CG005 Head Injury

1. Key Recommendations for operational use		
For use by: Critical Care teams **Internet:** Yes		
1	Anaesthesia	• Indications: - reduced GCS compromising safety of transport. - predicted deterioration during transport. - agitation not manageable with sedation alone. - ventilatory failure (PaO_2 <13kPa or $PaCO_2$ >6.0kPa). - hyperventilation causing $PaCO_2$ <4.0kPa. - severe facial trauma. - recurrent seizures. • Give opioid at induction if haemodynamic state allows. • Tape or loosely secure endotracheal tube, or tie above lower level of mastoids.
2	Neuroprotective Ventilation	• Be guided by arterial blood gas if available. • Aim for normal PaO_2 (>13kPa) and $PaCO_2$ (4.5-5.0kPa). • If arterial blood gas is unavailable, aim for $ETCO_2$ 4.0-4.5kPa. • Use mechanical ventilator in preference to BVM ventilation. • Consider hyperventilation to $PaCO_2$ 4.0kPa ($ETCO_2$ 3.5kPa) if evidence of raised intracranial pressure.
3	Cervical Spine Immobilisation	• Immobilise all patients with serious head injury. • Consider using head blocks and straps only. • If using a collar, ensure it does not impede cerebral venous return.
4	Optimise Cerebral Perfusion	• Exclude other injuries causing hypovolaemia. • For isolated head injury use IV crystalloid to optimise blood pressure. • Consider adding vasopressors if hypotension persists.
5	Head Elevation	• Position 20° head-up if patient packaging allows.
6	Glycaemic Control	• Aim to maintain blood glucose 6-10mmol/L. • Tight control of hyperglycaemia is not required.
7	Tranexamic Acid	• In isolated head injury, consider a 1g bolus TXA for patients with: - a GCS of 9 to 12. - a GCS of 13 to 15 if haemorrhage is demonstrated on CT. • If giving Tranexamic acid, aim to administer it within 3 hours from time of injury. • In a pre-hospital setting, only consider administration if there is a delay to definitive care. • Administer over 10 minutes to reduce the risk of seizures.

8	Hyperosmolar Therapy	• Consider hyperosmolar therapy if evidence of raised intracranial pressure after other neuroprotective measures: - 3% (2.7%) hypertonic saline (3-5ml/kg up to 350ml) or mannitol (0.25-1g/kg).
9	Anticonvulsants	• Consider loading with phenytoin (18mg/kg at 50mg/min) or levetiracetam 1g for adults (40mg/kg for children) if the patient has had a seizure following the head injury.
10	Reverse Anticoagulants	• Use prothrombin complex concentrate to reverse INR of patients taking warfarin with a strong suspicion of intracerebral bleed. • Do not delay waiting for CT or INR result. • If point-of-care INR is unavailable, use a mid-range estimate to calculate dose: eg INR 4-6. • Consider using Andexanet Alfa, if locally available, to reverse direct oral anticoagulant (DOAC) therapy.
11	Specialist Advice	• Secondary transfer of patients who have not undergone CT at the referring centre should be triaged to the ED at QEUH, Aberdeen Royal Infirmary, Edinburgh Royal Infirmary or Ninewells Hospital. • Neurosurgery teams are available at: - QEUH, Glasgow (0141 201 1100). - Ninewells, Dundee (0138 266 2200). - Western General, Edinburgh (0131 537 1000). - Aberdeen Royal Infirmary (0345 456 6000).

2. Document History			
Reference Number	CG005		
Version	2		
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	Medic 1		✓
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	ScotSTAR	EMRS West	✓
		EMRS North	✓
		Paediatric	✓
		Neonatal	X
	Tayside Trauma Team		✓

3. Scope and purpose

- Overall objectives:

Following severe head injury the aim of treatment is to minimise secondary insult to damaged brain tissue. Prompt implementation of neuroprotective strategies is known to improve patient outcomes. This guideline aims to summarise the specific interventions and modifications of standard therapies required to minimise secondary brain injury.

- Statement of intent:

This guideline is not intended to be construed or to serve as a standard of care. Adherence to guideline recommendations will not ensure a successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgement must be made by the appropriate healthcare professional(s) responsible for clinical decisions regarding a particular clinical procedure or treatment plan.

- Feedback:

Comments on this guideline can be sent to: sas.cpg@nhs.scot

- Equality Impact Assessment:

Applied to the ScotSTAR Clinical Standards group processes.

- Guideline process endorsed by the Scottish Trauma Network Prehospital, Transfer and Retrieval group.

4. Explanatory Statements		
4.1 Anaesthesia	**Authors' recommendation**	**Level [Reference]**
• *Indications:* - *Reduced GCS compromising safety of transport* - *Predicted deterioration during transport* - *Agitation not manageable with sedation alone* - *Ventilatory failure (PaO_2 <13kPa or $PaCO_2$ >6.0 kPa)* - *Hyperventilation causing $PaCO_2$ <4.0kPa* - *Severe facial trauma* - *Recurrent seizures* In all cases the risks, benefits and clinician experience must be carefully evaluated prior to undertaking anaesthesia.	Strong GPP	Guidelines [1] [2]
• *Give opioid at induction if hemodynamic state allows* The addition of an opioid at induction is widely used in neuroanaesthesia to obtund the rise in intracranial pressure seen during intubation. There is little contemporary high-level evidence regarding benefit in the head injured population. Doses may need to be adjusted or omitted for haemodynamically unstable patients.	Conditional	2- [3] [4] [5]
• *Tape or loosely secure endotracheal tube. Tube can be tied more securely if over the boney skull as this will not impair venous drainage within the internal jugular veins*	GPP	
4.2 Neuroprotective Ventilation		
• *Be guided by arterial blood gas if available*	Strong	Guideline [1]
• *Aim for normal PaO_2 (>13kPa) and $PaCO_2$ (4.5-5.0kPa)*	Strong	Guidelines [1] [2]
• *If arterial blood gas is unavailable, aim for $ETCO_2$ 4.0-4.5kPa*	GPP	
• *Use mechanical ventilator in preference to BVM ventilation*	GPP	
• *Consider hyperventilation to $PaCO_2$ 4.0kPa ($EtCO_2$ 3.5kPa) if evidence of raised intracranial pressure* Evidence of raised intracranial pressure may be radiological or clinical, for example bilateral or unilateral dilated pupil(s) or Cushing's response.	Strong	Guidelines [1] [2]

4.3 C-Spine Immobilisation	Authors' recommendation	Level [Reference]
• *Immobilise all patients with serious head injury*	Strong	Guideline [2]
• *Consider using head blocks and straps only*	GPP	
• *If collar is used ensure it does not impede cerebral venous return* The use of cervical collars is associated with painful pressure areas and jugular venous compression. Together these are likely to result in raised intracranial pressure however the clinical significance is unknown. Steps should be taken to reduce the pressure associated with prolonged c-spine immobilisation by loosening or removing the collar.	Conditional	2- [6]
4.4 Optimise Cerebral Perfusion		
• *Exclude other injuries causing hypovolaemia*	GPP	
• *In isolated head injury use IV crystalloid to optimise blood pressure*	Strong	Guidelines [1] [2]
• *Consider adding vasopressors if hypotension persists* Cited guidelines are inconsistent in recommending a specific target blood pressure (BP) but a target of 110-150mmHg systolic (MAP>90mmHg) should be considered, taking account of patient age, normal BP if known and presence of other injuries. If patient has other injuries causing hypovolaemia replacement with blood products should be considered over crystalloid and inotropes.	Conditional	Guideline [1]
4.5 Head Elevation		
• *Position 20° head-up if patient packaging allows* Clinical or packaging requirements such as haemodynamic instability or the need to maintain cervical spine immobilisation may prevent elevating the patient's head.	Strong	Guideline [1]
4.6 Glycaemic Control		
• *Aim to maintain blood glucose 6-10mmol/L*	Strong	1+ [7]
• *Tight control of hyperglycaemia is not required*	Strong	1+ [7]

4.7 Tranexamic Acid	Authors' recommendation	Level [Reference]
• *In isolated head injury, consider a 1g bolus TXA for patients with:* - *a GCS of 9 to 12.* - *a GCS of 13 to 15 if haemorrhage is demonstrated on CT.* • *If giving Tranexamic acid, aim to administer it within 3 hours from time of injury.* • *In a pre-hospital setting, only consider administration if there is a delay to definitive care.* • *Administer over 10 minutes to reduce the risk of seizures.* CRASH-3 [11], an in-hospital study, included patients with a GCS of 12 or less or intracranial bleeding on CT. It showed a reduction in head injury related deaths in mild to moderate head injury (RR 0.78 [0.64 to 0.95]) but not with severe head injury. For Tranexamic Acid to be beneficial, it needs to be administered within 3 hours of the insult. A pre-hospital randomised controlled trial [12] showed no mortality or disability benefit in moderate to severe head injury. A cohort study with adjustment for confounding variables suggested an increased mortality with the pre-hospital use of tranexamic acid in traumatic head injury.	Conditional	1++ [11,12] 2++ [13]
4.8 Hyperosmolar Therapy		
• *Consider hypertonic saline or mannitol if evidence of raised intracranial pressure after other neuroprotective measures* Both 3% (2.7%) hypertonic saline (3-5ml/kg up to 350ml) and mannitol (0.25-1g/kg) are recognised to lower intracranial pressure however there is insufficient evidence to support specific guidance in this area. It is appropriate to consider hyperosmolar therapy if there is evidence of raised ICP such as unilateral or bilateral dilated pupil(s), or hypertension with bradycardia (systolic BP>160mmHg, HR<60).	Conditional	Guideline [8]
4.9 Anticonvulsants		
• *Consider loading with phenytoin (18mg/kg at 50mg/min) or levetiracetam 1g for adults (or 40mg/kg for children) if the patient has had a seizure following the head injury.* Anticonvulsants are only recommended if patient has already had a seizure and not as prophylaxis. The dose of levetiracetam in children is based on the EcLiPSE study [14].	Conditional	Guideline [1] 1++ [14]
4.10 Reverse anticoagulants.		
• *Use prothrombin complex concentrate to reverse INR of patients taking warfarin with a strong suspicion of intracerebral bleed*	Strong	Guideline [9]
• *Do not delay waiting for CT or INR result.*	Strong	Guideline [9]
• *If point-of-care INR is unavailable use a mid-range estimate to calculate dose (eg INR 4-6)*	GPP	
• *Consider using Andexanet Alfa, if locally available, to reverse direct oral anticoagulant (DOAC) therapy.*	GPP	

4.11 Specialist Advice	Authors' recommendation	Level [Reference]
• *Secondary transfer of patients who have not undergone CT at the referring centre should be triaged to the ED at QEUH, Aberdeen Royal Infirmary, Edinburgh Royal Infirmary or Ninewells Hospital.*	GPP	
• *Neurosurgery teams are available at:* - *QEUH, Glasgow (0141 201 1100)* - *Ninewells, Dundee (0138 266 2200)* - *Western General, Edinburgh (0131 537 1000)* - *Aberdeen Royal Infirmary (0345 456 6000)* All patients whose CT scan reveals an intracranial lesion should be discussed with the on-call neurosurgical team. Even if the patient is not suitable for transfer ongoing liaison with neurosurgery is essential.	Strong	Guidelines [2] [10]

5. References

1. Guidelines for safe transfer of the brain-injured patient: trauma and stroke, 2019 Guidelines from the Association of Anaesthetists and the Neuro Anaesthesia and Critical Care Society.
2. National Institute for Health and Clinical Excellence. Head injury assessment and early management NICE Clinical Guideline 176. London: National Institute for Health and Clinical Excellence, 2014 (updated 2019).
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