
- Intussusception
- Immunodeficiency
Vascular access

Peripheral IV cannulation
- First attempt success rate in non-resuscitation events in our dept. (for all ages and conditions) = 85%

Resuscitation
- Younger ages
- Chronic illness (trashed veins)
- Collapsed veins
Vascular access

- Central IV cannulation
  - Slow
  - Difficult
  - The wrong choice for immediate fluid resuscitation
Vascular access

- Intraosseous needles
  - Published description of clinical use in 1941
  - Fell from use with availability of plastic cannulae
  - Not in routine use in 1980s in Australia or NZ
  - From early 1990s onwards have become essential in paediatric resuscitation
Vascular access

Manual IO needle insertion

- With experience, rapid and reliable
- With less experience
  - Significant failure rates
  - Only 1 attempt per bone – can run out of sites with multiple attempts
  - Most commonly used design vulnerable to displacement when transporting the patient
Vascular access

- Powered devices
  - Spring loaded guns
    - Failure rate
    - Operator injury
  - Drill
    - Has rapidly become the preferred device in Paediatric EDs in our region
    - Fast, reliable
    - Stable in place
    - Allows extension of technique to older children and adults
IO insertion success rates

- Self reported rates for our medical staff
- 8/26 Registrars, 2/3 Fellows, 3/3 Specialists had clinical experience of attempting IO insertion
- Overall 58 attempts, 37 successful insertions (64%)
- Increase in self reported success rate with greater experience
Vascular access

- Manual IO vs. Drill comparison
  - Mannequin model
  - Medical staff given short APLS course style instruction in both techniques

Subsequent

- Comparison of time taken and success rate for first insertion attempt
IO Insertion

- First attempt success
  - Manual: 24%
  - Drill: 64%

- Time taken
  - Manual: 32.3s
  - Drill: 4.3s
IO Insertion

- Size of drill hole
  - Manual: 116% of needle diameter
  - Drill: 103% of needle diameter

- Perceived difficulty (VAS 0-10)
  - Manual: 5.6
  - Drill: 2.1
Intraosseous access

- Increased familiarity and confidence with IO insertion is leading to earlier use
- No longer just for collapsed children
- Minimal apparent insertion discomfort in alert children
- Pain does occur with rapid fluid bolus administration
Fluid Resuscitation

Choice of fluids
- Crystalloid (Saline, lactated Ringer's)
- Colloid (albumin, starches)

All used frequently either alone or in combination

Meta-analysis, all ages excluding neonates. 1315 patients in 19 trials.

Children not separately identified or analysed.

Outcome measure mortality

4% (0-8%) excess mortality in colloid group.

Virtually no deaths in paediatric age group when papers reviewed.

N= 50


N= 230


N=383

All randomised, blinded. Measures haemodynamic, requirement for rescue therapy. Rate of “re=shock”

No differences of any clinical significance

Cochrane review/meta-analysis. 14 trials, 956 participants. Include some children (papers reviewed individually).

Outcome measure death. RR for hypertonic crystalloid in trauma = 0.84 (0.69-1.04), Burns 1.49 (0.56-3.95), Surgery 0.51 (0.09-2.73).

Mortality rare outcome in paediatric series, therefore meta-analysis may have limited relevance to this age group.

Cochrane review, meta-analysis. 63 eligible trials, 55 with mortality data. N = 7,754

“There is no evidence from RCTs that resuscitation with colloids reduces the risk of death, compared to resuscitation with crystalloids, in patients with trauma, burns or following surgery. As colloids are not associated with an improvement in survival, and as they are more expensive than crystalloids, it is hard to see how their continued use in these patients can be justified outside the context of RCTs.”

70 trials, 4375 participants. 46 trials give mortality data. No difference between different types of colloid.

“From this review, there is no evidence that one colloid solution is more effective or safe than any other, although the confidence intervals are wide and do not exclude clinically significant differences between colloids. Larger trials of fluid therapy are needed if clinically significant differences in mortality are to be detected or excluded.”
Evidence from 3 randomised blinded controlled trials in children with Dengue Shock Syndrome, and 2 open randomised trials in children (Burns, Septic shock) suggest no clinically important differences between colloid and isotonic crystalloid solutions for treatment.

Evidence from 3 large meta-analyses (predominantly adult) suggest no mortality differences between isotonic colloid and crystalloid solutions, hypertonic and isotonic crystalloids solutions or between different types of colloid solutions.
Conclusion

For fluid therapy in children for shock, or during resuscitation:

- There is insufficient evidence to support recommending any specific isotonic intravenous fluid.

- Colloids are associated with more adverse effects, increased cost and seem to have equivalent clinical effect to crystalloids.
Summary

- Critically ill & injured children frequently need IV fluids
- Recognition of early shock can be tricky – focus on a global assessment of appearance, behaviour, and heart rate
- IO needles are good
- Normal saline is as good as anything for initial fluid resuscitation