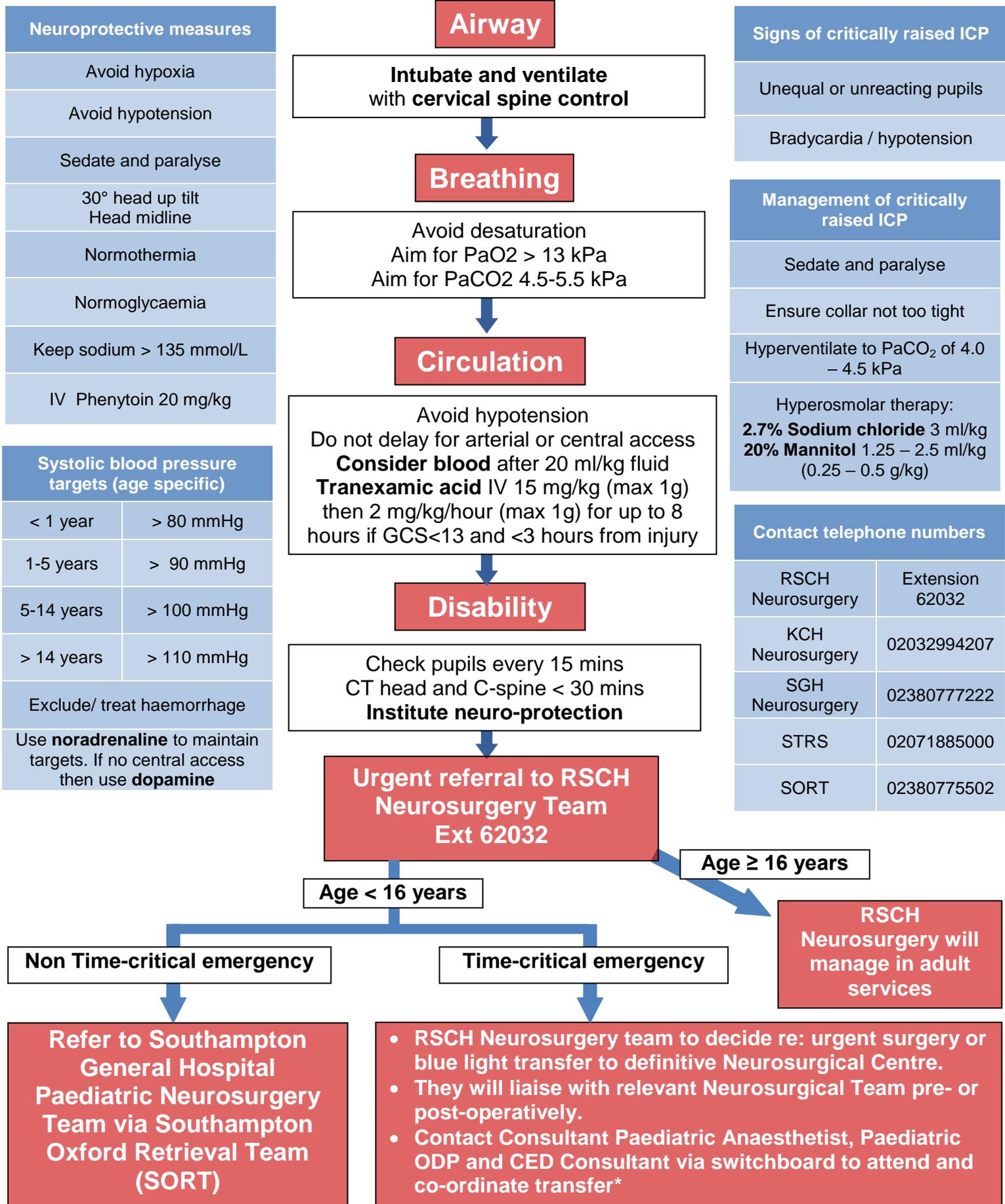


# Severe Traumatic Brain Injuries in Children

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# Paediatric Trauma Guidelines

## Management of Severe Traumatic Brain Injury (GCS 8 or less)



\*Contact STRS or SORT if having any difficulties contacting Neurosurgery at definitive centre

## Paediatric Trauma Guidelines

# Severe traumatic brain injury

### Background

NB. Children  $\geq 16$  years with severe injury will usually be managed post resuscitation at RSCH by adult services. Apply advice regarding transfer and retrieval to children  $< 16$  years.

In infancy, **non-accidental injuries** remain an important cause of significant brain injuries. If senior clinician has concerns that injury may have been inflicted (you do not have to be certain) – discuss with social care / police as soon as possible, **EVEN IF THE CHILD IS RETRIEVED.**

The Named / Designated Doctor should be informed for all suspected non-accidental head injuries, whether admitted to RACH or retrieved. See ‘Suspected abusive head trauma’ guideline on BSUH Microguide.

Severe traumatic brain injury is classified as a post-resuscitation GCS of 8 or less. This GCS should not be post-ictal. Management of significant traumatic brain injuries with a GCS  $> 8$  may be modified but the principles remain the same.

The principles of management are to prevent secondary damage from:

- Hypoxia
- Hypotension
- Raised intracranial pressure (ICP).

### Priorities

- 1.) Stabilise airway, breathing and circulation before attending to other injuries
- 2.) Facilitate rapid, safe CT head and C-spine to enable identification of time critical injury.
- 3.) If a time critical injury is identified, follow the current guideline for “head injuries with CT scan changes and other neurosurgical emergencies” on BSUH microguide.
- 4.) If emergency surgery is not performed at BSUH, the transfer team should depart within 60 minutes of the CT scan.

### Management

**On arrival to the ED, assess and deal with airway, breathing, circulation and disability as per APLS guidelines.**

#### **Airway (c-spine) and breathing**

- protect C-spine if mechanism of injury suggests the possibility of cervical spine injury. Start with manual in-line stabilisation. If not possible, use head blocks and strapping.

## Paediatric Trauma Guidelines

- Get patient off spinal board ASAP. Nurse flat with spine in alignment. Use 20° tilt to move patient.
- If spontaneously breathing administer high flow oxygen
- Intubate and ventilate if:
  - Severe respiratory distress or haemodynamic instability
  - Depressed conscious state (GCS < 9) or agitation
- Measure oxygen saturations, respiratory rate, and blood gas
- Perform CXR

## Circulation

- Assess and monitor heart rate, blood pressure and capillary return
- Insert large bore intravenous cannula (ideally x 2). If unable, gain I.O access.
- Take trauma panel bloods
- If circulation is inadequate give fluid bolus(es)
  - 10 ml/kg crystalloid in first instance then warmed blood in 10 ml/kg aliquots. Assess response after each aliquot
  - Activate the massive haemorrhage protocol if 40 ml/kg has not stabilised the child
- **Give tranexamic acid** if 1. GCS<13, and 2. Time from injury < 3 hours, or if GCS 13-15 but traumatic injury found on CT imaging.
  - 15 mg/kg (max 1g) IV loading dose over 10 minutes, followed by 2 mg/kg/hour (max 1g) infusion for up to 8 hours if TBI confirmed on imaging.
  - Infusion can be stopped if no significant TBI found on imaging.

## Disability

- Assess and monitor GCS and blood sugar
- Perform regular (15 minutely) pupil checks
- Check core temperature
- Analgesia

When intubated, insert nasogastric or orogastric tube (beware facial fractures).

Place a urinary catheter to measure UOP and avoidance of bladder distension.

**Once patient is resuscitated, urgent CT imaging of the head and spine is the next priority** (ideally within 30 minutes of arrival).

## Paediatric Trauma Guidelines

**The patient must be transferred to CT by an appropriately trained Anaesthetist with full monitoring.** At least: ECG, pulse oximetry, non-invasive blood pressure, end-tidal carbon dioxide monitoring.

If CT imaging identifies a time critical lesion requiring urgent neurosurgical intervention, the patient will need **rapid management by an appropriately trained Neurosurgical team.**

The first port of call for discussion of a seriously head injured child is the Neurosurgical team at the Royal Sussex Country Hospital (RSCH).

The patient should be discussed directly with the Registrar on call on extension 62032, or if they are unavailable, the on-call Consultant via the BSUH switchboard (ext. 198).

As soon as possible after telephone contact has been made, in order to facilitate clear communication and record keeping, refer the patient online via [www.referapatient.org](http://www.referapatient.org).

If transfer to a definitive care centre is required, the child must be accompanied by an appropriately trained anaesthetist. Our current definitive care centres are Southampton General Hospital and Kings College Hospital. The RSCH Neurosurgery team will liaise with their counterparts at the definitive care centre once a decision has been made about where the child should go.

### Neuroprotection measures

#### Imperative to avoid hypoxia or hypotension

#### 1. Airway and breathing

Oxygen saturations > 98%

Ventilate to maintain ET CO<sub>2</sub> 4.5 – 5.0 kPa (correlate with venous / capillary / arterial blood gases)

#### 2. Circulation

Cerebral perfusion pressure = MAP – ICP (ICP may be >20 mmHg)

Maintain systolic BP to targets for age:

<b>&lt; 1 year:</b>	>80 mmHg	<b>5-14 year</b>	>100 mmHg
<b>1-5 year</b>	>90 mmHg	<b>&gt;14year</b>	>110 mmHg

## Paediatric Trauma Guidelines

Treat hypotension aggressively with

- Fluid boluses (10 ml/kg)
- Blood products
- Inotropes: suggested agents would be dopamine if peripheral access only, or noradrenaline if central access gained.

Ensure active bleeding is managed prior to transfer – this may necessitate surgery at BSUH. Involve Paediatric Surgeons early.

### 3. CNS / disability

Maintain cervical spine immobilisation with blocks and tape.

20° tilt should be used if turning patient for any reason.

Keep patient 30 ° head up (tilt bed)

Keep head in midline. Avoid neck lines and ETT ties.

Once intubated, patients MUST be adequately sedated and paralysed. Recommended drugs are morphine and midazolam with paralysis or propofol if BP allows. Avoid spikes in intracranial pressure during handling / suction with boluses of sedation.

Keep blood sugar > 3 mmol/L

Maintain normothermia (core temp 36 – 37° C)

Load with IV phenytoin (20 mg/kg over 20 minutes. Beware hypotension)

Maintenance fluid 1-2 ml/kg – use 0.9% sodium chloride +/- 5% glucose

### Management of critically raised intracranial pressure

Bradycardia, hypertension, slowly reacting or fixed dilated pupil(s).

1. Ensure neuroprotective strategies are maintained.
2. Place patient on a manual bagging circuit and initiate manual hyperventilation to reduce ET CO<sub>2</sub> to 4 – 4.5 kPa.
3. Give a dose of either 3 ml/kg of 2.7% or 3% Sodium chloride or 1.25 ml/kg of 20% mannitol.

# Paediatric Trauma Guidelines

## Admission guidance for children with head injuries

Age	Problem	Admitting Team	Admitting ward
<1 years	Well, isolated head injuries with or without safeguarding concerns  If child is unwell / severe injury: either HDU care or retrieval to PICU	General paediatrics	RACH Level 9
> 1 year but < 16 years	Head injury with CT scan changes not requiring PICU e.g. stable contusions or injuries in more than one area e.g. abdominal injury with head injury	HDU / Paediatric Surgery <b>joint care</b>	RACH HDU
> 1 year but < 16 years	Isolated head injury requiring ward observation where patient requires more than SSU care or cannot be accommodated in SSU  If there are additional concerns such as safeguarding issues or complex medical history, child should receive <b>joint care with General Paediatrics</b>	Paediatric Surgery	RACH Level 8
≥16 years	Isolated head injuries requiring neurosurgical intervention or as part of polytrauma	Adult Trauma / Neurosurgical teams	RSCH ITU or Neurosurgical ward
≥16 years	Isolated head injuries requiring ward observation but no neurosurgical intervention	TBC. Current default is RACH HDU in conjunction with Southampton Neurosurgeons	SSU / RACH HDU

Please discuss with the CED Consultant on duty if there are any concerns or questions.

## Paediatric Trauma Guidelines

### Making and using 3% sodium chloride (“hypertonic saline”)

#### Commercially available 2.7% sodium chloride

“Hypertonic saline” can be obtained in commercially pre-packaged containers. Use ‘ready-made’ “hypertonic saline” solutions if available in preference to mixing 3% sodium chloride to reduce risk of drug preparation errors.

#### Making 500ml of 3% sodium chloride

- 1) Obtain a 500ml bag of 0.9% sodium chloride.
- 2) Remove 36ml from the 500ml bag of 0.9% sodium chloride and discard the 36ml.
- 3) Add 36ml of 30% sodium chloride to the bag of 0.9% sodium chloride.
- 4) This solution is now 3% sodium chloride.

#### Making 50ml of 3% sodium chloride

- 1) Draw up 5ml of 30% sodium chloride. Mix with 45ml of 5% glucose.
- 2) This solution is now 3% sodium chloride.

#### Using 3% sodium chloride

- 1) Do not connect bags of 3% sodium chloride to the patient, to prevent accidental excess infusion.
- 2) Draw up each dose of 3% sodium chloride in a syringe and deliver the dose to the patient over 20 minutes.