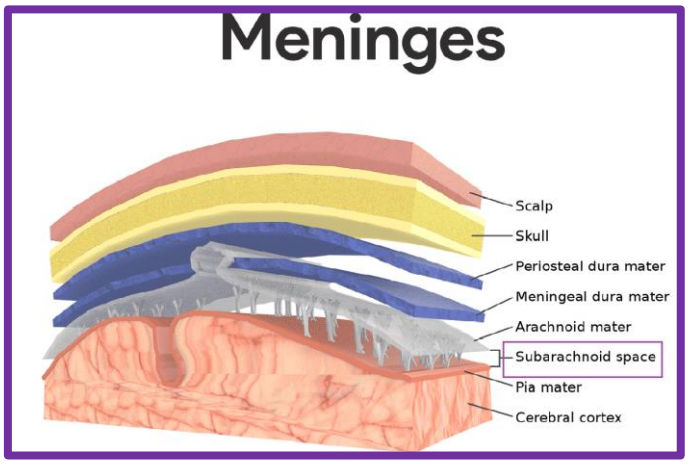
Management of Spontaneous Subarachnoid Haemorrhages

Definition

Arterial bleed into Subarachnoid space of the patient's brain



Key points:

- Most commonly caused by a burst aneurysm in the cerebral circulation – to prevent further bleeding the aneurysm can be coiled (an endovascular procedure) or clipped (an external procedure with a craniotomy)
- Important to establish whether aneurysm is unprotected or protected ie. pre or post coiling/clipping as this dictates cardiovascular parameters
- HIGH risk of complications - vasospasm (see separate guide) and rebleeding (50% case fatality)
- Must have 1-2 hourly FULL neurological assessment (GCS, pupils AND limbs documented)
- Require careful management and constant observation for changes as patients can deteriorate quickly
- A protected aneurysm is one that has been secured (either clipped or coiled and an unprotected aneurysm has not been and at a **VERY** high risk of re-bleeding

On admission:

- Send troponin and NT-proBNP with admission bloods and send urine electrolytes
- 12-lead ECG (must have daily ECGs if on inotropes)
- Ensure enteral access for Nimodipine ASAP (60mg 4 hourly or 30mg every 2 hours)
- The patient must not miss more than 2 doses and Nimodipine must not be given together with Paracetamol due to their combined hypotensive properties.
- Ascertain if aneurysm identified/protected? If not known – aim SBP 120-160mmHg but clarify with neurosurgical team!

Daily Management with PROTECTED ANEURYSM:

- PaO2 > 10kPa
- Maintain normovolaemia – calibrated LiDCO (Fluid Challenges against LiDCO
- Hb 80-100
- Daily ECG (if on inotropes)
- 1- 2 hourly neurological assessment (and FULL description on care plans/handover) – can de-escalate to 4 hourly after 48hrs or more stable
- If GCS drops or limb power changes **urgently** contact neuro surgeon and inform anaesthetic consultant
- Aim **SBP 120-220mmHg** or as per neuro consultant target – if vasospasm suspected then will be for higher SBP targets (see separate Vasospasm guide)
- Blood glucose 6-10mmol/l – start Insulin infusion if >10mmol for >4 hours
- Monitor Na+, K+, Mg (keep above 1.0 mmol/dl) & PO4 at least daily and replace as required – see Sodium Imbalances quick guide
- Ensure adequate pain relief and anti-emetics – at least Paracetamol QDS + Oramorph 10mg 4 hourly with 4-8mg IV Ondansetron + 50mg IV Cyclizine TDS PRN
- Laxatives – to avoid straining, give Docusate + Senna BD (escalate with Laxido if BNO >3 days and consider glycerine suppositories and/or phosphate enema if BNO >5 days)
- VTE prophylaxis – Flotrons at all times
- If patient has been coiled– must stay flat for 6 hrs post op with regular stab site and pedal pulse checks 15min intervals for 1st hour, 30 min for 2nd hour and hourly for 4 hours (report any signs of haematoma/swelling and/or loss of pedal pulse)

Daily management with UNPROTECTED ANEURYSM:

- Aim **SBP 120-160 mmHg**
- Be cautious if patient is on inotropes – slow double pumping
- If patient ventilated, try to avoid prolonged coughing/suctioning to prevent hypertension
- In all other aspects, manage as per protected aneurysm patients above

Vasospasm – Quick Guide

Key Points:

- Symptomatic vasospasm presents as a clinical deterioration in neurology post acute Subarachnoid Haemorrhage (SAH) -usually 4-10 days post bleed
- Occurs in the majority of patients who have an aneurysmal SAH (can be identified by angiogram) but only ~30% will become symptomatic
- Symptoms of vasospasm normally are a new focal deficit (limb weakness in one side/limb but can also be a generalised deterioration in GCS or new speech deficit
- In asymptomatic patients (when vasospasm identified on angiogram) – ensure normovolaemia, good oxygenation and a Map more than 60mmhg unless instructed otherwise by neuro surgeon (NS)
- With symptomatic patients – to rule out other causes of neuro deterioration (such as re-bleed, hydrocephalus, seizures and fluid/electrolyte imbalances) **Urgent** CT and CT angiogram at same time to diagnose potential vasospasm

Treatment:

- Hypertension – this depends on patient's current BP and neurology but normally SBP > 180mmHg or 20% above patient's baseline
- If this does not improve neurology then to increase BP until neurological symptoms improve (can be aiming SBP 200-220mmHg in some cases to achieve this)
- May also require Intra-arterial Nimodipine if in severe vasospasm – this is done in Neuro-radiology MRI suite and is decided by NICU and neuro-radiology consultants (can be done a number of times to treat severe spasm)

Nursing considerations:

- Extremely strict BP control - be prepared to adjust Noradrenaline rates frequently and only increase/reduce rate by 0.01mcg/kg/min at a time
- Nimodipine dosing MUST be 30mg every 2 hours to avoid big drops in BP however, in some patients this is often unavoidable (can pre-emptively increase Noradrenaline rate slightly immediately after giving Nimodipine if patient known to be sensitive)
- Avoid anti-hypertensive drugs if at all possible – these should be stopped anyway if vasospasm identified but, if prescribed, check with neuro registrar if still appropriate to give
- Patients in vasospasm are also often sensitive to Paracetamol therefore, **NEVER** give at the same time as Nimodipine (if replacing magnesium intravenously also be aware of potential drop in BP)
- If vasospasm suspected/confirmed, ensure LiDCO is attached and calibrated every 24 hours (use a variety of measurements to assess fluid status – SVV, lactate, Hct and give any fluid boluses against LiDCO to aim for normovolaemia)
- If patient is going for IA Nimodipine treat as a pre-op patient – complete peri-op checklist, keep NBM/aspirate NGT etc and monitor groin stab site and pedal pulses post-procedure
- If doctors decide to start weaning off hypertensive therapy, ascertain before reducing Noradrenaline what their neurological symptoms were when vasospasm was identified – when reducing their BP, it can be useful to know what to look out for
- When weaning off hypertensive therapy, make a note of patient's SBP when/if neurological symptoms occur and inform doctors
- As SAH and vasospasm can cause a degree of cardiac stunning – ensure daily ECGs are done and NT-proBNP + troponin sent with daily bloods
- If requiring high doses of Noradrenaline, ensure bedside echo has been performed and consider use of Dobutamine to maintain good cardiac output
- As vasospasm causes reduced perfusion to the brain, it is essential to maintain good oxygenation – SpO_2 > 97% and PaO_2 > 10kPa

  BE VIGILANT FOR ANY SLIGHT DETERIORATION IN THESE PATIENTS AS IF CHANGES HAPPEN THEY MUST BE ACTED ON QUICKLY TO PREVENT LIFE THREATENING COMPLICATIONS!

EVDs – Quick Guide

An EVD is an extraventricular drain which is inserted under local +/- general anaesthetic by the neurosurgical (Neuro Surgical) consultant/registrar in theatre. It sits in one of the 4 ventricles and provides pressure relief by letting CSF (cerebrospinal fluid) drain into a closed, sterile burette and drainage bag. EVDs are commonly inserted in patients who have an increase in intracranial pressure due to hydrocephalus (a build-up of CSF in the ventricles). These patients include those with SAH, TBI, infection, tumours and congenital CSF drainage problems.

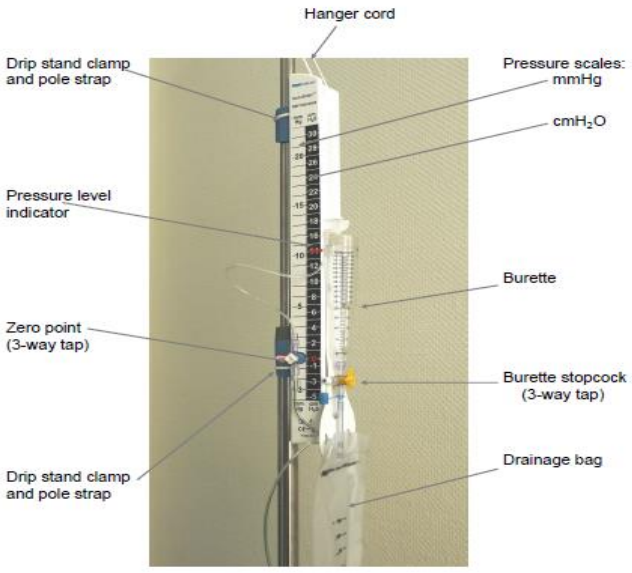
The EVD itself is a temporary measure to provide time until the underlying cause of hydrocephalus has been/can be resolved.

All EVDs must be

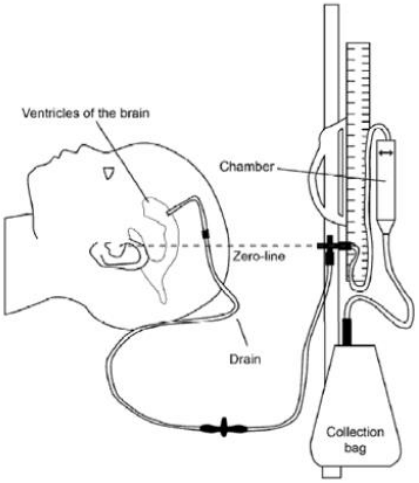
- Zeroed at appropriate level (tragus of ear when supine, bridge of nose when side-lying) to avoid under/over drainage
- Set at the prescribed level (e.g. 10cmH2O) and only moved if advised by neurosurgical registrar/consultant
- Clamped when moving the patient in bed/transferring out to chair then re-levelled and unclamped once procedure completed
- Output monitored/recorded hourly (unless otherwise stated by neurosurgeon aim 1-20ml/hr) – if no drainage or oscillation seen to notify NS registrar **immediately**
- Clamped at both points on the drainage set when transferring to CT/MRI/ward – only Unclamp when back in bed space with drain at prescribed level
- Labelled clearly to differentiate drainage tubing from CVC line
- Raised 10-20cmH2O when performing chest physio or if patient coughing ++ - return to Prescribed level once procedure complete

IT Vancomycin:

- All patients with EVDs in situ must be given a daily prophylactic Vancomycin dose intrathecally through the EVD – this must be done by the **NS SHO** as an aseptic procedure (they will know this needs to be done but may need bleeping to remind them)
- IT Vancomycin doses are kept in the unit fridge and are in pre-made up syringes – liaise with pharmacy for supplies of these
- If the EVD is an orange tube, this is a Bactiseal EVD which is antimicrobial-impregnated and does not require daily IT Vancomycin. If unsure – liaise with **NS**
- To change drainage bag or to take CSF sample it MUST be an aseptic procedure – **DO NOT EMPTY THE BAG OR TAKE SAMPLES UNLESS TRAINED TO DO SO!**



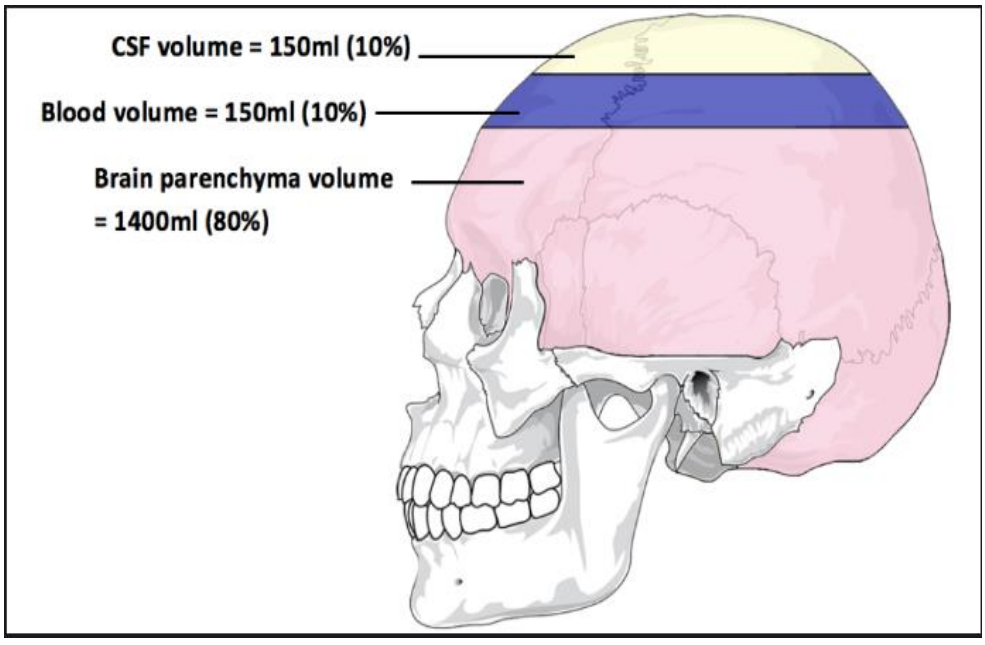
The Integra™ Accudrain™



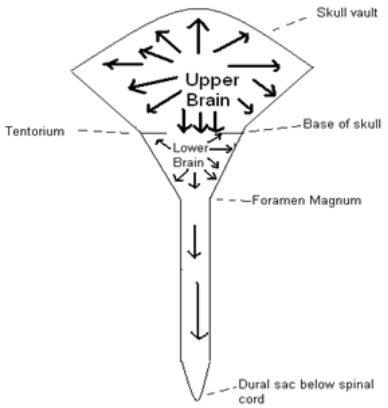
Background of ICP

The basis for treatment of an intracranial pressure rise is the Monro-Kellie doctrine: The skull is a closed box containing blood (~150ml, 10%), cerebrospinal fluid (CSF) (~150ml, 10%) and brain tissue (~1400ml, 80%). These 3 components usually exist in equilibrium to each other, if the volume of one increases; the volume of one of the others must decrease (autoregulation). To achieve equilibrium, the main compensatory mechanisms are increased drainage of blood or CSF from the cranial cavity. Autoregulation will compensate for a long time for slow growing tumours for example, but will quickly fail due to a sudden brain injury or subarachnoid haemorrhage (SAH). When autoregulation is exhausted, there is no further drainage of blood/CSF and consequently a rise in ICP. This rise can present itself through the Cushing's triad: **a RISE in BP with a simultaneous DROP in HR and respirations**. If this is not treated, the brain tissue itself can become displaced (herniation). The most dangerous are uncal and tonsillar herniation: In these cases, the rise in pressure is so great that the brainstem itself can be forced into/through the foramen magnum at the base of the skull. This results in the brain taking the shape of an upside down cone (the patient is 'coning') and a cut off of blood flow and oxygenation, thus being fatal to the patient.

Monro-Kellie doctrine:

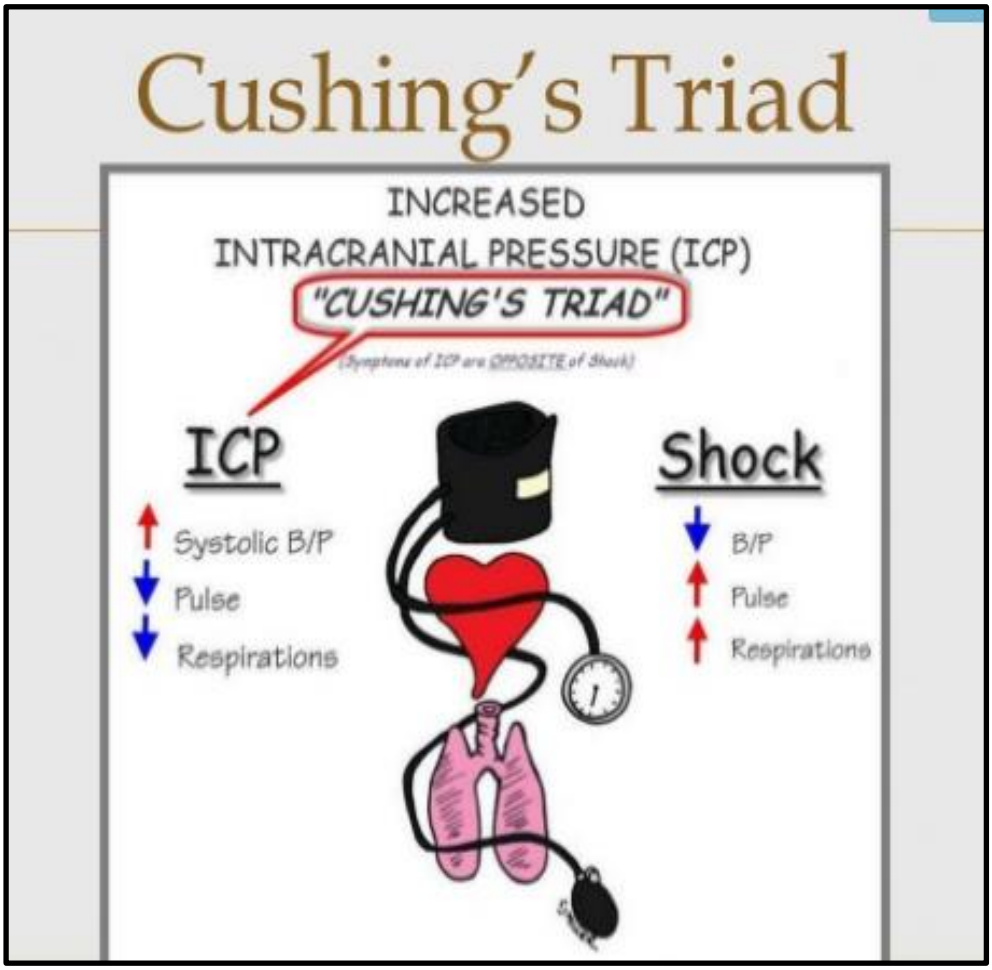


Coning



- Huge pressure in the upper brain
- Less pressure in the lower brain
- Almost no pressure at the base of the spinal cord
- Creates a "pressure cone" in which the upper brain forces itself through the tentorium, crushing the brain stem

Cushing's Triad



General Treatment of Traumatic Brain Injury Patients (TBI)

Bedside preparation:

- 2 drip stands: 1 for transducer plate, 1 for ICP monitor
- 3 transducer cables (arterial line, CVP, ICP monitor), temperature probe attachment for monitor
- Transferable ventilator with 2 full oxygen cylinders and 120 minutes of battery time (i.e. SERVO U); **DO NOT** change ventilators to transfer patients to CT, this creates unnecessary ICP instability
- LiDCO monitor
- Propofol, Fentanyl/Alfentanil, Metaraminol, Glycopyrrolate (in vial) and 2x Noradrenaline ready

On patient arrival:

- Check pupils (patient is most likely paralysed, these will be the only indication of a problem)
- Change ventilator over and use a volume controlled mode of ventilation (VC or PRVC)
- Transfer patient to bed (if spine not cleared, log roll patient)
- Transfer/attach sedative infusions
- Attach monitoring and take 12 lead ECG
- Check ABG, aim adequate oxygenation and paCO2 (**paO2 > 10kPa and paCO2 4.5-5.0kPa**) + take full set of ICU bloods including MgSO4 and G+S
- Level arterial transducer to tragus of ear (to measure BP at level of 3rd ventricle), maintain MAP >90mmHg, starting Metaraminol (peripheral) or Noradrenaline (central) if necessary and line cleared
- Zero ICP on Camino monitor and sync to bedside monitor (ask/ring NICU for tips on how to find ICP/CPP on monitors)
- Initial ICP target between **0-25mmHg**, **CPP > 60mmHg**
- Nurse head up 30-45 degrees (ensure spinal clearance completed and documented)

During the first 24 hours:

- Neurological:
  - As these patients are usually deeply sedated, **RASS** and **GCS** should only be checked + recorded 4 hourly and need to be **-5 and 3/15** respectively
  - Check + record pupils **HOURLY**
  - If required, get spinal clearance OR maintain neutral alignment of spine and attach Miami J collar
- Respiratory:
  - Maintain tight paCO2 control, checking ABG 2-4 hourly **(4.5-5.0kPa)**
  - Use closed suction system to reduce break of ventilation, remove secretions as required and ensure HME is clear
- Cardiovascular:
  - Maintain CPP >60mmHg and ensure monitoring targets are agreed by neuro consultant/registrar
  - Calibrate LiDCO and give targeted fluid boluses to aid with CPP control
  - Maintain serum Na+ >140mmol/l, MgSO4- >1mmol/dl, PO4- >1mmol/l and K+ >4.0mmol/l
- GI:
  - Insert NGT/OGT and oesophageal temperature probe (ensure **NO skull fractures** prior to insertion of NG probes!!) + start as per ICU feeding protocol
  - Start PPI as per unit guidelines
  - If patient has reduced GI motility (aspirates > 300mls) start Metoclopramide 10mg IV TDS and/or Erythromycin 250 mg NG QDS
  - Maintain BSL < 10mmol/l and **AVOID** hypoglycaemia
  - **DO NOT GIVE DEXTROSE AT ANY POINT** – encourages brain swelling
- Elimination:
  - Maintain euvolaemia, hourly fluid balance
  - Report UOP >300ml/hr to neuro registrar/consultant
  - Bowel care: Senna and Sodium Docusate +/- Laxido as required; if spinal injury, follow spinal bowel care guideline
- Miscellaneous and Integumentary system:
  - Check temperature 2-4 hourly and aim for normothermia < 37.5 degrees
  - Mechanical VTE prophylaxis initially, review daily if pharmacological thromboprophylaxis feasible
  - Regular eye and mouth care
  - Turn as per PUP guidance – if patient does not tolerate side-lying, turn/logroll every 4 – 6 hours, then bring back and maintain in supine position

Treatment of Raised ICPs

First tier treatment for high ICP

- Ensure **CPP > 60mmHg** - give boluses of sedation & increase Noradrenaline rate to achieve this
- Ensure adequate oxygenation and check paCO2 (aim **paO2 > 10kPa and paCO2 4.5-5.0kPa**) – patients should be on PRVC mode ventilation to allow tight CO2 control (titrate ventilation slowly!)
- Check for secretions on chest – give 5% sodium chloride nebs if thick secretions
- Due to sedation, patients will not cough – if secretions can be auscultated, but not cleared, **DO NOT** deliver manual assisted cough (this increases ICP)
- Check positioning – **sit patient up to 45 degrees**, head straight with knees **unbent** (use towels to keep head and neck straight to allow good venous drainage)
- If ICP rises when bent at the hips, put patient flat and reverse trendelenburg up to 45 degrees head up (use pillows to prevent patient from slipping to bed end)
- Check temperature – if > 37.5 degrees consider Arctic Sun to target normothermia
- Seizures - use BIS monitoring if available. If ICP > 25mmHg and BIS > 50 then consider loading with Levetiracetam (Keppra) (60mg/kg in 250ml NaCl over 10mins) then BD maintenance doses (500-1500mg in 100ml NaCl) +/- starting Midazolam infusion
- If EVD in situ – ensure adequately draining, check for blockage/tap turned off or if positioned too high (**level at tragus of ear when lying supine or bridge of nose if on side**)

Second tier treatment for high ICP

- If requiring multiple boluses of sedation, consider increasing Propofol (max: 5mg/kg/hr) + Fentanyl/Alfentanil rates and consider Midazolam infusion
- Lower paCO2 to **4.0-4.5kPa**, after discussion with Neuro consultant
- Can give bolus of 5% sodium chloride IV, but **MUST** be discussed with Neuro consultant/senior registrar first (1-2ml/kg bolus) 4-6hrly. Max 8ml/kg in 24hrs. Only give if Na+ <160mmol/l. Consider checking serum Na+ and osmolality levels BD
- If consistently high ICPs, check pupils on pupillometer (**NPi > 3 = brisk, 0.1-3 = sluggish, 0 = unreactive**) and report if new sluggish/unreactive pupils seen
- Inform Neurosurgical SpR – may require urgent (within 30 mins) CT head and possible surgery (either EVD insertion or decompressive craniectomy = removal of a piece of skull to allow for pressure reduction)

Third tier treatment for high ICP

- Therapeutic hypothermia down to 35 degrees
- Barbiturate (Thiopentone) coma:
    - made by a senior experienced doctor (consultant only)
    - only considered for salvageable patients (i.e. those with a potentially good outcome)
    - only considered on haemodynamically stable patients
    - only considered after maximal medical therapies have been exhausted and surgical therapies are not an option

Second and third tier treatments are potentially hazardous and should only be authorised by someone experienced in managing head injuries – consultant level

Sodium Imbalances – quick guide

Urine output 0.5 – 1 ml/kg/hr	High - >1000 ml/ 3hours	High	Low
Urine S.G. 1.010- 1.035	Low - <1.005	Normal	High
Urine Na+ ~20mmol/l (If doing a 24 hour urine collection 40- 220 mmol/24 hrs)	Low	High	High (concentrated)
Serum Na+ 135- 145 mmol/l	High and Rising	Low	Low (dilutional)
Total body water	Falling rapidly	Low	High (retention)
Likely Diagnosis	**Diabetes Insipidus (DI)**	**Cerebral Salt Wasting (CSW)**	**SIADH**
Treatment	DDAVP Replace output	Replace volume and sodium Fludrocortisone	Fluid restrict

ENSURE HOURLY FLUID BALANCE IS COMPLETED

Definitions

CSW – Over excretion of Sodium and water

DI – Over excretion of water

SIADH – Retention of water

Management of Cerebral Salt Wasting (CSW)

- All spontaneous SAH patients MUST have urine electrolytes and NT-proBNP sent with daily morning bloods
- 4-6 hourly ABGs for sodium and potassium levels. Do NOT correct sodium >10mmol/l in 24hrs
- Sodium supplements – if on NG feeding, can use IV preparation diluted in sterile water (3g in 10ml vials)
- Check MgSO4 and PO4 at least daily: give IV/enteral supplements as required to keep > 1mmol/l
- Patients with severe cerebral salt wasting may require BD serum and urine U&Es sending – ask consultant on ward round
- Can send urine/serum osmolality with daily bloods but must be sent together – on consultant/senior registrar instruction
- If able to drink – discourage patients from drinking pure water and offer squash/juice instead. Check on ward round what fluid balance we are aiming for and whether for IV replacement (0.9 or 1.8% sodium chloride)

Management of Diabetes Insipidus (DI)

- Common in post-op transphenoidal surgery patients, TBI patients and in brain-stem death
- Caused by impaired production/release of ADH so kidneys no longer conserve water – urine becomes very dilute and serum sodium increases rapidly
- If suspected DI – send serum + urine osmolality and check urine Specific Gravity (SG) (inform doctors if < 1.005)
- If patient able to E&D – encourage patient to drink, if patient ventilated then adjust IV volume replacement to urine output and add enteral water boluses
- If severe cases of DI, can give dose of DDAVP – 0.1-0.5mcg IV but MUST be discussed with NICU and/or NS consultant first
- 4-6 hourly ABGs

Management of syndrome of inappropriate antidiuretic Hormone (SIADH)

- Must rule out cerebral salt wasting diagnosis first
- If mild hyponatraemia (133-135mmol/l) can try fluid restricting 1-1.5L per 24hrs
- If severe hyponatraemia (< 120mmol/l) then consider 1.8% sodium chloride infusion – start at 50ml/hr but discuss with consultants
- 4-6 hourly ABGs, BD serum U&Es

Post-operative Care of Neurosurgical Patients

Neurosurgical patients tend to be confused postoperatively and can be anything between sleepy and all the way up to combative. This often resolves within the first 2-6 hours.

Neurological:

- Check GCS, limb assessment and pupil size and reaction ¼ hourly for 1 hour, ½ hourly for 2 hours and hourly for the next 4 hours, even overnight. Thereafter, neurological observations can be done 2 hourly, but **NO LESS OFTEN** than that. If the patient has been stable for >24hrs, these can be done 4 hourly
- Use a second opinion and the pupillometer if unsure of pupillary reaction
- Report any deterioration (apart from E4 to E3) to the ICU registrar
- Keep headrest at 30-45 degrees to aid cerebral drainage, unless flat bed rest has been ordered post-operatively (e.g. post coiling)

Respiratory:

- Record observations at the same time as neurological assessments above
- Check that patients can maintain their airway; patients often need naso/oropharyngeal support for 1-2 hours post-operatively, as neurosurgeons do not want them to cough too forcefully when extubating and they are still fairly well sedated. If a patient is deteriorating or unable to maintain their airway after 1 hour, check with the neurosurgeon and ascertain what level of consciousness is expected of the patient. The patient might need an urgent (within 30 mins) CT scan
- Post fossa surgery patients can take longer to wake up and can have difficulty maintaining their airway – report a weak/ineffective cough as aspiration risk is very high
- Maintain SpO2 >95% and paO2 >10kPa by titrating O2 accordingly. Use humidified O2 via facemask initially and change to nasal cannula as able (unless patient had **transphenoidal surgery*** - keep facemask as needed for these patients)
- Check ABG 4 hourly
- Auscultate chest 4 hourly and assist with secretion removal as needed

Cardiovascular:

- Maintain MAP >70mmHg, use Metaraminol infusion if required. Patients often only require this overnight and as long as the patients' neurological status remains stable lower MAPs can be accepted after 24 hours
- Calibrate a LiDCO and administer fluid boluses to achieve euvolaemia
- Use NaCl if Na+ <140mmol/l and CSL if Na+ >140mmol/l
- Maintain K+ >4.0mmol/l, MgSO4 > 1.0mmol/dl and PO4->1.0mmol/l
- Post-op ECG and daily ICU bloods

Gastrointestinal:

- If there are no signs of airway protection difficulties, patients can progress from sips of water to a full diet as able
- If patients cough after having sips of water, **KEEP NBM** and arrange for formal SLT assessment. Observe patients who had post fossa surgery closely: swelling/bleeding into that area will increase pressure on the brainstem, resulting in swallowing difficulties
- Record oral fluid intake closely – if patients cannot drink, ensure background fluids are running depending on Na+ levels (see cardiovascular)
- Nausea is a big problem after neurosurgery: ensure Ondansetron, Cyclizine and Metoclopramide are prescribed IV as required and Prochlorperazine (Stemetil) IM is available if the first 3 have no effect. Post fossa patients should have Ondansetron IV prescribed regularly TDS with the other 3 anti-emetics on PRN side

Renal:

- Most patients come with a catheter – strict hourly fluid balance, maintaining euvolaemia
- If no catheter in situ and a patient has not passed urine within 6 hours post-operatively, do bladder scan and discuss catheter insertion (some neurosurgical consultants want to avoid IDC insertion due to risk of infection)
- If UOP >300ml/hr for 2 hours, inform registrar and monitor Na+ levels – see separate sodium imbalances quick guide

Elimination:

- Start Sodium Docusate and Senna regularly from the first day, straining can worsen headaches and even cause re-bleeding. Add Laxido if BNO for 3 days

Pain:

- Can administer 2mg Morphine IV in 5 minute intervals up to 10-20mg (depending on level of pain, prescription and patient consciousness level) in the first 24 hours post-op
- Patients tend to have strong headaches – give Paracetamol IV regularly
- **DO NOT** give Ibuprofen – it has blood thinning properties and these patients are at risk of bleeding

Postoperative neurosurgical patients cont..

Skin/Wound Care:

- If a patient has to remain on flat bed rest, ensure they keep in a supine position with their legs straight and turn once to check their back in that period
- **Chronic Subdural** patients must be sat up very gradually to avoid a re- collection
- All other patients turn as per PUP protocol and maintain headrest at 30-45 degrees
- If a patient had aneurysmal coiling:
    - Monitor groin stab site(s) and pedal pulses at the same time as neurological observations and refer urgently if haematoma/swelling/bleeding occurs
    - Use Femstop if needed
- If a patient had **transphenoidal surgery***:
  Transphenoidal surgery is an endoscopic procedure going up through the nose to remove pituitary tumours and meningiomas
    - Monitor bleeding from nose and ask patient if they can taste blood/have a salty taste in the back of their throat when doing obs – if so: urgent neurosurgical review, patient might have CSF leak
    - Use nasal bolsters for oozing from nose and record how many bolsters used
    - If more than 3 bolster changes in 1 hour, urgent neurosurgical review
    - 24 hours post-op patients can start with nasal douching – skull base tumour CNS will offer assistance
- If a patient had aneurysmal **clipping or a craniotomy**:
    - Observe wound for excessive bleeding, oozing
    - Check drain patency and apply prescribed suction requirement (gravity/half suction/full suction) when doing obs
    - Record drain output at midnight and incorporate in fluid balance
    - In most cases wound drains get removed after 24-48 hours prior to discharge to the ward
- If a patient had **Gliolan** (a substance that helps neurosurgeons see the tumour)
    - Ensure the patient is in a darkened side room or the curtains are closed at all times with the lights off. If the patient brought sunglasses, ensure they wear them
    - Gliolan causes hypersensitivity to light for 24 hours post operatively; patients will get strong headaches if exposed to light
    - After 24 hours, patients should refrain from sun exposure for at least a week as they can become sunburnt extremely quickly
- If a patient had an EVD inserted: see separate guide
- If a patient had a craniotomy for evacuation of a Chronic SubDural Haematoma (CSDH), be cautious with sitting them up. Lie flat for first 12-24 hrs then up to 30 degrees unless told otherwise by NS team

BLANK PAGE

Spinal Injury Admission

Initial Management

To be completed within the first 4 hours of admission

- Do not put the patient on an air mattress
- Complete a FULL spinal Assessment – see video below for guidance
    - https://www.youtube.com/watch?v=kRAdWRmR9rY
- Ensure Miami J Collar Fitted (if unsure how to do this please watch the video on collars)
    - https://www.youtube.com/watch?v=7LGTaB3CCU8
- Keep Atropine and Glycopyrolate at bedside – easily accessible
- Measure patient's Vital Capacity (if unsure how to do liaise with physios)
- Analgesia needs to be prescribed and given
- Ensure Laxatives prescribed (BD Senna & Sodium Docusate with daily suppositories at 6am)
- Insert arterial line, central line and NGT
- Catheterise patient
- VTE prophylaxis
- Log Roll Patient (Please see video for how to log roll)
    - https://www.youtube.com/watch?v=C04my6p6Q80
    - Check skin integrity
    - Do PR and assess Anal tone (if unsure speak with neuro surgeon)

Within 24 Hours

- A surgical plan needs to be documented
- Physio assessment completed
- Spinal Clearance documentation completed
- ASIA Assessment completed (to be completed by Physios and neurosurgeons)
- Trauma Secondary Survey completed
- Occupational Therapy referral
- Physios to refer patient to Spinal Injury Unit
- SLT referral must be completed

BLANK PAGE

SPINAL BOWEL QUICK GUIDE

Bowel Sounds Present

1. Commence enteral feeding and refer to a Dietician.
2. Commence laxative regime: stool softener (e.g. sodium docusate) twice daily, bowel stimulant (e.g. senna) at night (i.e. 8 – 12 hours before bowel care).
3. **Daily DRE** and digital removal of faeces.

Faecal incontinence does NOT exclude the presence of hard stool in the rectum or bowel.

<table>
<tr><td colspan="4">Preparation and DRE as section 1</td></tr>
<tr><td rowspan="2">Digital removal of faeces</td><td colspan="3">Is stool present?</td></tr>
<tr><td>Yes</td><td colspan="2">No</td></tr>
<tr><td>As section 1</td><td>Patient has passed liquid stool within past 6 hours</td><td>Patient has NOT passed liquid stool within past 6 hours</td></tr>
<tr><td></td><td></td><td>Withdraw the finger</td><td>o Insert 2 glycerin suppositories or a micro-enema to stimulate the reflex bowel.
o Leave for 20 minutes while applying abdominal massage (unless contra-indicated).
o Repeat DRE. Remove any faeces in the rectum (as section 1).
o Leave for 10 minutes and repeat DRE.
o Repeat until no further stool present in the rectum</td></tr>
<tr><td></td><td colspan="3">Clean and dry the patient's skin thoroughly. Document the procedure thoroughly.</td></tr>
</table>

If the procedure above does not produce results, consider using gastro-colic stimulation, rectal stimulation or both.

Abdominal massage Stimulate peristalsis and aids mass movement toward rectum **May be contra-indicated in cases of abdominal trauma – seek surgical advice**	o If possible, explain procedure and obtain consent. Ensure privacy. o Follow the line of the colon from the lower right abdomen clockwise to the lower left abdomen. o Use the heel of the hand or a tennis ball. o Apply and release firm but gentle pressure to each portion of the colon in turn, pushing down and in the direction of flow.

Gastro-colic stimulation Stimulates mass movement toward rectum	o Give 200ml water or feed enterally 15 – 30 minutes before starting bowel care. o If the patient is bolus fed, time bowel care for 15-30 minutes after feeding.

Digital rectal stimulation Stimulates reflex bowel activity	o Preparation as for DRE o Inform the patient you are about to begin. o Insert a lubricated double-gloved finger gently into the rectum. o Slowly rotate the finger in a circular movement, keeping the pad of the finger in gentle contact with the rectal mucosa. o Continue until – - the external sphincter relaxes - stool or flatus is passed - the internal sphincter constricts o This typically takes 15 – 20 seconds o Remove the finger to allow reflex activity to happen o Repeat every 5 – 10 minutes until evacuation is complete (no further stool is passed or felt in the rectum.

If a patient with active bowel sounds does not pass stool for more than 72 hours after the start of enteral feeding despite active bowel care, or if the abdomen is distended, consider an abdominal x-ray.

Bowel Sounds NOT present

Paralytic ileus is common during the first 48 hours following SCI. The aims of active bowel management in this phase are 1) to assess anal sphincter function and 2) to keep the rectum clear of stool.

- Nil enterally
- Twice daily assessment for return of bowel sounds.
- Daily digital rectal examination / digital removal of faeces.

<table>
<tr><td>Preparation</td><td colspan="3">o If possible, explain procedure and obtain consent.
o Ensure privacy.
o The patient should be lying on his left side. The procedure should be timed to coincide with the turning schedule.
o Ensure all necessary equipment is to hand</td></tr>
<tr><td>DRE</td><td colspan="3">▪ Inspect the peri-anal region for faecal smearing and for skin integrity.
▪ Inform the patient you are about to begin
▪ Insert a lubricated double-gloved finger gently into the rectum.
▪ Ask the patient to say if he can feel anything.</td></tr>
<tr><td rowspan="3">Digital removal of faeces</td><td colspan="3">Is stool present?</td></tr>
<tr><td>Yes – soft stool</td><td>Yes – hard stool</td><td>No</td></tr>
<tr><td>Use the finger gently to break up the stool and remove small sections until no more can be felt. Apply more lubricant as needed.</td><td>Insert 2 glycerin suppositories or micro-enema to lubricate the stool. Leave for 20 minutes, and then proceed as for soft stool.
If stool is still too hard to break, stop the procedure and seek advice.</td><td>Withdraw the finger</td></tr>
<tr><td></td><td colspan="3">o Clean and dry the patient's skin thoroughly. Document the procedure thoroughly.</td></tr>
</table>

Management of a Traumatic spinal Patient

Neurological

- Ensure 2 hourly full spinal assessment if patient is conscious)if unsure how to complete spinal assessment please see video
  - https://www.youtube.com/watch?v=kRAdWRmR9rY

Airway

- Check neck for any swelling
- When securing the airway maintain manual inline Stabilisation
  - Use of a fibrotic scope is not recommended

Breathing

- Measure Patients Vital Capacity (Vc) once every shift (if unsure how to do this please liaise with the physiotherapists) *if Vc < 15ml/kg please refer this to the anaesthetist urgently
- Check patient for signs of respiratory fatigue Some spinal patients breath better when lying flat
- Consider the use of the cough Assist and/or BiBPAP for lesions above T11
- Consider ventilation if RR > 30 b/min or VC <15ml/kg

Once Patient is ready to weane from the ventilator the given an individual weaning plan, **DO NOT** deviate from this plan unless you are directed to by neuro anaesthetic consultant

Neurogenic pulmonary odeama can be present in high cervical spinal cord injuries

Suxamethonium can be used up to 48 hours post-injury. After this time it can cause life threatening hyperkalaemia

Haemodynamic management

Spinal injury causes hypotension (neurogenic shock), bradycardia (T6 and above) and poikilothermia)

- Hypotension may be due to combination of blood loss and vasodilation
  so a central venous catheter would be helpful.
- Exclude other injuries that can cause hypotension. A combination of fluid resuscitation and vasonstrictors may be needed. The use of LiDCo is helpful and is recommended.

Aim for MAP ~ 80- 90mmHg.

- Increased vagal activity may cause bradycardia (often triggered by airway manipulation):
- Pre-oxygenation and atropine are useful preventative measures.

Gastrointestinal management

- Paralytic ileus is common.
- The incidence of aspiration may be as high as 35%
- Insert a Naso/orogastric tube within 4 hours from admission. (See Spinal Admission quick guide
    - Establish feeding slowly with the addition of pro-kinetics as needed.
    - PPI is mandatory.

Bladder and Bowel Management

- Monitor urine output hourly aim for euvolaemia unless instructed otherwise instructed
- Follow Bowel care quick guide for bowel management

DVT prophylaxis

- Prescribe DVT prophylaxis as per guidelines.
- Apply mechanical protection early if not contraindicated.

Positioning

- Ensure Patient is rolled every 4 hours and if spine has not been documented as clear ensure the patient is log rolled
- If possible lie patient on their side where possible whilst keep spine in alignment (if unsure how to do this please see log roll video)
- Ensure passive limb movement are performed when turning to prevent contracted limbs, if you limbs are becoming contracted liase with physios and OT.
    - https://youtu.be/C04my6p6Q80If
- pt has a Miami J collar full skin check and a log roll out of the collar must be done once per shift

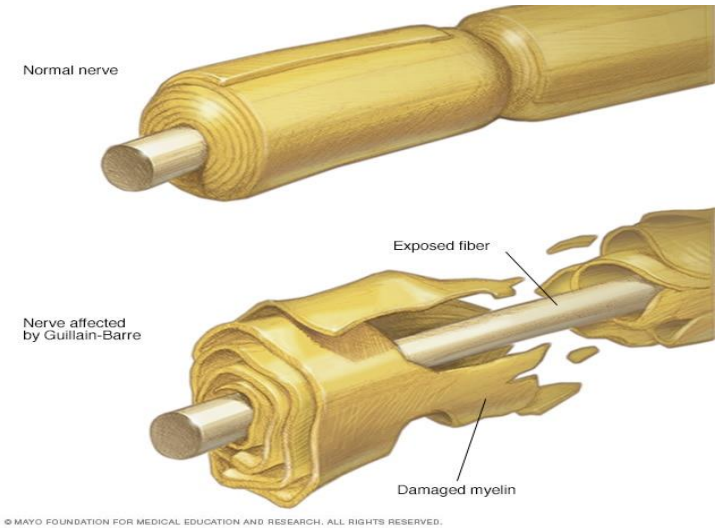
Psychological Care

- This Client group as extremely and understandably prone to anxiety and depression this can dramatically hinder their recovery
- They need a lot of time and reassurance

Guillain-Barré Syndrome – Quick Guide

Definition:

- A disorder in which the body's immune system attacks parts of the peripheral nervous system resulting in generalised flaccid paralysis (in an ascending and symmetrical pattern – feet to face)
- It can often be the result of an infection or occasionally following a vaccination – it is not fully understood why this occurs
- It is not contagious, can affect people of any age, has an acute onset with rapid progression and can be potentially life threatening
- The immune system destroys the myelin sheath surrounding axons of peripheral nerves, preventing effective transmission of signals ie. loss of sensory and motor function

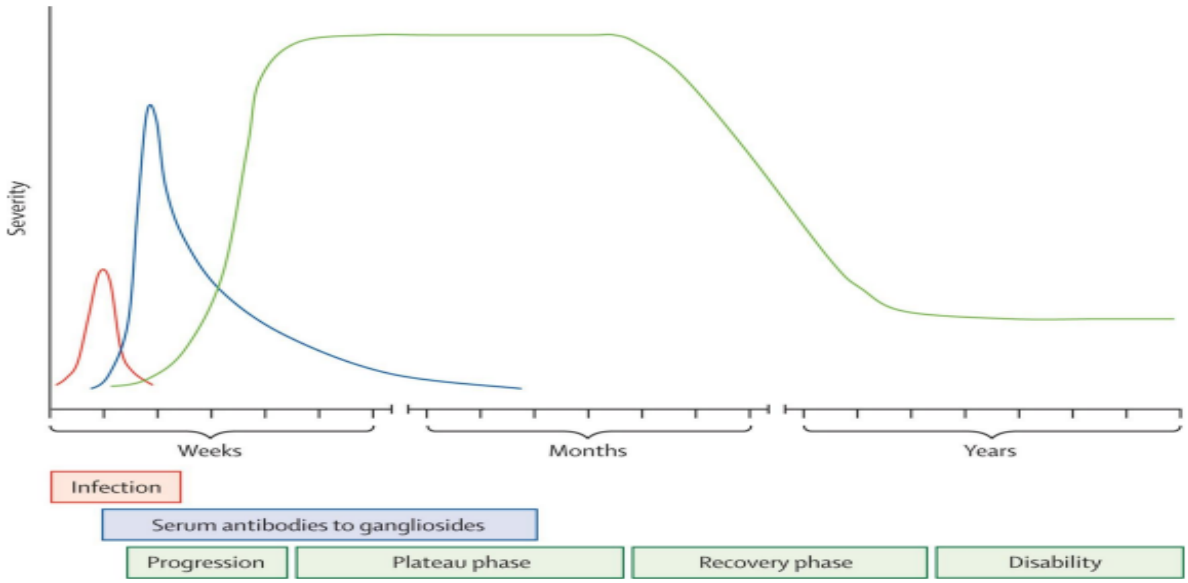


Diagnosis & investigation:

- Exclude other causes of progressive weakness – is it symmetrical?
- EMG studies – reduced nerve conduction
- Lumbar puncture LP – raised protein count (>0.5g/L) with normal cell count
- Lack of cranial/spinal reflexes

Prognosis & treatment:

- Within 24-72 hrs the disease can progress up to quadriparesis and respiratory paralysis with max. neurological deficit occurring by 2-3 weeks from onset
- Recovery occurs over weeks-months but can be up to a year – require ongoing rehabilitation after hospital stay
- 80% make fully recovery, 20% will be left with lasting disability
- Approx. 5-8% mortality from complications including respiratory failure, sepsis, PEs and other co-morbidities
- Those patients who go into respiratory failure – 10% are left severely disabled
- Treatments shown to improve recovery are 5 day course of Intravenous Immunoglobulin (IVIg) when first diagnosed, often followed by Plasmapharesis (Plasma Exchange) daily for 4-5 days (may require an additional course if suffer a relapse)



Nursing Considerations:

Airway & Breathing:

- If weakness spreads to cranial nerves (specifically bulbar function) patients are at serious risk of aspiration/airway problems so will require intubation & ventilation
- When assessing breathing in early stages, do NOT wait for respiratory decompensation – electively intubate if showing signs of respiratory distress
- BD-TDS Vital Capacity (VC) measurements can help detect breathing deterioration – VCs < 15ml/kg or < 1L require intubation

GBS QUICK GUIDE PART 2

- GBS patients normally require tracheostomy where rapid onset occurred once in recovery phase - prolonged weaning usually required while respiratory muscles recover: usually 3-4 weeks post onset
- Weaning process involves whole MDT but initiation/planning often orchestrated by doctors, physios and SLT then administrated by nursing and physio staff
- Progression of respiratory weaning will normally involve –
    1. PSIMV to PS (fully mandatory to spontaneous ventilation mode)
    2. PS to CPAP (high/medium level ventilatory support to PEEP only)
    3. VFB (Ventilator Free Breathing) sprints increasing in time with PS in between and overnight to rest (put onto trache mask with humidified O2. MUST go onto PS not CPAP to allow proper rest in between sprints to prevent decompensation)
    4. Continuous VFB on trache mask down to trache bib
    5. Decannulation
- Cuff deflation and speaking valve sessions usually occur between stages 2-5 and led by SLTs - speaking valve can be placed over trache when on trache mask or used in-line with ventilator circuit but cuff MUST be deflated before applying speaking valve! (when using valve in ventilator circuit, a non-invasive ventilator setting is usually required to prevent ventilator alarming)
- These patients will require careful respiratory management with daily (or even twice daily) chest physio sessions with additional chest physio on every turn
- With the loss of/weakness in chest wall muscles, they require deep breaths to prevent atelectasis and with the loss of diaphragm and often abdominal muscle movement, they require manually assisted coughs. NiPPY Clearway cough-assist machines are, therefore, used frequently. These will be set up by physios but can be used pre/post turning to aid secretion clearance

Cardiovascular:

- Impaired baroreceptor buffering can cause rapid fluctuation between hypotension & hypertension in GBS patients
- Avoid using beta blockers in hypotension as can increase risk of cardiac arrest. Instead, treat with fluid boluses and head down position
- Cardiac arrhythmias often occur during procedures such as intubation and suctioning (these include sinus bradycardia, VT and AV block) – ALL GBS patients must have glycopyrronium syringe and atropine minjet in an easily-accessible place at bedspace

Neurological:

- Once diagnosis of GBS made, neurological observations can be done 6-12 hourly – DO NOT apply painful stimulus even if ventilated and fully paralysed in the acute onset phase
- On-going motor/sensory function and cranial nerve function tests usually done on doctors' daily assessment and monitored by Physio team

Pain management:

- Patients can suffer from severe neuropathic pain from onset and continuing throughout their hospital stay – they must be started on regular anti-epileptic agents used for neuropathic pain (eg. Gabapentin, Pregabalin) soon after admission, in addition to regular Paracetamol, NSAIDs and opiates
- Can also be started on nightly tricyclic antidepressant (such as Amitryptyline) used for neuropathic pain

Nutrition & Elimination:

- If loss of bulbar function then will need NG feeding until this returns. Progression to eating and drinking will be orchestrated and monitored by SLT – this must be supervised closely by nursing staff due to high risk of aspiration and respiratory compensation
- Paralytic ileus can occur in these patients so 4-6 hrly GRV measurements must be done when on NG feeding. Report any GRV > 500ml to doctor and inform dietician – may require free gastric drainage, pro-kinetics and intra-abdominal pressure monitoring if severe
- Strict fluid balance – maintain euvolaemia
- All GBS patients should be on regular laxatives and softeners (Senna & Docusate) with additional aperients if BNO > 3 days

GBS QUICK GUIDE PART 3

Hygiene & Skin:

- With loss of movement GBS patients are at high risk for pressure damage to skin – strict 3-4 hourly turning in bed with monitoring of at-risk areas (heels, sacrum, elbows + NGTs, ETTs and catheters)
- VTE prophylaxis – Flotrons and LMWH usually but can switch to TED stockings at night if patient not tolerating
- Regular limb movement exercises to maintain range of movement and flexibility (started by physios but can be taught to visiting family and nursing staff)
- Resting foot splints to be used during day (2hrs alternating legs) to prevent foot drop and hand/arm splints to be applied as per OT advice
- Massage therapy is often well-received by GBS patients and can be organised through an external company (full circle)

Psychosocial:

- The inability to move means GBS patients can really struggle to sleep; affecting their ability to take part in rehab and can result in severe delirium and PTSD – important to establish routine with patient (when they wish to be washed, positions they prefer to sleep in, skin care routine and any methods to aid sleep such as music, podcasts, essential oils)
- GBS patients can get very frustrated with trying to communicate – weakness in the face can mean small gestures like nodding, grimacing, eyebrow raising can cause tiredness quickly so frequent input from SLT is essential to optimise communication
- Lack of communication and movement often results in patients feeling depressed, anxious, helpless and isolated – try to facilitate communication as much as possible and involve neuropsychiatry if concerned

BLANK PAGE

Miscellaneous Neurological Conditions

Myasthenia Gravis:

- Autoimmune condition where immune system attacks neuromuscular synapses causing muscle weakness and muscle fatigue
- Symptoms include drooping eyelids/visual disturbances, arm/leg/neck weakness and weakness in the face associated with difficulty chewing and swallowing
- Diagnosed by antibody tests and EMG

  Important nursing considerations:
- Ensure pyridostigmine doses given on time **(Handle with gloves and Visor DO NOT handle if pregnant)**
- Monitor closely for fatigue when talking, eating/drinking and ensure patient gets adequate time to rest
- There are many drugs that must be avoided with MG patients MG – see list below

Antibiotics & Antimalarials	Beta - Blockers	Other Heart Drugs	Drugs Used In Neurology & Psychiatry
Acrosoxacin	Acebutolol	Procainamide	Chlorpromazine
Amikacin	Atenolol	Quinidine	Clozapine
Azithromycin	Betaxolol		Flupenthixol
Cinoxacin	Bisoprolol		Isocarboxacid
Ciprofloxacin	Carvedilol		Lithium
Chloroquine	Celiprolol		Loxapine
Doxycycline	Esmolol		Methotrimeprazine
Erythromycin	Labetolol		Oxypertine
Gentamicin	Metoprolol		Pericyazine
Hydroxychloroquine	Nadolol		Perphenazine
Kanamicin	Oxprenolol		Phenelzine
Levofloxacin	Pindolol		Pimozine
Lymecycline	Propranolol		Prochlorperazine
Minocycline	Sotalol		Promzine
Naladixic Acid	Timolol		Phenytoin
Netilmicin			Risperidone
Norfloxacin			Sulpiride
Ofloxacin			Thioridazine
Oxytetracycline			Tranylcypromide
Streptomycin			Trifluoroperzaine
Telithromycin			Zuclopenthixol
Tetracycline			
Tobramycin			

Telithromycin MUST be avoided as has caused deaths in MG patients

Magnesium should not be given to these patients as it can worsen breathing

Encephalitis:

- Inflammation and swelling of the brain parenchyma, often caused by an infection
- Clinical symptoms include headache, confusion, agitation and pyrexia with differing symptoms depending on the area affected – these can include behavioural changes, focal seizures, dysphasia, hemiparesis, hallucinations/double vision and reduced consciousness
- Diagnosed by MRI scan, EEG and lumbar puncture (high opening pressure, low glucose and high protein levels in CSF)
- Treatment – Aciclovir (antibiotics can be prescribed if bacterial cause found in CSF/blood cultures), Levetiracetam to prevent seizures, sedatives (either if patient requires ventilation or to reduced restlessness/irritability) and Paracetamol to reduced temperature

Nursing management:

- Maintain adequate oxygenation (spO2 > 97%, PaO2 > 10kPa)
- Maintain euvolaemia
- Close neurological monitoring in acute phase – watch for signs of raised ICP (Hypertension with widened pulse pressures, bradycardia, bradypnoea with reduced GCS, nausea/vomiting and pupil changes)
- Ensure adequate pain relief – Paracetamol for temperature and opiates PRN (can also darken room to help relieve headache)
- Maintain adequate nutrition and ensure regular bowel motions with BD laxatives
- Ensure good mouthcare and regular repositioning in bed
- Reorient patient as much as possible if confused/delirious

Motor Neurone Disease:

- Motor Neurone Disease or Amyotrophic Lateral Sclerosis (MND or ALS) is a neurodegenerative condition causing progressive muscle weakness
- Loss of respiratory muscle use and ineffective cough can require ICU admission for non-invasive ventilation or even invasive ventilation and tracheostomy

Nursing considerations:

- Due to its degenerative nature, the decision to use NIV and/or IV must be a consultant-led decision involving the patient's wishes as much as possible
- Patients may have issues communicating so ensure SLT are involved to help facilitate good communication
- Loss of bulbar function can cause swallowing difficulties – **watch carefully for signs of aspiration and inform SLT if seen!**
- Patients can suffer from severe pain and spasticity so ensure adequate pain relief

Baclofen, dantrolene and gabapentin can be effect in MND for this.

NEURO VIDEOS

For Videos on

- Collar care
- Log rolling
- Spinal Assessment
- GCS
- Pupil Assessment

Please scan here