ICU Management of Subarachnoid Haemorrhage

Sandra Fairley
Senior Nurse in Neurocritical Care
sandra.fairley@uclh.nhs.uk
More poor grade SAH patients admitted to ICU

Guidelines

Recognised lack of guidance on the ICU management of aneurysmal SAH patients

2011 consensus guidelines from expert group

Critical Care Management of Patients Following Aneurysmal Subarachnoid Hemorrhage: Recommendations from the Neurocritical Care Society’s Multidisciplinary Consensus Conference

Stroke: Journal of the American Heart Association

Guidelines for the Management of Aneurysmal Subarachnoid Hemorrhage: A Statement for Healthcare Professionals From a Special Writing Group of the Stroke Council, American Heart Association

Coil embolisation of ruptured intracranial aneurysms

Understanding NICE guidance – Information for people considering the procedure, and for the public
Consensus Guidelines

Key areas that might improve outcome

- Medical measures to prevent rebleeding
- Seizures and prophylactic anticonvulsants
- Deep vein thrombosis prophylaxis
- Management of hyponatraemia
- Management of delayed cerebral ischaemia
Medical measures to prevent rebleeding

2 strong recommendations

1. Early aneurysm repair
2. Blood pressure control
Early identification of SAH
Prompt transfer to a neurosurgical centre
Prompt management thereafter
Medical measures to prevent rebleeding

2 strong recommendations

1. Early aneurysm repair

This requires a transfer and management pathway
**Subarachnoid Haemorrhage (SAH)**

**Admission and Management Pathway**

- **Referral to NHNN**
  - Neurosurgical SpR
  - Referral accepted
  - Confirm requirement for ward or intensive care bed
  - London Ambulance Service "Critical transfer"

- **Transfer to NHNN**
  - **NHNN Surgical ward**
    - Patient stable
  - **NHNN HDU**
    - If patient requires level 2 care or if no ward bed available
  - **Surgical Intensive Care Unit**
    - Patient intubated, sedated

- **NHNN Radiology**
  - 4/6 vessel angiography
  - Post procedure patient will return to clinical area appropriate to angiography findings and treatment given
  - Ward Patient
  - HDU Patient
  - SITU Patient

**Expert guidance to referring unit**

- **Angiography +/- proceed to definitive treatment within 24 hours of admission to NHNN**
  - (If patient medically fit for intervention)

- **Nimodipine**
  - 60mg / 4 hourly PO or NG
  - Commenced as soon as SAH diagnosed and continued for 21 days
  - If hypotension occurs give 30mg / 2 hourly
  - If not absorbing give IV via dedicated lumen on central line (run concurrently with 0.9% saline 40ml/hr)

- **ECG changes** associated with SAH
  - ST segment depression
  - Bundle branch block
  - Sinus arrhythmias
  - MI must be excluded
  - in acute phase pharmacological management of ECG abnormalities should be implemented with care

---

**Acute Management and Referral of Adults with Subarachnoid Haemorrhage (SAH)**

**GCS**

- **GCS 3 or falling**
  - All patients must be reviewed by a member of the admitting medical or surgical team
  - (see 'Guidelines for anaesthesia considering short acting agent (e.g. Labetalol)

**Neurological observations**

- GCS
  - Motor deficit
  - +
  - Set BP target
  - 15
  - May need to give 30mg 2 hrly

**Drug therapy**

- Nimodipine 60mg 4 hourly
- +/- arterial line
- Routine bloods including eGFR
- 12 lead ECG**
- Bed rest
- Surgical team book angiography

**Situations**

- Blood pressure normal BP for patient
  - Give 100mls Colloid and 2
  - 5

**Surgical team book angiography**

- 2
- Initially with fluids
- Minimum +/
- NIC of receiving ward
- Present or absent improvement

**hypertension**

- Treat hypertension
- Cardiac abnormalities are common in acute phase pharmacological management of ECG abnormalities should be implemented with care

**Angiography**

- +/– proceed to definitive treatment within 24 hours of admission to NHNN
  - (If patient medically fit for intervention)

**Guidelines for anaesthesia considering short acting agent (e.g. Labetalol)**

- Large bore peripheral cannula
- Short acting muscle relaxants
- Propofol & Fentanyl infusions
- Must be used with caution, avoid surges

**THE NATIONAL HOSPITAL FOR NEUROLOGY AND NEUROSURGERY**

Post-care instructions for interventional neuroradiology

- This must include a review of the post-care instructions (in particular point 7).

---

**Localisation to pain**

- Abnormal flexion to pain
- Contraindicated

**Abnormalities**

- None
- Spontaneous
- Reassess

---

**THE NATIONAL HOSPITAL FOR NEUROLOGY AND NEUROSURGERY**

- Name
- Signature
- Date

---

**Environment**

- Confirm requirement for ward or intensive care bed

---

**SITU admission**

- Referral accepted
- Referral to NHNN

---

**SITU**

- Recovery
- HDU
  - 24hrs
  - Patient – ve angio
  - ve or +ve angio
  - Rx

---

**Lumbar puncture**

- Only used when CT confirm

---

**Anticoagulants**

- Contraindicated

---

**Spinal CSF**

- None
- Spontaneous

---

**Exercise**

- Do not give NSAIDs

---

**Ultrasound imaging**

- Cardiac abnormalities are common in acute phase pharmacological management of ECG abnormalities should be implemented with care

---

**Radiology**

- Angiography
  - “Reopro” given intra
  - Normal
  - Abnormal

---

**Critical care**

- Must be excluded
- In acute phase pharmacological management of ECG abnormalities should be implemented with care

---

**National Transport**

- Levels
  - 1
  - 2
  - 3

---

**Intensive Care Unit**

- 4/6 vessel angiography
  - Post procedure patient will return to clinical area appropriate to angiography findings and treatment given

---

**Ward**

- Recovery
  - HDU
  - 24hrs
  - Patient – ve angio
  - ve or +ve angio
  - Rx

---

**Emergencies**

- Referral accepted
- Referral to NHNN

---

**Clinical**

- Bed rest if BM < 4mmol/l
- Present or absent improvement

---

**GCS**

- Motor deficit
- +
- Set BP target
- 15
- May need to give 30mg 2 hrly

---

**Cardiac abnormalities**

- Cardiac abnormalities are common in acute phase pharmacological management of ECG abnormalities should be implemented with care

---

**Ventilator**

- Must be excluded
- In acute phase pharmacological management of ECG abnormalities should be implemented with care
Immediate management

BP / fluid management

Referral process
Immediate management

- Neurosurgical SpR
- Referral accepted
- Confirm requirement for ward or intensive care bed
- London Ambulance Service: Critical transfer

Key principles of management are the same whichever clinical area the patient is in

Transfer to NHNN Surgical ward

- Patient stable requiring level 1 care
- Minimum 2 hourly neurological observations and vital signs
- IV fluids
- Nimodipine 60mg 4 hourly
- Routine bloods including eGFR
- 12 lead ECG$

- Bed rest
- Surgical team book angiography

Investigation, treatment and post-treatment care

- NHNN HDU
- Patient intubated, sedated and ventilated
- Requires level 3 care
- Pupil assessment 1 hourly
- 1 hourly vital signs – set BP target
- Arterial line central line
- IV fluids
- Nimodipine 60mg 4 hourly
- 12 lead ECG$

- Bed rest
- Surgical team book angiography

Angiography + treatment within 24 hours

- NHNN Radiology
- Neurosurgical referral

Nimodipine

60mg / 4 hourly PO or NG
Commenced as soon as SAH diagnosed
and continued for 21 days

If hypotension occurs give 30mg / 2 hourly
If not absorbing give IV via dedicated lumen on central line (run concurrently with 0.9% saline 40ml/hr)

**ECG changes associated with SAH

- ST segment depression
- Bundle branch block
- Sinus arrhythmias

Ml must be excluded in acute phase pharmacological management of ECG abnormalities should be implemented with care

Post procedure patient will return to clinical area appropriate to angiography findings and treatment given
2. Blood pressure control

Treat extreme hypertension if unprotected, recently ruptured aneurysm
Moderate elevations in BP do not require therapy (*mean BP <110mmHg*)
Pre-morbid baseline BP should be used to set targets
Hypotension should be avoided
Phenytoin should **not** be used for routine prophylaxis.

Other anticonvulsants can be considered -if so, give short course of 3-7 days

*Levetiracetam recommended*

If patient does have a seizure then local practice should determine the duration of anticonvulsant treatment.
Deep vein thrombosis prophylaxis

Strong recommendation

Measures to prevent DVT should be used in all patients with SAH

Sequential compression device

Withhold LMWH or unfractionated heparin if aneurysm unprotected and 24 hours pre and post surgical procedure
Fluid restriction should not be used to treat hyponatraemia. Mild hypertonic solutions can be used. Free water intake via IV and enteral routes should be limited.
HYPERNATRAEMIA

Hypernatraemia may be due to dehydratio (secondary to use of osmotic agents for ICP control). Diabetes insipidus (seen in severe TBI or major cerebral insult due to gross generalised brain swelling), Pituitary dysfunction (transphenoidal surgery/craniopharyngioma - these patients usually require input from endocrinology team) or may be seen in patients who are brain stem dead.

Diabetes insipidus leads to rapid fluid & electrolyte depletion and should be treated promptly once diagnosis is established on clinical findings and confirmed by laboratory results.

Consider treating serum sodium >155mmol/l

Consider treating serum sodium ≤130mmol/l

DIABETES INSIPIDUS

DEHYDRATION

Signs
Low CVP (<5mmHg)
High urine output (>1000ml in 4hr*)

Signs
Low CVP (<5mmHg)
Low urine output (<0.5ml/kg/hr)

SIADH

Syndrome of inappropriate antidiuretic hormone (SIADH)

Management of Sodium and Water Balance

HYPERNATRAEMIA

2 main causes of hyponatraemia - Syndrome of inappropriate antiidiuretic hormone (SIADH) and cerebral salt wasting (CSW) (Na+ levels of <125mmol can cause nausea, anorexia, emesis, confusion, obtundation and seizures)

Accurate diagnosis based on clinical findings (importantly volume status) and laboratory results essential as treatment markedly different

Treatment
AIM TO REPLACE SODIUM AND WATER WITH SODIUM CONTAINING ISOTONIC FLUIDS

In severe cases consider HYPERTONIC SALINE (1.8%) for 24-48 hours via central venous line to increase sodium concentration by maximum 6-10mmol in 24 hours

(Hourly rise not >2mmol/l unless Na+ consistently low)

(1.8% saline can be given peripherally but IV site must be closely monitored – not recommended if treatment required for > 48hrs)

The rate of infusion should be prescribed for each patient individually and hourly / daily target rise in Na+ set

Hypertonic saline usually started at around 30-40ml/hr

Once daily target achieved hypertonic saline should be stopped

(Rapid increase or decrease can cause myelinolysis)

CSW

Fluid and Na+ depletion

Signs
Low CVP
High urine output
Normal specific gravity
Normal urinary osmolarity (<280mmol/kg)

Variable urine osmolarity

High urinary sodium (>60mmol/l)

Treatment
AIM TO RESTRICT INTAKE OF WATER

FLUID RESTRICTION

Dependent on individual patient requirements consider risks in patients with SAH

Restriction to 1.5 litres is usually sufficient

(Rapid increase or decrease can cause myelinolysis)

In SAH patient with low Na+

assume CSW until sure of diagnosis of SIADH because of consequences of fluid restriction

Hypertonic saline may be required in severe cases but seek senior advice

HYPERSONATREMIA

Consider treating serum sodium >155mmol/l

Consideing treating serum sodium ≤130mmol/l

DIABETES INSIPIDUS

DEHYDRATION

Signs
Low CVP (<5mmHg)
High urine output (>1000ml in 4hr*)

Signs
Low CVP (<5mmHg)
Low urine output (<0.5ml/kg/hr)

SIADH

Syndrome of inappropriate antidiuretic hormone (SIADH)

Management of Sodium and Water Balance

HYPERNATRAEMIA

2 main causes of hyponatraemia - Syndrome of inappropriate antiidiuretic hormone (SIADH) and cerebral salt wasting (CSW) (Na+ levels of <125mmol can cause nausea, anorexia, emesis, confusion, obtundation and seizures)

Accurate diagnosis based on clinical findings (importantly volume status) and laboratory results essential as treatment markedly different

Treatment
AIM TO REPLACE SODIUM AND WATER WITH SODIUM CONTAINING ISOTONIC FLUIDS

In severe cases consider HYPERTONIC SALINE (1.8%) for 24-48 hours via central venous line to increase sodium concentration by maximum 6-10mmol in 24 hours

(Hourly rise not >2mmol/l unless Na+ consistently low)

(1.8% saline can be given peripherally but IV site must be closely monitored – not recommended if treatment required for > 48hrs)

The rate of infusion should be prescribed for each patient individually and hourly / daily target rise in Na+ set

Hypertonic saline usually started at around 30-40ml/hr

Once daily target achieved hypertonic saline should be stopped

(Rapid increase or decrease can cause myelinolysis)

CSW

Fluid and Na+ depletion

Signs
Low CVP
High urine output
Normal specific gravity
Normal urinary osmolarity (<280mmol/kg)

Variable urine osmolarity

High urinary sodium (>60mmol/l)

Treatment
AIM TO RESTRICT INTAKE OF WATER

FLUID RESTRICTION

Dependent on individual patient requirements consider risks in patients with SAH

Restriction to 1.5 litres is usually sufficient

(Rapid increase or decrease can cause myelinolysis)

In SAH patient with low Na+

assume CSW until sure of diagnosis of SIADH because of consequences of fluid restriction

Hypertonic saline may be required in severe cases but seek senior advice

HYPERSONATREMIA

Consider treating serum sodium >155mmol/l

Consideing treating serum sodium ≤130mmol/l

DIABETES INSIPIDUS

DEHYDRATION

Signs
Low CVP (<5mmHg)
High urine output (>1000ml in 4hr*)

Signs
Low CVP (<5mmHg)
Low urine output (<0.5ml/kg/hr)

SIADH

Syndrome of inappropriate antidiuretic hormone (SIADH)

Management of Sodium and Water Balance

HYPERNATRAEMIA

2 main causes of hyponatraemia - Syndrome of inappropriate antiidiuretic hormone (SIADH) and cerebral salt wasting (CSW) (Na+ levels of <125mmol can cause nausea, anorexia, emesis, confusion, obtundation and seizures)

Accurate diagnosis based on clinical findings (importantly volume status) and laboratory results essential as treatment markedly different

Treatment
AIM TO REPLACE SODIUM AND WATER WITH SODIUM CONTAINING ISOTONIC FLUIDS

In severe cases consider HYPERTONIC SALINE (1.8%) for 24-48 hours via central venous line to increase sodium concentration by maximum 6-10mmol in 24 hours

(Hourly rise not >2mmol/l unless Na+ consistently low)

(1.8% saline can be given peripherally but IV site must be closely monitored – not recommended if treatment required for > 48hrs)

The rate of infusion should be prescribed for each patient individually and hourly / daily target rise in Na+ set

Hypertonic saline usually started at around 30-40ml/hr

Once daily target achieved hypertonic saline should be stopped

(Rapid increase or decrease can cause myelinolysis)

CSW

Fluid and Na+ depletion

Signs
Low CVP
High urine output
Normal specific gravity
Normal urinary osmolarity (<280mmol/kg)

Variable urine osmolarity

High urinary sodium (>60mmol/l)

Treatment
AIM TO RESTRICT INTAKE OF WATER

FLUID RESTRICTION

Dependent on individual patient requirements consider risks in patients with SAH

Restriction to 1.5 litres is usually sufficient

(Rapid increase or decrease can cause myelinolysis)

In SAH patient with low Na+

assume CSW until sure of diagnosis of SIADH because of consequences of fluid restriction

Hypertonic saline may be required in severe cases but seek senior advice

HYPERSONATREMIA

Consider treating serum sodium >155mmol/l

Consideing treating serum sodium ≤130mmol/l

DIABETES INSIPIDUS

DEHYDRATION

Signs
Low CVP (<5mmHg)
High urine output (>1000ml in 4hr*)

Signs
Low CVP (<5mmHg)
Low urine output (<0.5ml/kg/hr)

SIADH

Syndrome of inappropriate antidiuretic hormone (SIADH)

Management of Sodium and Water Balance

HYPERNATRAEMIA

2 main causes of hyponatraemia - Syndrome of inappropriate antiidiuretic hormone (SIADH) and cerebral salt wasting (CSW) (Na+ levels of <125mmol can cause nausea, anorexia, emesis, confusion, obtundation and seizures)

Accurate diagnosis based on clinical findings (importantly volume status) and laboratory results essential as treatment markedly different

Treatment
AIM TO REPLACE SODIUM AND WATER WITH SODIUM CONTAINING ISOTONIC FLUIDS

In severe cases consider HYPERTONIC SALINE (1.8%) for 24-48 hours via central venous line to increase sodium concentration by maximum 6-10mmol in 24 hours

(Hourly rise not >2mmol/l unless Na+ consistently low)

(1.8% saline can be given peripherally but IV site must be closely monitored – not recommended if treatment required for > 48hrs)

The rate of infusion should be prescribed for each patient individually and hourly / daily target rise in Na+ set

Hypertonic saline usually started at around 30-40ml/hr

Once daily target achieved hypertonic saline should be stopped

(Rapid increase or decrease can cause myelinolysis)
Management Protocol for Patient with Aneurysmal Subarachnoid Haemorrhage

**NEUROLOGY**

**Neurological Assessment**
- Minimum 2 hourly GCS, pupil and limb assessments
- Monitor for subtle signs e.g. arm drift
- Report any changes according to Adverse Clinical Signs protocol

**VITAL SIGNS**

**Heart rate**

**Blood pressure**
- 12 Lead ECG on admission
- Possible ECG changes after SAH – ST segment depression, – bundle branch block – sinus arrhythmias – MI must be excluded.
- In acute phase pharmacological management of ECG abnormalities should be implemented with care

**Blood Pressure**
- Set BP parameters
- Use ‘normal’ BP for patient as guide
- Extremes of BP should be avoided
- Untreated aneurysm
- Hypotension (SBP<120mmHg)
  – treat with fluids (0.9% saline + colloid)
  – treat with fluids
  – With IV infusion needed if IV infusion needed
- Treat sustained hypertension (SBP >160mmHg)
  – Will require transfer to HDU bed
  – If IV infusion needed

**Respiratory**
- Record respiratory rate
- Monitor SaO₂
- Oxygen therapy only if SaO₂ <95%

**Temperature**
- Paracetamol 1g qds if temperature

**Fluid therapy**
- 0.9% saline + colloid (avoid glucose)
- Oral diet and fluids if able
- If not, NG tube and feed

**Blood glucose**
- 6 - 10mmol/l
- Daily bloods
- Monitor Na⁺
- Na⁺ problems

**PREVENTING DVT**
- Preventing DVT
- Monitor fluid balance
- Aim for intake of 3litres in 24hr (consider patient requirement)

**HYDRATION AND NUTRITION**

**Blood glucose**
- 6 - 10mmol/l
- Daily bloods
- Monitor Na⁺
- Na⁺ problems

**ELIMINATION**
- Monitor urine output
- Chart bowel movements
- Prescribe regular aperients

**ANALGESIA**
- Paracetamol
- Morphine
- NSAIDs
- Not recommended prior to treatment of aneurysm but can be considered once aneurysm treated
- Anti-emetic
- Cyclizine

**PREVENTION of DVT**
- Anti-embolic stockings
- Mechanical intermittent compression device
- LMWH contra-indicated prior to treatment of aneurysm

**SEIZURE CONTROL**
- Routine prophylaxis not recommended
- Phenytoin should not be used for routine prophylaxis (due to associated cognitive effects and poor outcome)
- Other anticonvulsants can be considered
  - If so, give short course of 3-7 days (levetiracetam recommended)
- If patient does have a seizure then local practice should determine the duration of anticonvulsant treatment
Delayed cerebral ischaemia has a major impact on outcome from SAH.

The consensus guidelines make strong recommendations about preventative measures.
Critical Care Management of Patients Following Subarachnoid Hemorrhage: Recommendations from the Neurocritical Care Society’s Multidisciplinary Consensus Conference


Published online: 13 July 2011
© Springer Science+Business Media, LLC 2011

Abstract Subarachnoid hemorrhage (SAH) is an acute cerebrovascular event which can have devastating effects on the central nervous system as well as a profound impact on several other organs. SAH patients are routinely admitted to an intensive care unit and are cared for by a multidisciplinary team. A lack of high-quality data has led to numerous approaches to management and limited guidance on choosing among them. Existing guideline recommendations lack clarity, prevention, natural history, and prevention of occlusion, but provide limited discussion of the complex critical care issues involved in the care of SAH patients. The Neurocritical Care Society organized an international, multidisciplinary consensus conference on critical care issues of SAH to address these needs. Experts from neurocritical care, neurosurgery, neurology, interventional neuroradiology, and neurointerventional surgery from Europe and North America were recruited based on their publications and expertise. A body of four experienced neurointerventionists was selected for their experience in clinical investigations and development of practice guidelines. Recommendations were developed based on evidence review using the GRADE system, discussion integrating the literature with the collective experience of the participants and critical review by an impartial jury. Recommendations were developed using the GRADE system. Emphasis was placed on the principle that

- **Intravascular volume**
- **Target euvolaemia and avoid hypervolaemia therapy**
- **Isotonic crystalloid preferred**
- **If persistent negative fluid balance consider fludrocortisone or hydrocortisone**
Most important ‘H’ in ‘Triple H’ therapy is hypertension

Induced hypertension

30mg 2 hourly

If aneurysm thought to have ruptured is unsecured cautious BP elevation may be attempted

Unsecured aneurysms not thought responsible for acute SAH should not influence haemodynamic management
Critical Care Management of Patients Following Aneurysmal Subarachnoid Hemorrhage: Recommendations from the Neurocritical Care Society’s Multidisciplinary Consensus Conference


Published: 30 July 2011
© Springer Science+Business Media, LLC 2011

Abstract Subarachnoid hemorrhage (SAH) is an acute cerebrovascular event which can have devastating effects on the central nervous system as well as a profound impact on several other organs. S AH patients are routinely admitted to an intensive care unit and are cared for by a multidisciplinary team. A lack of high-quality data has led to numerous approaches to management and limited guidance on choosing among them. Existing guidelines emphasize risk factors, prevention, natural history, and prevention of embolization, but provide limited discussion of the complex medical and surgical issues involved in the care of SAH patients. The Neurocritical Care Society organized an international, multidisciplinary consensus conference on the critical care management of SAH to address this need. Experts from neurocritical care, neurosurgery, neurology, interventional neuroradiology, and neurointerventional surgery from Europe and North America were recruited based on their publications and expertise. A group of four experienced neurointerventionists was selected for their experience in clinical investigations and development of practice guidelines. Recommendations were developed based on literature review using the GRADE system, discussion integrating the literature with the collective experience of the participants and critical review by an impartial jury. Recommendations were developed using the GRADE system. Emphasis was placed on the principle that

Rescue therapy for ischaemic symptoms refractory to medical treatment should be considered.

Intra-arterial vasodilators and/or angioplasty may be considered for vasospasm related DCI.
In summary

Subarachnoid Haemorrhage (SAH) Admission and Management Pathway

Management of Sodium and Water Balance

Help clarify complex management protocols.

Thank you