12 Neuroanaesthesia

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12.1 Prevention of hyperthermia in patients with acute brain injury

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Why do this quality improvement project?

Acute brain injury is a leading cause of death and disability. Management focuses on the prevention of secondary neuronal damage. Patients with acute brain injury commonly develop pyrexia. The prevention of hyperthermia in these patients may improve long-term outcomes.

Background

Patients with acute brain injury have been demonstrated to suffer adversely as a consequence of pyrexia.[1] Every intensive care unit (ICU) should have established guidelines to both monitor and treat hyperthermia in patients with acute brain injury. This is particularly relevant during the acute phase of the admission but may be extended if there is evidence of continuing cerebral ischaemia or inflammation.

Best practice

For every one degree C rise in admission temperature, the relative risk of a worse outcome is doubled for stroke patients.[2] The European Stroke Organisation (ESO) guidelines recommend that the cerebral metabolic rate should be limited by avoiding hyperthermia.[3] In acute ischaemic stroke, the ESO advocates prompt investigation for concurrent infection and treatment with paracetamol and fanning should the temperature reach 37.5 degrees C.[3]

Fever is an independent risk factor for poor outcome following aneurysmal subarachnoid haemorrhage. It is recommended that temperature is controlled using pharmacological and/or physical means.[1] Pyrexia has also been shown to independently increase mortality and worsen secondary injury after traumatic brain injury.[4]

Evidence from patients sustaining out of hospital cardiac arrest suggests that normothermia may be just as advantageous as hypothermia, (33 degrees C vs 36 degrees C).[5] Furthermore, patients with peak temperatures of less than 37 degrees C also demonstrated an increased mortality.[6] Targeted temperature management should be closely monitored to maintain the core temperature at 37 degrees C plus or minus 0.5 degrees C.[7]

Suggested indicators

The definition of acute brain injury for the purposes of this quality improvement project includes traumatic brain injury, thrombotic or haemorrhagic stroke, subarachnoid haemorrhage and cardiac arrest.

The aim is for 95% of patients with acute brain injury as defined above to remain normothermic during admission to ICU by the locally agreed date.

Suggested data to collect

Standards	Measures
100% of patients with acute brain injury should have their core temperature measured and recorded on an hourly basis as a minimum.	■ Percentage of patients with acute brain injury remaining normothermic (36.5-37.5 degrees C) throughout admission to ICU. ■ Proportion of patients who have hourly core temperature measurements from admission to ICU (or juncture at which acute brain injury is diagnosed if subsequent to admission) until discharge from ICU.
100% of patients with a core temperature greater than 37.5 degrees C should receive prompt interventions within an hour to reduce their temperature.	■ Time taken for active cooling to commence when temperature rises higher than 37.5 degrees C. ■ Analyse reasons when core temperature remains elevated for over 1 hour to identify problems to work on, and processes to improve actions to lower temperature quickly.

100% of ventilated patients should have their temperature maintained below 38 degrees C.	■ Highest and lowest recorded temperatures. ■ Time spent with a temperature above 38 degrees C.
100% of patients with a temperature rising greater than 37.5 degrees C should be investigated for concurrent pyrogenic infection.	■ Rate of undertaking investigations including white cell count and C-reactive protein. ■ Time taken for culture samples to be taken.

Quality improvement methodology

- Draw a process map for an acute brain injury from the time of admission of the patient to ICU until discharge. Develop the map with representatives of all the staff involved. Identify delays and steps that do not add value.
- Brainstorm ideas for improvement and then test in a small group of patients to see whether they are effective. Learn from the test, adapt your idea and test again until working well (eg where would it be most helpful to remind staff to measure patient temperatures and or intervene to treat hyperthermia? Which members of staff are most reliable at intervening to treat hyperthermia? Do they have lessons to share?).
- Review cases that failed the standard by a long way. Are there common themes that could be improved?
- Review cases where processes worked well and determine the reasons, so these cases can be repeated.
- Measure each step and share the results with the team.

Mapping

ACSA standard: 2.1.1.9

Curriculum competences: Annex C NA_IK_02, NA_IK_03, NA_IS_10, NA_IS_14, Annex D NA_HK_03, NA_HK_04, Annex G AR_BK_05, AR_BK_06, AR_BK_07, AR_BS_10, AR_HS_09, AR_AS_04

GPAS 2020: 2.18, 3.2.31, 5.15, 5.2.2, 14.2.8

References

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5. Nielsen N et al. Targeted temperature management at 33°C versus 36°C after cardiac arrest. N Engl J Med 2013;369:2197–2206.
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7. Andrews PJD et al. Targeted temperature management in patients with intracerebral haemorrhage, subarachnoid haemorrhage, or acute ischaemic stroke: consensus recommendations. Br J Anaesth 2018;121:768–775.

12.2 Transfer of the patient with traumatic brain injury

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Why do this quality improvement project?

Transfer of patients with an acute brain injury is potentially hazardous if poorly executed. Consensus guidelines agree that high-quality transfers will be associated with better outcomes.

Background

Many patients with a serious brain injury (Glasgow Coma Scale score of less than 8) need to be transferred urgently between or within hospitals. Priorities for care are the prevention of secondary brain injury and the early detection and evacuation of intracranial haematomas. Secondary brain injury occurs as a consequence of cerebral hypoxia due to either reduced oxygen supply (raised intracranial pressure, hypotension or hypoxaemia) or increased oxygen demand (hyperthermia or seizures). Surgical evacuation of intracranial haematomas is time critical; a maximum of four hours is the commonly accepted target.

Best practice

- The transfer of patients with brain injury measures against standards set by the Association of Anaesthetists and the Neuro Anaesthesia and Critical Care Society and endorsed by the RCoA, the Intensive Care Society and the Joint Royal Colleges Ambulance Liaison Committee.[1]
- Aim: 95% of appropriate patients with significant brain injuries as defined above are transferred to neuroscience unit within four hours of injury, following guidelines from the Association of Anaesthetists and the Neuro Anaesthesia and Critical Care Society.[1]

Suggested data to collect

Standards	Measures
There should be designated consultants in referring hospitals and neuroscience units with overall responsibility for the safe transfer of patients with a brain injury.	■ Percentage of referring units and neuroscience units with named consultant lead.
Local guidelines, consistent with national guidelines, should be available and should state that transfers should only be undertaken by individuals with appropriate training and should occur in a timely manner.	■ Percentage of units with transfer protocols in place. ■ Percentage of individuals undertaking transfer who have received training in patient transfer. ■ Time from injury to receiving definitive treatment. ■ Number of delayed transfers (over four hours) with documentation of reasons for delay (analyse reasons for delays over four hours and transfers faster than two hours, with reasons).
All patients must be haemodynamically stable prior to transfer, arterial oxyhaemoglobin saturation (SaO_2) and end-tidal CO_2 should be checked against arterial blood gases prior to transfer.	■ Percentage of patients with documented SaO_2 and end-tidal CO_2 checked against blood gas prior to transfer.

All patients should have high-quality care during transfer with the airway controlled by intubation and mechanical ventilation with end-tidal CO_2 monitoring.	■ Targets of SaO_2 greater than 95% and end-tidal CO_2 4.5-5.0 kPa achieved. ■ Percentage of patients intubated and ventilated with end-tidal CO_2 monitoring during transfer. ■ Percentage of patients where ventilation parameters were recorded during transfer and percentage of those who required adjustment (analyse where changes were made and identify issues).
All patients should be sedated with continuous intravenous infusion; neuromuscular blocking agents should be used with appropriate monitoring.	■ Percentage of patients without continuous intravenous sedation. ■ Percentage of patients receiving muscle relaxation. ■ Percentage of patients who had peripheral nerve stimulator monitoring.
All patients should have monitoring with electrocardiogram, SaO_2, pupillary reactions and invasive blood pressure.	■ Percentage of patients who received all of the above as per monitoring guidance.
All patients should achieve blood pressure targets of 110–150 mmHg systolic and mean arterial pressure greater than 90 for isolated traumatic brain injury.	■ Percentage compliance with guidance for blood pressure targets. ■ Percentage of patients who received treatment for hypotension. ■ Percentage of patients receiving treatment for hypertension (analyse effectiveness of treatments).
Staff at the neurosciences unit should be available to receive a handover. There should be a written record of transfer and patient observations.	■ Percentage of patients arriving in the neurosurgical centre with appropriate medical handover, as defined by a written record of transfer, including patient observations, untoward events during transfers such as equipment failures, proportion of patients who deteriorate (eg pupils becoming unreactive), transport problems (eg delays or navigation errors), missed injuries identified at the receiving hospital.

12.2 Transfer of the patient with traumatic brain injury

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Quality improvement methodology

- The qualitative data collected can be summarised using an affinity diagram. This will allow you to categorise the data into groups that have some affinity.
- The affinity diagram will reduce a large amount of information to a few useful focus areas for an improvement effort; for example, identify common themes (eg barriers to improving compliance with recommended monitoring and achieving ventilatory or blood pressure targets) and focus improvement in these areas.
- Process map each step using the staff involved and identify issues and delays, as well as steps that do not add value.
- Display baseline measures in a run chart and share with staff.
- Collect patient stories where there has been delay and the impact of the delay.
- Identify all improvement ideas and test on a small number of patients first; see what happens and adapt as necessary, always including the views of the staff who helped with the testing, to get engagement and ownership of the new idea. This will increase the change that the improvement will be sustained.

Mapping

ACSA standards: 5.1.1.2, 5.1.1.3, 5.1.1.4
Curriculum competences: NA_IK_22, NA_IS_07, MT_IK_04, MT_IS_06
CPD matrix codes: 2A11, 2C04, 2F01, 3F05
GPAS 2020: 5.2.13, 5.2.15, 5.2.16, 7.3.12, 7.3.13, 14.2.4, 14.4, 14.5.11,14.5.12, 14.5.17, 14.7.2

References

1. Nathanson MH et al. 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. Anaesthesia 2019; doi:10.1111/anae.14866.

Further reading

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Neuroanaesthesia

12.3 Subarachnoid haemorrhage

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Why do this quality improvement project?

Subarachnoid haemorrhage (SAH) results in significant morbidity and mortality. Anaesthetists are involved in early resuscitation, patient transfer, providing anaesthesia for neuroimaging or definitive treatment in the operating theatre or neuroradiology. Critical care management includes prevention of rebleeding and treatment of other complications. Optimal management may lead to dramatic improvements in outcome for patients when applied promptly.

Background

There are more than 100,000 cases of stroke every year in the UK, of which SAH accounts for 5%.[1] Management includes early investigation with computed tomography (CT) or lumbar puncture with negative imaging, prevention of rebleeding and treatment of other complications.

Best practice

National and international guidelines from NCEPOD, the European Stroke Organisation and the American Heart/Stroke Association outline the best evidence based practice in management of SAH.[2–4]

Standards include:

- time to secure aneurysm: definitive treatment within 48 hours
- blood pressure control: unsecured aneurysms systolic blood pressure less than 160 mmHg
- nimodipine should be commenced on admission for 21 days
- glucose should be controlled at 6-10 mmol/l.

Aim: 95% all appropriate patients with SAH to receive immediate protocolised treatment and definitive surgical treatment within 48 hours of the onset of symptoms.

Suggested data to collect

Standards	Measures
There should be protocols for the care of patients with aneurysmal SAH, covering initial assessment and diagnosis, management, referral, transfer to a neurosurgical/neuroscience centre and subsequent repatriation to secondary care, including rehabilitation.	■ Percentage of appropriate patients receiving full immediate treatment protocol and definitive surgery within 48 hours. ■ Baseline measures: protocol available and covers all minimal elements.
All patients presenting with acute severe headache should have a neurological examination and immediate CT of the head.	■ Time from admission to secondary care to undergoing CT examination.
Upon diagnosis, all patients with SAH should have a documented Glasgow Coma Scale-based grading.	■ Percentage of patients with clearly documented World Federation of Neurological Surgeons scale grading on admission.
Hypertension should be avoided in unsecured aneurysmal SAH, maintaining systolic blood pressure less than 160 mmHg.	■ Percentage of patients with systolic blood pressure over 160 mmHg for longer than 15 minutes (or other specified time). ■ Analysis of what interventions were used and effectiveness of interventions.
All patients with SAH should immediately be commenced on nimodipine.	■ Percentage of patients commenced on nimodipine and the time elapsed to first dose. Agree a local standard target time for the first dose (eg 15 minutes/30 minutes after arrival).

Hyperthermia (greater than 37.5 degrees C) should be avoided, pharmacological and physical measures used to aim for normothermia.	■ Percentage of patients with temperature above 37.5 degrees C. Analyse methods use to decrease temperature and measure frequency and effectiveness of each method.
Hyperglycaemia (glucose level above 10 mmol/l) should be avoided.	■ Percentage of patients with glucose above 10 mmol/l during their stay.
All aneurysmal SAH cases should have a definitive treatment with clipping or coiling.	■ Percentage of patients with aneurysm treated within 48 hours of diagnosis. A run chart of treatment times for consecutive patients is helpful in analysis.
Thromboprophylaxis should be commenced in all patients with compression stockings or pneumatic compression device on admission, with low molecular weight heparin after intervention if no contraindications are present.	■ Percentage of patients with active thromboprophylaxis (pharmacological or physical means). ■ Percentage of patients who develop deep venous thrombosis during admission.
Following fatal SAH, the option of organ donation should be sought.	■ Percentage of patients with fatal SAH who were referred to the organ donation pathway.

Quality improvement methodology

- Use a process map to detail the patient's journey from admission to treatment.
- Identify delays, unreliable steps and steps that do not add value.
- Include timings measured in your own audits, and benchmark against standards at specific points to identify areas of improvement.

Mapping

ACSA standards: 2.1.1.9, 2.1.1.12

Curriculum competences: NA_IK_09, NA_IK_10, NA_IK_19, NA_IK_23

CPD matrix codes: 2F01, 3F00

GPAS 2020: 14.1.6, 14.2.11, 14.2.13, 14.5.17

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12.4 Initial management of spinal cord injury

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Why do this quality improvement project?

Acute spinal cord injury is a devastating event requiring a multidisciplinary team approach. Improving the initial care that these patients receive is critical in preventing secondary cord injury and will have major implications for long-term outcome.

Background

Spinal cord injury is a major cause of morbidity, often resulting in severe and permanent disability. Approximately 500-600 people sustain acute traumatic spinal cord injuries every year in the UK, often leading to serious neurological damage, causing paraplegia, tetraplegia or death.[1] The majority are incomplete lesions with significant potential for neurological improvement.[2] Early recognition and prevention of secondary injury is paramount to future quality of life. Initial management in the critical care unit is targeted at preserving spinal cord function, minimising secondary injury and prevention of further morbidity.

Best practice

Evidence for best practice in the management of spinal cord injuries is published by the British Association of Spinal Cord Injury Specialists, the National Spinal Cord Injury Strategy Board and by the American Association of Neurological Surgeons.[1–3] The National Institute for Health and Care Excellence has also published guidance on the initial assessment and management of spinal injuries.[4] Local protocols may vary according to the services available but should all be in accordance with national recommendations.

Aim: 95% patients with a spinal cord injury to receive all standards to care in 24 hours in the intensive care unit by an agreed date within a department.

Suggested data to collect

Outcome measures

- American Spinal Cord Injury Association (ASIAIS) Impairment Scale scoring in six months compared with ASIAIS scoring on admission and 72 hours from admission.
- Deterioration of neurology within the first seven days from admission.
- Percentage of patients receiving all standards of care within 4, 24 and 72 hours of admission to the intensive care unit (ICU).

Process measures

Within four hours of admission to ICU:

Standards	Measures
All patients admitted to ICU with a spinal cord injury at T6 or above should have their airway secured or regular vital capacity measurements taken if not intubated.	■ Proportion of patients meeting this standard.
An arterial line should be inserted in all patients and a target mean arterial pressure documented.	■ Proportion of patients meeting this standard.
All patients should have both a nasogastric and a urinary catheter inserted.	■ Proportion of patients meeting this standard.

All patients should have appropriate venous thromboprophylaxis prescribed.	■ Proportion of patients meeting this standard.
All patients should be log-rolled and have their skin inspected, with assessment of anal tone and sensation.	■ Proportion of patients meeting this standard. ■ Percentage of patients receiving all five standards within four hours of ICU admission.
Within 24 hours of admission to ICU:	
All patients should have bowel management prescribed and initiated.	■ Proportion of patients meeting this standard.
All patients should have ASIAIS assessment completed.	■ Proportion of patients meeting this standard.
All patients should have secondary trauma survey completed.	■ Proportion of patients meeting this standard.
All patients should have spinal clearance form filled.	■ Proportion of patients meeting this standard. ■ Percentage of patients receiving all standards required within 24 hours.
Within 72 hours of admission to ICU:	
All patients should be referred to a spinal cord injury specialist centre.	■ Proportion of patients meeting this standard.
All patients should have a repeat ASIAIS assessment.	■ Proportion of patients meeting this standard.
All patients should be referred to a speech and language specialist and a dietician.	■ Proportion of patients meeting this standard. ■ Percentage of patients receiving all standards required by 72 hours.

Quality improvement methodology

Admission to ICU

- Baseline measures of the above to determine current compliance with clinical care within four hours of admission to ICU. Identify areas for improvement. Is there potential to design a specialised spinal cord injury pro forma with a checklist to ensure that all parameters are covered?
- Process map with the staff to identify areas of delay or noncompliance and use baseline data to display issues. Identify processes that add or do not add value. Identify areas to focus improvement work on, brainstorm ideas and then test them in a small group of patients first and see what results in an improvement.
- Develop a driver diagram to identify measures and display the whole project on a page.
- Involve all multidisciplinary stakeholders in the planning of process map and driver diagram and in the planning and testing of improvements.
- Display the compliance with the standards in run charts easily visible for all staff and document interventions made.

Within 24 hours of admission to ICU

- Look at the daily review notes of a patient with a spinal cord injury. Are all aspects reviewed and discussed in the ward round? Is there potential to design a specialised daily proforma for patients with spinal cord injury?

12.4 Initial management of spinal cord injury

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- Develop a bedside checklist for patients with a spinal cord injury so all members of multidisciplinary team are fully informed.

Overall

- Is there scope to improve education within the multidisciplinary team?
- Potential to hold a course on the advanced management of patients with a spinal cord injury with workshops (respiratory, bowel, rehab) and simulation? Is there an opportunity to collaborate with other centres to develop this course?

Mapping

ACSA standards: 2.1.1.11
Curriculum competence: MT_BS_06
CPD matrix codes: 2F02, 3FOO
GPAS 2020: 14.5.11, 14.5.12, 14.5.17

References

1. British Association of Spinal Cord Injury Specialists. Good practice (http://www.bascis.org.uk/?page_id=8).
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12.5 Management of raised intracranial pressure in severe traumatic brain injury

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Why do this quality improvement project?

Improving the care of patients with raised intracranial pressure following a severe traumatic brain injury through adherence to guidelines will ensure better patient outcomes.

Background

Despite the development of specialist neurointensive care, severe traumatic brain injury (Glasgow Coma Scale less than 8) is still a common cause of morbidity and mortality.[1–4] The early transfer of patients to and the implementation of evidence-based protocols in these specialist units have been shown to reduce mortality in patients with traumatic brain injury,[2,4] but there is still marked variation in adoption and adherence of local guidelines for the management of raised intracranial pressure.[5]

Best practice

Guidelines for the management of severe traumatic brain injury include those by the Brain Trauma Foundation in the United States.[6] There are no universally agreed UK guidelines, but neuroscience units should have locally agreed guidelines based on best practice and evidence.

Aim: by the date agreed within the department, 95% patients with traumatic brain injury, as defined by a Glasgow Coma Scale score of less than 8, receive appropriate care as defined by local protocols, including measurement of intracranial pressure and standard management of raised intracranial pressure.

Aim for 100% of all future neuro-intensive care admissions of patients with severe traumatic brain injury receive appropriate care defined by local protocols, including appropriate level of multimodal monitoring.

Suggested data to collect

Standards	Measures
A target intracranial pressure with triggers for escalation in treatment should be set for each patient.	■ Percentage of patients meeting this standard.
An optimal cerebral perfusion pressure target should be set for each patient. For calculations, the arterial transducer should be placed at the level of the tragus.	■ Percentage of patients meeting these standards.
Levels of care for intracranial pressure management should be determined. Failure to control intracranial pressure within one level should prompt rapid progression to next level.	■ Compliance with each level of care for intracranial pressure management. Analyse reasons for escalation of care.
Level of sedation (including agents to be used and reasons for use of paralysis) and ventilation targets (PaCO2 and PaO2) should be set.	■ Proportion of patients with monitoring of depth of sedation and ventilatory target set.
Hyperosmolar therapy (including mannitol and hypertonic saline) should be used intermittently if required.	■ Percentage of these that were within set indications. Review reasons administered in those outside indications set.

Hyperthermia (temperature over 37.5 degrees C) is associated with adverse outcome and should be treated.	■ Proportion of patients with targeted temperature management: - target temperature - percentage patients receiving cooling. ■ Technique used for targeted temperature management (invasive or non-invasive).
In those patients who fail to respond to lower level interventions for reduction of intracranial pressure decompressive craniectomy or barbiturate coma should be considered.	■ Percentage of patients receiving decompressive craniectomy. ■ Percentage of patients receiving barbiturate coma. ■ Percentage of patients having electroencephalogram monitoring.

Quality improvement methodology

- Identify improved adherence with guidelines:
  - Process map with the staff the current pathway and identify delays or divergence from guidelines. Identify steps that do not add value.
  - Brainstorm ideas for improvement with the staff and test interventions on a small number of patients first to see whether the ideas are effective.
  - Adapt and develop using the learning from the testing and involve the staff caring for these patients.
  - Use a run chart to show the impact of the interventions on improved adherence to the guidelines and display for all staff to see.
- Consider assessment of qualitative data (staff confidence in using guidelines). Assessment of staff confidence before any intervention will allow understanding as to the correct intervention methods to use. For example, the reduced compliance may be due to new or agency medical and nursing staff not understanding the reasons for the guidelines.

Mapping

ACSA standards: 1.3.1.5, 2.1.1.9
Curriculum competences: NA_IK_20, NA_IK_04
CPD matrix codes: 2F01, 2F03, 2A11, 2A02, 3F00
GPAS 2020: 14.4, 14.7.2

References

1. Dinsmore J. Traumatic brain injury: an evidence-based review of management. BJA Educ 2013;6:189–195.
2. Patel HC et al. Trends in head injury outcome from 1989 to 2003 and the effect of neurosurgical care: an observational study. Lancet 2005;366:1538–1544.
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5. Volovici V et al. Variation in Guideline Implementation and Adherence Regarding Severe Traumatic Brain Injury Treatment: A CENTER-TBI Survey Study in Europe. World Neurosurg 2019;125:e515–e520.
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12.6 Management for the unconscious patient in intensive care at risk of spinal cord injury

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Why do this quality improvement project?

The incidence of cervical, thoracic and lumbar spine trauma is reported at 5% in patients with blunt multi-trauma.[1–2] A delay in spinal clearance, diagnosis or mobility management plan predisposes the unconscious patient to the complications of immobilisation and resultant increase in morbidity. An improved multidisciplinary approach to the assessment of risk, decision making and adherence to local guidelines will lead to better patient outcomes.

Background

This group of patients may be unconscious for a long time; waiting for Glasgow Coma scale to improve prior to clearance is not appropriate. However, there is little consensus on spinal clearance in the patient under sedation, so it can be difficult to get someone to accept responsibility.[2]

The Eastern Association for the Surgery of Trauma Practice Management Guidelines Committee in the United States has produced recommendations for cervical spine evaluation and thoracolumbar clearance but there remains a lack of level 1 evidence in both.[1,4] In the UK there is currently no national guidance and we rely on expert opinion and consensus recommendations.[2,3,5,6] The National Institute for Health and Care Excellence (NICE) has included guidance for the management of cervical spine injuries within their head injury guidelines.[7] Locally agreed guidelines tend to be based on available evidence and best practice.

Best practice

The safe, timely and correct decision making measured against standards set by NICE and locally agreed guidelines based on best practice and evidence. The locally agreed guidelines will include the personnel, imaging, timing and techniques necessary for managing the patient's conscientiousness.

Suggested data to collect

Quantitative

- Location and timing of initial imaging performed.
- Adequacy of the imaging performed.
- Time of the imaging reported.
- Personnel reporting the imaging.
- Personnel involved with the spinal management plan.
- Timing of intervention of the management plan.
- Nursing management when turning the patient before reporting the imaging.
- Documentation and duration of use of the hard collar.
- Duration of time before the management plan is defined.

Qualitative

- Staff confidence in reporting imaging.
- Staff confidence in understanding spinal management guideline.

Quality improvement methodology

Identify adherence with local guidelines

- Collect baseline measures and see where improvements are required.
- Brainstorm ideas with the team and test ideas for improvement on a small number of patients first to see whether effective.
- Adapt with learning from the testing and develop until working well.
- Involve the staff in the changes so that implementations are owned by the staff doing the interventions.
- Use a run chart to show the impact of the interventions on improved adherence to the guidelines.
- Consider assessment of qualitative data (staff confidence in using guidelines).
- Assessment of staff confidence before any intervention will allow understanding as to the correct intervention methods to use. For example, reduced compliance may be due to new or agency medical and nursing staff not being confident to follow guidance in high-risk areas.

Identify areas to focus on

- Consider plotting a process map to identify where the quality improvement project needs to focus to improve care.
- Develop the map with the staff involved. Identify areas for improvement and steps that do not add value.
- Identify steps that can be measured.
- This system should identify whether it is a training, communication or resource issue preventing optimal care.

Mapping

ACSA standards: 1.3.1.5, 2.1.1.5
Curriculum competences: NA_IK_13, NA_IK_14
CPD matrix codes: 2A02, 2F02, 2F03, 3F00
GPAS 2020: 14.2.6

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12.7 Endovascular thrombectomy

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Why do this quality improvement project?

Stroke is the third leading cause of death and the leading cause of disability in the developed world. High-quality evidence supports the use of endovascular thrombectomy (EVT) in the management of acute ischaemic stroke. Improving outcomes will have major benefits for individual patients and society as a whole.

Background

EVT is recommended in acute ischaemic stroke for patients with anterior circulation, large vessel occlusions who present up to six hours after symptom onset. EVT should also be considered for up to 24 hours in patients with potentially salvageable brain tissue. Anaesthetic input is required to reduce pain and maintain physiological stability, and for airway management. Time from stroke onset to successful reperfusion is crucially important and any delay may contribute to poor outcome. Studies have found an association between periprocedural hypotension and adverse outcome. More controversially, retrospective observational studies have also reported an association between general anaesthesia and poor outcome.

Best practice

- UK and international consensus standards exist for the provision of safe thrombectomy services.
- The aim is to have 90% of appropriate patients receive recommended treatment (EVT) within six hours symptoms by a specified date agreed within the department.

Suggested data to collect

Standards	Measures
Outcomes for all patients, including successful reperfusion, should be documented and adjusted for baseline stroke severity.	■ Percentage of patients who have documented successful reperfusion (successful reperfusion being clearly defined so measured consistently). ■ Length of hospital stay.
All hospitals performing EVT require rapid access to cerebral angiography, experienced neurointerventionalists and a comprehensive periprocedural stroke team. Hospitals should develop and adhere to care protocols reflecting national guidance.	■ Baseline measures as part of planning and defining areas to work on: - the presence of a protocol - adherence to each aspect of the protocol as below - reasons for deviations from protocol with reasons. ■ Review handful of cases and identify some 'patient stories' to support engaging staff in your improvement ideas.
Levels of care for intracranial pressure management should be determined. Failure to control intracranial pressure within one level should prompt rapid progression to next level.	■ Compliance with each level of care for intracranial pressure management. Analyse reasons for escalation of care.
All patients should have an assessment of stroke severity, American Society of Anesthesiologists (ASA) physical status category, baseline investigations and medical history obtained on arrival.	■ Percentage of patients with full baseline assessment documented (ASA status, stroke severity by National Institutes of Health Stroke Scale score, documentation of medical history, electrocardiogram). ■ If compliance with this is low, identify which aspect(s) is commonly missing and identify project idea for improvement.

Time critical procedures and delays must be minimised. Standard is six hours from onset of symptoms to groin puncture.	■ Times from stroke onset to arrival in the interventional neuroradiology (INR) suite: - from arrival to induction of anaesthesia - from arrival to arterial puncture - overall time from stroke onset to thrombectomy. ■ Document reasons for delays.
General anaesthesia is recommended in patients with a reduced level of consciousness, those who are uncooperative or agitated, those who cannot protect their airway or those already intubated.	■ Percentage of patients receiving general anaesthesia. ■ Percentage of patients converted from local to general anaesthesia. ■ Percentage of patients with documented incidence of aspiration.
Systolic blood pressure should be maintained between 140-180 mmHg or within 10-15% of baseline with fluids and vasopressors.	■ Baseline percentage of patients with hypotension lasting more than five minutes. ■ Review strategies for and effectiveness of management of hypotension. ■ Consider setting a standard management protocol and measure compliance with the protocol and track whether the number of episodes of hypotension longer than five minutes improves.
Supplemental oxygen should be titrated to maintain arterial oxyhaemoglobin saturation (SaO^2) greater than 94%. Hyperoxia should be avoided.	■ Proportion of patients with SaO_2 less than 94%.
100% of patients ASA score of 3 or above should have access to level 2/3 care.	■ Percentage of patients ASA score of 3 or above admitted to critical care. ■ Overall percentage patients admitted to critical care. ■ Duration of stay on critical care.

Quality improvement methodology

Avoiding delays

- Develop a process map of patient journey including all the steps from arrival in hospital to the end of successful treatment.
- Develop the map with the teams involved.
- Identify steps that do not add any value or where there are delays.
- Identify where changes could be made to simplify or minimise delays.
- Produce baseline run chart of time from arrival to treatment and review the variation in times.
- Review cases where there is a significant delay and identify any common features in these cases that you can improve, as well as reviewing cases where the time is short, to see what worked well and can be repeated.
- The process map will help to identify which of the above processes you need to improve and start there.

Improving preprocedural documentation

- Draw out a process map from the time between referral and arrival in the INR suite. Develop with the staff in those areas. Identify delays and reasons.
- Brainstorm ideas for improvement with the staff (eg where is it most helpful to remind staff to record and handover necessary information?).

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- Test those ideas on a small number of patients and see what happens and adapt the process according to what you find (ie learn from the test).

Design a driver diagram for the overall project, identifying the key drivers. Identify projects and key measures. It is useful to demonstrate to everyone where it all fits together and display the whole project on a page. It can also identify your key measures.

Mapping

ACSA standards: 1.3.1.5, 2.1.1.2, 2.1.1.5, 2.1.1.9, 2.1.1.12
Curriculum competences: NA_1K_10, NA_HK_01, NA_HK_02
CPD matrix code: 3F00
GPAS 2020: 14.7.2, 14.1.4, 14.1.11

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