

Clinical Guidance

Paediatric Critical Care: Time Critical Neurosurgical Transfer

Summary

This guideline is for the management of patients with intracranial pathology and raised intracranial pressure requiring emergency transfer to a neurosurgical centre. The goal is for a quick and safe transfer. A practical checklist is also provided.

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<p>This clinical guideline has been produced by the South Thames Retrieval Service (STRS) at Evelina London for nurses, doctors and ambulance staff to refer to in the emergency care of critically ill children.</p> <p>This guideline represents the views of STRS and was produced after careful consideration of available evidence in conjunction with clinical expertise and experience. The guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient.</p>	

Change History		
Date	Change details, since approval	Approved by
03/2019	Checklist added, hyperlink for hypertonic sodium chloride added	ELCGC 2019
11/2022	Updated hospital contact details and online referral information. Updated inotrope selection and seizure management medication.	PGC 2022

Paediatric Critical Care Time Critical Neurosurgical Transfer

King's College Hospital

- 1) Call neurosurgical registrar: **020 3299 4207, bleep 31892**
- 2) Online referral: [Neurosurgery Acute Referral System](#)
- 3) Call STRS: **020 7188 5000**

Responsibilities of Paediatric Team

- Recognition of emergency – raised intracranial pressure
- CONSULTANT should be present
- Commence resuscitation and inform anaesthetic team ASAP
- Organise URGENT CT, report and send to neurosurgeon
- Referral to neurosurgery – 'is this a time critical lesion?'
- Referral to STRS for advice and assistance with PICU bed
- Contact emergency ambulance service via 999 stating 'Paediatric neurosurgical critical care transfer' with ETD
- Support anaesthetic team: nurse or Dr in transfer team

Responsibilities of STRS and receiving PICU

- Secure bed on PICU and help facilitate neurosurgical referral
- Advise DGH on patient management & encourage swift transfer

St George's Hospital

- 1) Call neurosurgical registrar: **020 8672 1255, bleep 7242**
- 2) Online referral: [Acute Neurosurgical Referral](#)
- 3) Call STRS: **020 7188 5000**

Responsibilities of Anaesthetic Team

- Continue resuscitation
- Commence airway and breathing support as needed
- Mobilise team: ODA/ Consultant/ ICU outreach nurse
- Decide who in team will transfer the child
- Setup portable monitor and ventilator
- Monitor child closely and transfer ASAP

Responsibilities of Neurosurgical Team

- Diagnosis : 'This is a time critical lesion'
- Feedback to local DGH within 30 minutes of referral
- Liaise with receiving PICU
- Inform DGH what site in receiving hospital the child should be taken e.g. A&E, theatre or PICU

- **Head CT scan should be done within 30 minutes of the suspicion of intracranial mass lesion**
- **Delay in the transfer to a neurosurgical centre risks serious brain injury or death**
- **To reduce time delay, transfer to neurosurgical centre should be done by the local anaesthetic team NOT STRS**
- **Departure to neurosurgical centre should occur within a MAXIMUM of 60 minutes from end of scan**

AIRWAY

- Need for intubation to be determined by local team
- Cardio-stable induction: ketamine/ fentanyl/ rocuronium
- Adequate anaesthesia pre-laryngoscopy ↓ risk of ICP spike
- Ensure ETT safely secured, caution with ties around neck
- Avoid nasal ETT in coagulopathy or basal skull fracture
- C-spine immobilisation (if trauma), keep head midline
- NG or OG tube insertion - leave on free drainage if ventilated

BREATHING

- Monitor end tidal CO₂ (aim 4-5 kPa)
- Urgent CXR post intubation for tube position/complications
- Standard settings for ventilator: PEEP 5, rate 15 to 20, Insp time 1.0 sec, PIP to move chest

CIRCULATION

- Two patent well-secured intravenous lines
- Do NOT delay for difficult central or arterial access
- Consider intraosseous line
- Maintain BP around age appropriate targets* (see right)
- Use fluid boluses & peripheral noradrenaline to maintain BP
- If concerns with cardiac function or <5kg then use adrenaline rather than noradrenaline as first line agent

DISABILITY - target neuro-protective care

- Normocapnia: ET CO₂ 4-5kPa, normothermia (aim 36-37°C), normoglycaemia (4-8), head in midline & elevated to 30°
- Check pupil response every 15mins (do not tape eyes)
- Ensure deep sedation – minimise potential for ICP spike
- Levetiracetam or phenytoin load if seizures noted
- Trauma patients: perform secondary survey if possible

TRANSFER TO AMBULANCE and onward journey

- Child well-secured on ambulance trolley
- Ayre's T-piece and mask on trolley
- Bolus drugs for transfer (sedation/muscle relaxation)
- Full oxygen cylinder on trolley + spare
- As smooth a journey as possible – minimise ICP spikes

STRATEGY: AVOID HYPOXIA AND HYPOTENSION

- Arterial saturations > 98%
- Maintain systolic BP: approximate targets for age*

< 1 yr	>80mmHg
1 -5 yr	>90mmHg
5-14 yr	>100mmHg
>14 yr	>110mmHg
- Maintain end tidal CO₂ between 4-5 kPa
- Keep temperature 36-37C : treat hyperthermia
- Identify and treat seizures
- Maintain normal blood sugar
- Maintain plasma sodium >140 mmol/L
- Identify associated injuries (falling Hb/ hypotension)

INTRACRANIAL HYPERTENSIVE CRISIS BRADYCARDIA/HYPERTENSION/PUPIL DILATATION

- Ensure end tidal CO₂ between 4-4.5 kPa
- Give 3 mL/kg of hypertonic sodium chloride (see below *)
- Give bolus of sedation and muscle relaxation
- Do not delay urgent transfer: keep moving

PRE DEPARTURE AND ON ROUTE

- Inform receiving PICU of departure from DGH
- Check where the child is expected (theatre /PICU)
- Receiving PICU should inform neurosurgeon
- Record observations every 15 minutes
- Update PICU or neurosurgeon if any deterioration

DOCUMENTATION

- Copy notes with results and observation charts
- Image link all X-rays and CT scans or place on CD or have hard copies

PARENTS

- Directions to destination hospital and PICU
- Telephone number of receiving PICU
- Make sure transfer team have parents contact details

Hypertonic sodium chloride: most departments have pre-made 2.7%. If not available make up 3% using [guideline](#)

PAEDIATRIC TIME-CRITICAL NEUROSURGICAL TRANSFER CHECKLIST

This checklist will assist you to carry out the time-critical transfer in a safe and timely manner

AIRWAY

- ETT secure(correct size & length/avoid nasal)
- Position of ETT and NGT confirmed (ETT tip at T2 on CXR ideal for transfer)
- Appropriate HME filter for patient size
- C-spine immobilised**
- Orogastric tube on free drainage

BREATHING

- Avoid hypoxia - SpO₂ >92%
- Attach ETCO₂ monitoring (aim 4-5kPa)
- Standard ventilator settings : PEEP 5/ Rate 15-30 / Ti 0.8 / PIP to move chest

CIRCULATION

- Minimum 2 points of IV access for transfer
 - Discuss inotropes with transport consultant
 - Consider IO access – no transfer delay for CVC
- Maintain age appropriate systolic BP
- Regular BP - no transfer delay for arterial line
- Consider obtaining a blood group/cross match sample to accompany patient (fully labelled)

DISABILITY AND EXPOSURE

- CT Head <30min
- Adequate sedation and muscle relaxants
- Position head tilt 20-30°
- 15min pupillary monitoring**
- C-Spine protection (if necessary)
- Identify and treat seizures
- Maintain normal blood glucose
- Aim plasma sodium >140 mmol/L
- Intracranial hypertensive crisis – Bradycardia/hypertension/pupillary dilatation**
 - Aim pCO₂/EtCO₂ 4-5 kPa
 - Hypertonic sodium chloride (HTC- 2.7 or 3%) 3mL/kg over 15min
 - Repeat HTC if required
 - Sedate adequately (bolus pre-suction)
 - Keep moving – don't delay
- Maintain normothermia - regular/core temperature monitoring
- Secondary survey (if trauma)

PREPARATION, PACKAGING & TRANSFER

- Request urgent 999 Ambulance transfer (Category RED1 or RED2)
- Emergency airway & breathing equipment portable suction/fluids/drugs/adequate O₂
- Ensure patient & equipment is adequately secured to ambulance trolley
- Ensure smooth journey due to effects on haemodynamics and ICP
- Travel safe –seatbelt on at all times
- Transfer letter with photocopy of relevant notes, results, drugs charts, anaesthetic charts etc
- PACS/ copy of all imaging
- Document and highlight any safeguarding issues
- Keep parents up to date
- Phone receiving team with ETA and inform them if there are any changes in the patient's condition or you are concerned that the patient is deteriorating further**