

ICU Management of Subarachnoid Haemorrhage



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Guidelines

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REVIEW

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

Michael N. Diringer · Thomas P. Bleck · J. Claude Hemphill III · David Menon · Lori Shutter · Paul Vespa · Nicolas Bruder · E. Sander Connolly Jr. · Giuseppe Citerio · Daryl Gress · Daniel Hänggi · Brian L. Hoh · Giuseppe Lanzino · Peter Le Roux · Alejandro Rabinstein · Erich Schmutzhard · Nino Stocchetti · Jose I. Suarez · Miriam Treggiari · Ming-Yuan Tseng · Mervyn D. I. Vergouwen · Stefan Wolf · Gregory Zipfel

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2011 consensus guidelines from expert group

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The Organizer, Members of the Jury, and Conference participants in the International Multi-disciplinary Consensus Conference on the Critical Care Management of Subarachnoid Hemorrhage are listed in Appendix.

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Stroke

JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Stroke Association

A Division of 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

Joshua B. Bederson, E. Sander Connolly, Jr., H. Hunt Batjer, Ralph G. Dacey, Jacques E. Dion, Michael N. Diringer, John E. Duldner, Jr., Robert E. Harbaugh, Aman B. Patel and Robert H. Rosenwasser

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Coil embolisation of ruptured intracranial aneurysms

Understanding NICE guidance – information for people considering the procedure, and for the public

January 2005



Information from Interventional Procedure Guidance 106

Consensus Guidelines

Medical measures to prevent rebleeding

Seizures and prophylactic anticonvulsants

Deep vein thrombosis prophylaxis

Management of hyponatraemia

Management of delayed cerebral ischaemia

Key areas that might improve outcome

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Daniel F. Mervin ·

Erich Mervin ·

Mervin ·

Abstract
Objective
Background
Conclusion
Several

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Medical measures to prevent rebleeding

2 strong recommendations

1. Early aneurysm repair

2. Blood pressure control

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Medical measures to prevent rebleeding

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1. Early aneurysm repair

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This requires a transfer and
management pathway

SAH
S

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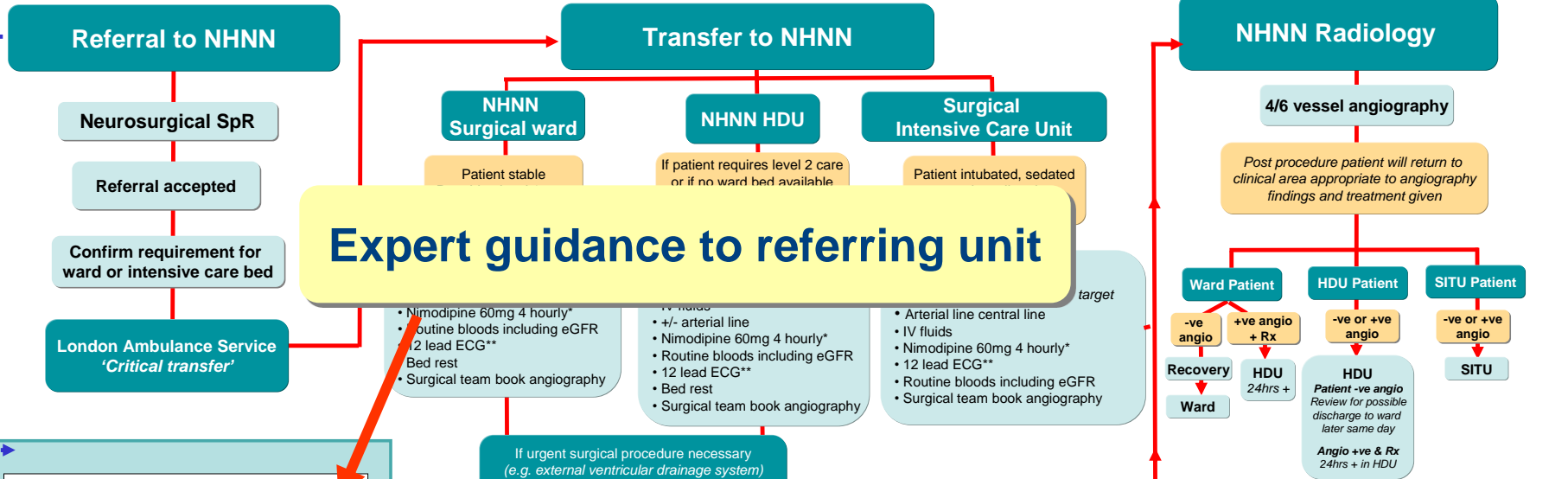
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Subarachnoid Haemorrhage (SAH) Admission and Management Pathway



Expert guidance to referring unit

- NHNN Surgical ward**
 - Nimodipine 60mg 4 hourly*
 - Routine bloods including eGFR
 - 12 lead ECG**
 - Bed rest
 - Surgical team book angiography
- NHNN HDU**
 - IV fluids
 - +/- arterial line
 - Nimodipine 60mg 4 hourly*
 - Routine bloods including eGFR
 - 12 lead ECG**
 - Bed rest
 - Surgical team book angiography
- Surgical Intensive Care Unit**
 - Arterial line central line
 - IV fluids
 - Nimodipine 60mg 4 hourly*
 - 12 lead ECG**
 - Routine bloods including eGFR
 - Surgical team book angiography

If urgent surgical procedure necessary (e.g. external ventricular drainage system) patient may require a higher level of care post-operatively

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)

SUSPECTED SAH
Sudden onset of severe headache with or without nausea & vomiting, tearing or loss of consciousness or focal neurological deficit
Is patient pregnant?

NIHSS	Modified Rankin Scale	Initial Glasgow Coma Scale	Initial pupillary response	Initial limb power	Initial limb reflex	Initial limb reflex
0	1	15	4/4	4/4	4/4	4/4
1	2	14	4/4	4/4	4/4	4/4
2	3	13	4/4	4/4	4/4	4/4
3	4	12	4/4	4/4	4/4	4/4
4	5	11	4/4	4/4	4/4	4/4
5	6	10	4/4	4/4	4/4	4/4
6	7	9	4/4	4/4	4/4	4/4
7	8	8	4/4	4/4	4/4	4/4
8	9	7	4/4	4/4	4/4	4/4
9	10	6	4/4	4/4	4/4	4/4
10	11	5	4/4	4/4	4/4	4/4
11	12	4	4/4	4/4	4/4	4/4
12	13	3	4/4	4/4	4/4	4/4
13	14	2	4/4	4/4	4/4	4/4
14	15	1	4/4	4/4	4/4	4/4
15	16	0	4/4	4/4	4/4	4/4

GCS ≤ 8 or falling

- Institute**: Rapid response activation with Susannah team. Use Fentanyl to reduce hyperreflexia response. Avoid hypotensive drugs.
- Ventilate**: P_{Fi} 0.21, PaCO₂ 5.5-5.8kPa
- Lines**: Large bore peripheral cannula. Arterial and central venous catheters.
- Sedation and Analgesia**: Propofol & Fentanyl infusions. Blood sampling (Urea/Electrolytes).
- Blood pressure**: Aim for high normal BP for patient.
- Fluid therapy**: Support BP with IV fluids.
- Medication for urgent cases**: Nimodipine 60mg 4 hourly PO or NG.
- Neurological observations**: Once stabilised & paralytic away 20 minutes.

GCS ≥ 9

- Neurological Referral**: National Hospital for Neurology & Neurosurgery (020 3456 7890).
- For transfer to SITU**: Fentanyl 500mcg, Midazolam 5mg, Propofol 100mg.
- Antibiotic Cover**: Neurological critical review.
- Blood pressure**: Aim for high normal BP for patient.
- Fluid therapy**: Support BP with IV fluids.
- Medication for urgent cases**: Nimodipine 60mg 4 hourly PO or NG.
- Neurological observations**: Once stabilised & paralytic away 20 minutes.

After Rx follow Post care instructions for interventional Radiology

THE NATIONAL HOSPITAL FOR NEUROLOGY AND NEUROSURGERY

Post-care instructions for interventional neuroradiology

- Puncture site**
 - pressure only R L
 - sealing device
- Mobilisation**
 - keep supine - 0 to 30° _____ hours
 - can then mobilise gently provided there are no contraindications
- Thromboprophylaxis / drug intervention**
 - aspirin _____ 14 days Other
 - clopidogrel _____ once only 14 days Other
 - heparin infusion - maintain APTT @ 2 x normal until reviewed by radiologists
 - heparin _____
 - abacimab (Bicoron) given intra-procedure
 - NIH to not receive any live virus (attenuated) until following reviewed
 - other _____
- Aneurysm status**
 - protected
 - unprotected
 - other _____
- Blood pressure parameters**
 - review frequently in relation to neurological status
 - if necessary request and act on CVP monitor (transcranial Doppler) (see Guidelines for essential - Neurophysiology Data)
- Neurological observations**
 - (GCS plus can patient read and write)
 - Should the patient develop any new focal neurological deficit +/- new severe headache, inform the neurologist and patient's clinical team immediately. Consider interventional radiology.
 - Consider urgent CT scan.
- Patient at particular risk of ...**
- Additional instructions**
 - Refer to 'Guidelines for post-procedural care of angiography patients'


All patients must be reviewed by a member of the admitting medical or surgical team on the day of the procedure. This must include a review of the post-care instructions (in particular point 7).

Name _____ Signature _____ Date _____

Immediate management


Referral process

BP / fluid management



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

University College London Hospitals



Airway • Breathing • Circulation • Disability • Exposure

SUSPECTED SAH

Sudden onset of severe / explosive headache with or without nausea & vomiting, collapse or loss of consciousness or focal neurological deficit

Is patient pregnant?
(Not possible to differentiate SAH and pre-eclampsia)

GCS ≤ 8 or falling

Intubate

Rapid sequence induction with Suxamethonium
Use Fentanyl to reduce hypertensive response
Insert naso-gastric tube

Ventilate

P_{ET} >13kPa
PaCO₂ 5.0-5.5kPa

Lines

Large bore peripheral cannula
Arterial and central (femoral) lines

Sedation and Analgesia

Propofol & Fentanyl infusions
Short acting muscle relaxants
Consider hypotensive effects of agents

Blood pressure

Aim for high normal BP for patient
(SBP 120-160mmHg if previously normotensive)

At hypotension initially with fluids
Use vasopressors *only* if unable to maintain BP or urine output

Treat **sustained hypertension** (SBP >180mmHg) with caution
Ensure adequate sedation and analgesia before considering short acting agent (e.g. Labetalol)

Fluid therapy

Support BP with IV fluids (0.9% Saline)
Aim for total 3 litres fluid / 24hrs
If BP ↓ give 100mls Colloid and reassess

Drug therapy

Commence Nimodipine 60mg 4hrly via NGT as soon as SAH confirmed
Beware of hypotensive effects - may need to give 30mg 2 hrly

Other

Blood sugar 5.5-9mmol/l
Glucose *only* if BM < 4mmol/l
Insert urinary catheter

Neurological Observations

Once sedated & paralysed continue pupil checks every 20 minutes

Neurosurgical Referral

National Hospital for Neurology & Neurosurgery (NHNN)

020 3456 7890 bleep 8100

For transfers to SITU

Anaesthetic SpR
NHNN
020 3456 7890 bleep 8131

Ambulance Control "Neurosurgical critical transfer"

Prior to leaving

Ensure patient stable, bring all notes, scans and x-rays
NIC of receiving ward or for SITU admission
(direct line 020 344 84706)

Indications for urgent rescan and / or discussion with neurosurgeon

Change in neurology

(deterioration or improvement)

Acute deterioration may be due to rebleed or hydrocephalus
Risk of rebleed greatest in first 24 hours
Acute hydrocephalus requires immediate neurosurgical intervention
Initial poor GCS may be due to seizure

Pupil changes

Seizures

(Treat with benzodiazepines as per local policy)

CT scan if not already done

GCS ≥ 9

GCS, pupil & limb assessment

½ hourly for 2 hours
Then 1 hourly until transfer or 1 hourly for 12 hours
Then 2 hourly thereafter if stable,
if deterioration to GCS ≤ 8 follow red pathway

Lines

Insert peripheral line

Blood pressure

Aim for high normal BP for patient
(SBP 120-160mmHg if previously normotensive)

Treat **sustained hypertension** (SBP >180mmHg) with caution
(May resolve with administration of Nimodipine)
Exclude pain or nausea as cause

Fluid therapy

Support BP with IV fluids (0.9% Saline)
Aim for total 3 litres fluid / 24hrs
If BP ↓ give 100mls Colloid and reassess

Drug therapy

Commence Nimodipine 60mg 4 hrly orally as soon as SAH confirmed
Beware of hypotensive effects - may need to give 30mg 2 hrly
If patient drowsy or nauseated insert naso-gastric tube

Analgesia and Anti-emetics

Give regular Paracetamol and if required Morphine and anti-emetics
Do not give NSAIDs

Other

Whilst awaiting transfer, patient must be on bed rest with maximum head elevation 15-30°
Anti-embolism stockings
Anticoagulants contraindicated

World Federation of Neurological Surgeons (WFNS) grading scale		
Grade	GCS	Motor deficit
1	15	Absent/Present
2	14-13	Absent
3	14-13	Present
4	12-7	Present or absent
5	6-3	Present or absent

Glasgow Coma Scale & Score	
Eye opening	
Spontaneous	4
To speech	3
To pain	2
None	1
Verbal response	
Orientated	5
Confused	4
Inappropriate words	3
Incomprehensible sounds	2
None	1
Motor Response	
Obeys commands	6
Localises to pain	5
Flexes to pain	4
Abnormal flexion to pain	3
Extension to pain	2
None	1

CONSIDERATIONS IN SAH		
Lumbar puncture is only used when CT imaging is negative but the history is suggestive of SAH		
Cardiac abnormalities are common in the acute stage and can range from asymptomatic ECG changes to significant life-threatening changes <i>MI should be excluded</i>		
NIMODIPINE IV preparation via central line if patient not absorbing		
VASOPRESSORS Must be used with caution, avoid surges in BP to reduce risk of rebleed		

SAH IN PREGNANCY Signs, symptoms & investigations for SAH and pre-eclampsia		
Signs & symptoms	SAH	Pre-eclampsia
Headache	+++	+
Loss of consciousness	++	+
Photophobia	++	+
Focal neurology	++	-
Xanthochromia on LP	++	-
Weight gain	-	++
Seizures	+	++
Epigastric pain	-	+
Thrombocytopenia	-	+
Proteinuria	+	+

References

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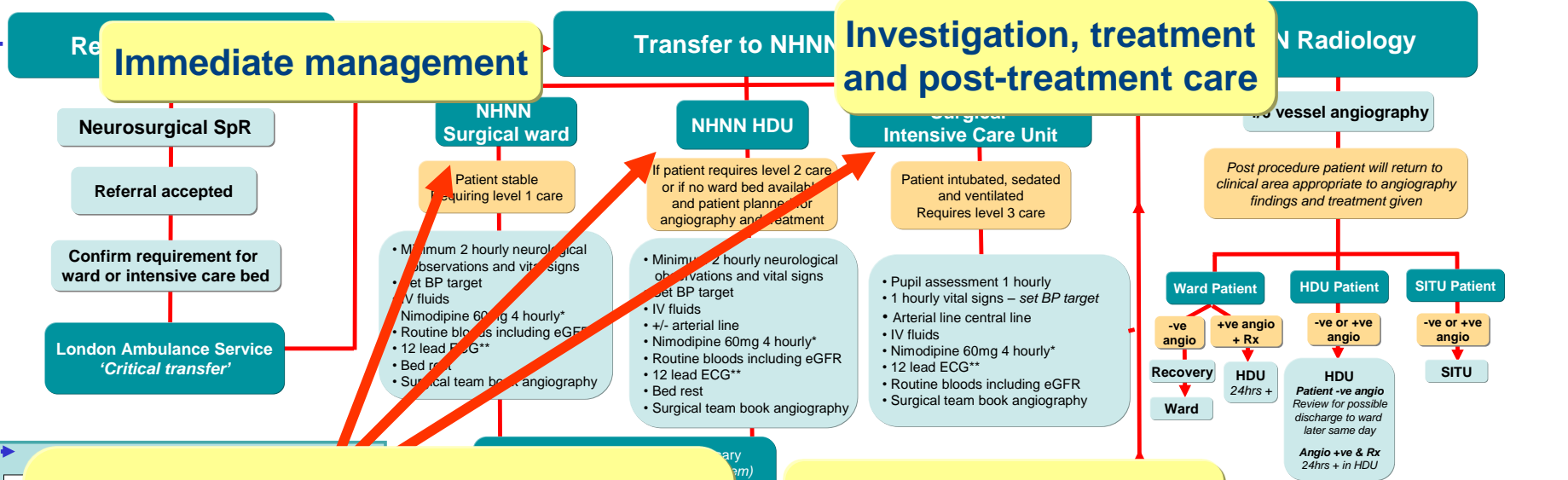
Subarachnoid Haemorrhage: Resuscitation Conference Report (2011)

Guidelines for the Management of Acute/Chronic Subarachnoid Haemorrhage. <http://www.stroke.gov.au/pubs/2008/03/04>

Neurosurgical and Neurosurgical Critical Care Multidisciplinary Team 2014



Subarachnoid Haemorrhage (SAH) Admission and Management Pathway



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

Angiography + treatment within 24 hours

***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

<p>Ventilate PaO₂ > 70kPa PaCO₂ 5.5-5.8kPa</p> <p>Lines Large bore peripheral cannula Arterial and central venous catheters</p> <p>Sedation and Analgesia Propofol & Fentanyl infusions Should be kept titrated to minimum effective doses</p> <p>Blood pressure Aim for high normal BP for patient SBP 100-130mmHg Treat hypotension only with fluids Use vasopressors only if needed Avoid SBP < 90mmHg</p> <p>Treat raised intracranial pressure (ICP > 20mmHg) with caution Head of bed up to 30° Elevate head of bed</p> <p>Fluid therapy Support BP with IV fluids (0.9% saline) Aim for total 3 litres fluid / 24hrs & BP > 90/60mmHg Avoid hypotension</p> <p>Drug therapy Commence Nimodipine 60mg 4 hourly PO or NG as soon as SAH confirmed Nimodipine 60mg 4 hourly PO or NG</p> <p>Other Blood sugar 5.5-7.8mmol/l Glucose only if BM < 4mmol/l Treat ongoing patient</p> <p>Neurological Observations Once stabilised & patient can give history every 20 minutes</p>	<p>For transfer to SITU SBP > 90/60 100-130/60-90 100-130/60-90 100-130/60-90</p> <p>Anticoagulant Control 'Neurosurgeon critical review'</p> <p>Blood pressure Aim for high normal BP for patient SBP 100-130mmHg Treat hypotension only with fluids Use vasopressors only if needed Avoid SBP < 90mmHg</p> <p>Fluid therapy Support BP with IV fluids (0.9% saline) Aim for total 3 litres fluid / 24hrs & BP > 90/60mmHg Avoid hypotension</p> <p>Drug therapy Commence Nimodipine 60mg 4 hourly PO or NG as soon as SAH confirmed Nimodipine 60mg 4 hourly PO or NG</p> <p>Other Blood sugar 5.5-7.8mmol/l Glucose only if BM < 4mmol/l Treat ongoing patient</p> <p>Neurological Observations Once stabilised & patient can give history every 20 minutes</p>	<p>SBP > 90/60 SBP > 90/60 SBP > 90/60 SBP > 90/60</p> <p>SBP > 90/60 SBP > 90/60 SBP > 90/60 SBP > 90/60</p> <p>SBP > 90/60 SBP > 90/60 SBP > 90/60 SBP > 90/60</p> <p>SBP > 90/60 SBP > 90/60 SBP > 90/60 SBP > 90/60</p>
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Post care instructions for interventional radiology

NATIONAL HOSPITAL FOR NEUROLOGY AND NEUROSURGERY

Post-care instructions for interventional neurology

1. Puncture site	R	L
• pressure only	<input type="checkbox"/>	<input type="checkbox"/>
• sealing device	<input type="checkbox"/>	<input type="checkbox"/>
2. Mobilisation	_____ hours	
• keep supine - 0 to 30°		
can then mobilise gently provided there are no contraindications		
3. Thromboprophylaxis / drug intervention		
• aspirin	once only <input type="checkbox"/>	14 days <input type="checkbox"/>
• clopidogrel	once only <input type="checkbox"/>	14 days <input type="checkbox"/>
• heparin infusion - maintain APTT @ 2 x normal until reviewed by radiologists		
• abciximab (Reopro) given intra procedure		
• other		
4. Aneurysm status		
• protected	<input type="checkbox"/>	
• unprotected	<input type="checkbox"/>	
• other		
5. Blood pressure parameters		
• review frequently in relation to neurological status		
• SBP < 90mmHg		
6. Neurological observations (GCS plus can patient read and write)		
• Should the patient develop any new focal neurological deficit +/- new severe headache, inform the neurologist and patient's clinical team immediately. Consider angiography. Consider urgent CT scan.		
7. Patient at particular risk of ...		
8. Additional instructions		
• Refer to 'Guidelines for post-procedural care of angiography patients'		

All patients must be reviewed by a member of the admitting medical or surgical team on the day of the procedure. This must include a review of the post-care instructions (in particular point 7).

Name _____ Signature _____ Date _____

Medical measures to prevent rebleeding

2 strong recommendations

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

Neurocritical Care (2011) 15:211–240
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The Organizer, the International Critical Care Medicine Appendix.

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Seizures and prophylactic anticonvulsants

Strong recommendation

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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

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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

Management of hyponatraemia

Strong recommendation

Fluid restriction

Hypertonic saline solutions

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

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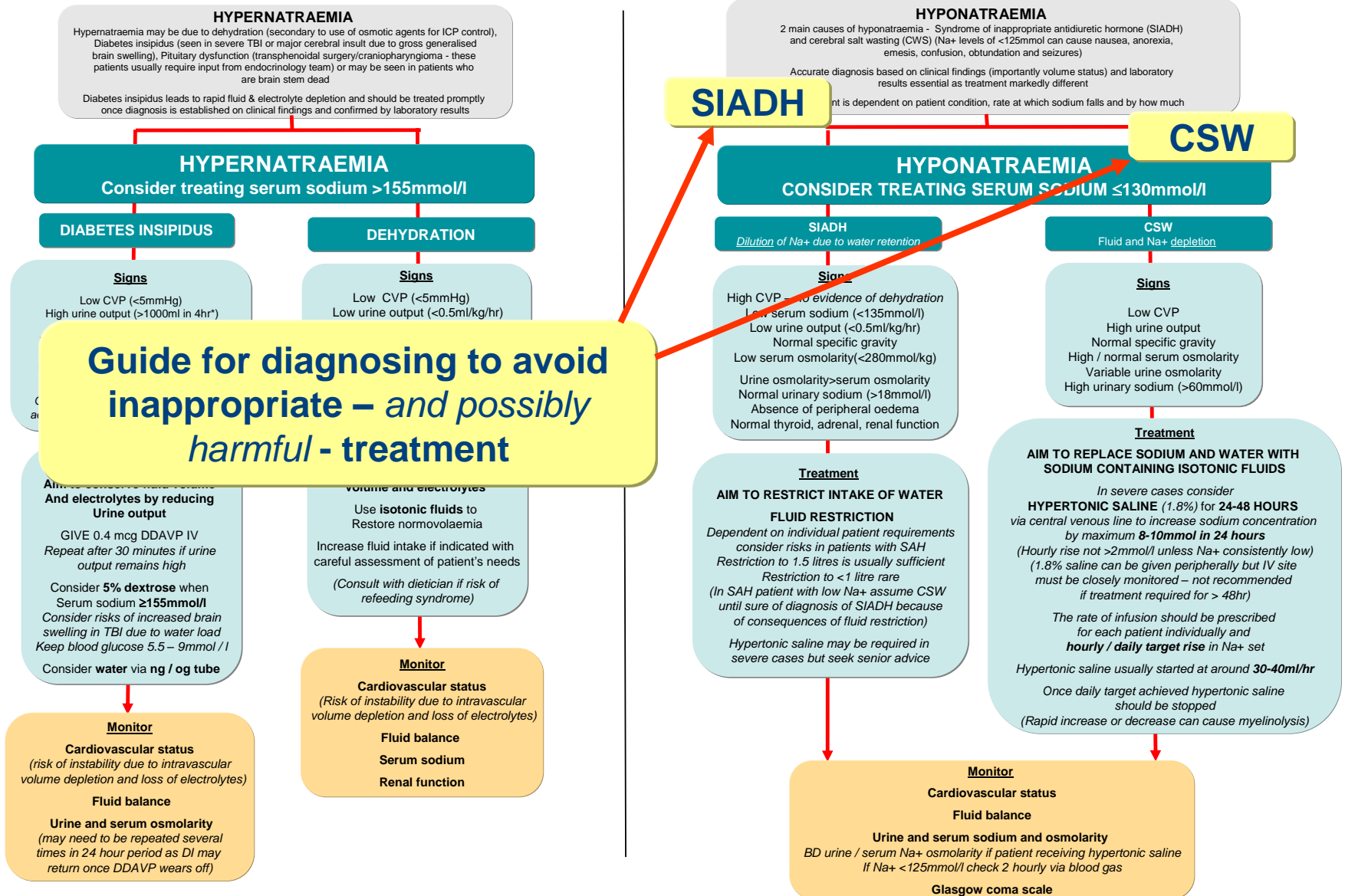
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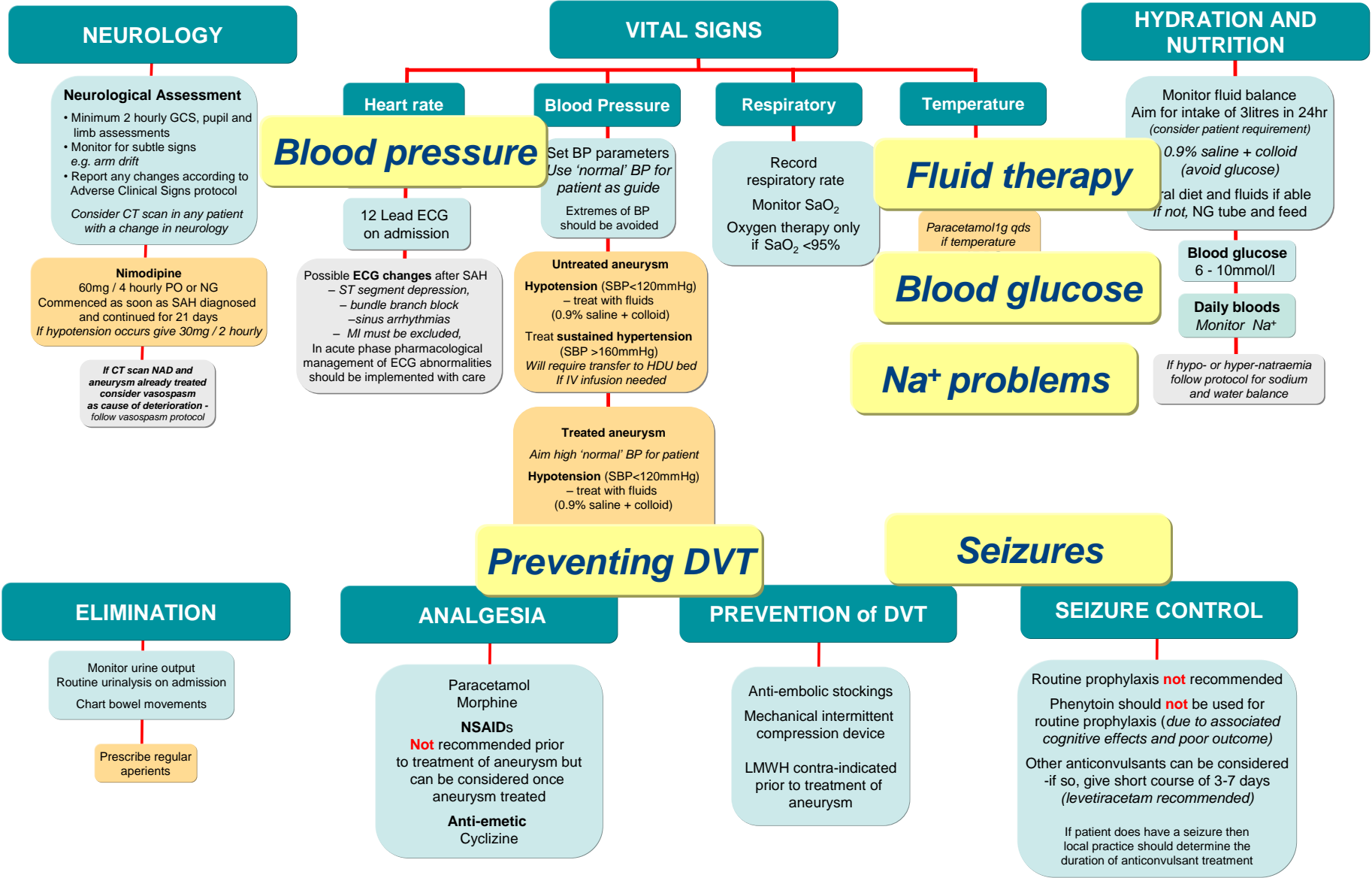


Management of Sodium and Water Balance





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

Consider CT scan in any patient with a change in neurology

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 CT scan NAD and aneurysm already treated consider vasospasm as cause of deterioration - follow vasospasm protocol

VITAL SIGNS

Heart rate

Blood pressure

Blood Pressure

Set BP parameters
Use 'normal' BP for patient as guide
Extremes of BP should be avoided

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

Untreated aneurysm

Hypotension (SBP<120mmHg)
- treat with fluids (0.9% saline + colloid)

Treat sustained hypertension (SBP >160mmHg)
Will require transfer to HDU bed
If IV infusion needed

Treated aneurysm

Aim high 'normal' BP for patient

Hypotension (SBP<120mmHg)
- treat with fluids (0.9% saline + colloid)

Respiratory

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

Temperature

Fluid therapy

Paracetamol 1g qds if temperature

Blood glucose

Na⁺ problems

HYDRATION AND NUTRITION

Monitor fluid balance
Aim for intake of 3litres in 24hr (consider patient requirement)

0.9% saline + colloid (avoid glucose)
Normal diet and fluids if able if not, NG tube and feed

Blood glucose
6 - 10mmol/l

Daily bloods
Monitor Na⁺

If hypo- or hyper-natraemia follow protocol for sodium and water balance

ELIMINATION

Monitor urine output
Routine urinalysis on admission
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

Preventing DVT

Seizures

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

Strong recommendations

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Delayed cerebral ischaemia has a major impact on outcome from SAH

The consensus guidelines make strong recommendations about preventative measures

Delayed cerebral ischaemia

Strong recommendations

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Intravascular volume

Target euvolaemia and avoid hypervolaemia therapy

Isotonic crystalloid preferred

If persistent negative fluid balance consider fludrocortisone or hydrocortisone

Delayed cerebral ischaemia

Strong recommendations

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Columbia University, New York, NY, USA

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

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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



Management of Cerebral Vasospasm following Subarachnoid Haemorrhage (SAH)

Monitoring & Diagnosis

MONITORING

DIAGNOSIS

Observations

GCS, pupil and limb assessment

Detected clinically:

Reduction in conscious level

Diagnosis of exclusion
Patient needs CT scan to exclude hydrocephalus, established stroke

Prevention & Treatment

TREATMENT

Nimodipine

60mg / 4 hourly PO or
Commenced as soon as SAH diagnosed and
If hypotension observed after administration

If patient not absorbing give IV (1-2mg/hr) via dedicated central line lumen (run concurrently with 0.9% saline 40ml/hr)

Diagnosis of exclusion
Patient needs CT scan to exclude hydrocephalus, established stroke

BP

FLUID THERAPY

VASOPRESSORS

BP and fluid balance

Euvolaemia

IV fluid therapy
0.9% Saline
Colloid

Clinical signs of vasospasm?

YES

Give fluid bolus

Clinical signs of vasospasm?

NO

Continue monitoring and preventive measures

Continue monitoring and preventive measures

SBP ~ 180-200mmHg

Make stepwise increases and titrate to neurology to determine BP target

↑ Systolic BP to reverse neurological deficit (may be up to 180mmHg)

BP target set by ICU Consultant after d/w Interventional Radiologist and Surgeon

Adjust target based on patient's response to initial elevation of BP

Clinical signs of vasospasm?

YES

1. Transcranial Dopplers (TCD)
2. CT perfusion – after discussion with Consultant Radiologist
3. Proceed to angiography after d/w Consultant Interventional Radiologist

Continue monitoring and preventive measures

Duration of induced hypertension
Review at 24 hours
Review TCD results

Consider trial of lowering BP targets to determine continued need for induced hypertension
Consider rescans to rule out established infarct
∴ contra-indication to induced hypertension

Interventional radiology

Endovascular options
Angioplasty
Direct intra-arterial injection with vasodilators

Discuss with Interventional Radiologist any conscious patient in whom no reversal of neurological deficit seen after 1 hour of hypertensive therapy

Continue monitoring and preventive measures

Blood gas targets
PaO₂ >13kPa
Normal PaCO₂

Do not hyperventilate due to added risk of ischaemia from vasospasm

Daily Transcranial Dopplers

If there is good evidence of vasospasm from angiography or direct observation of blood vessels at operation a period of prophylactic hypertensive therapy may be specified if the patient is not clinically assessable

CEREBRAL VASOSPASM

With current emphasis on early protection of a ruptured aneurysm, cerebral vasospasm leading to delayed ischaemic neurologic deficit (DIND) is the most common cause of late morbidity and mortality

Vasospasm is angiographically demonstrable in about two thirds of patients and one third will go on to develop clinical symptoms of cerebral ischaemia

Vasospasm occurs in a delayed fashion and may be reversible with aggressive preventive and treatment strategies in intensive care

PATHOPHYSIOLOGY

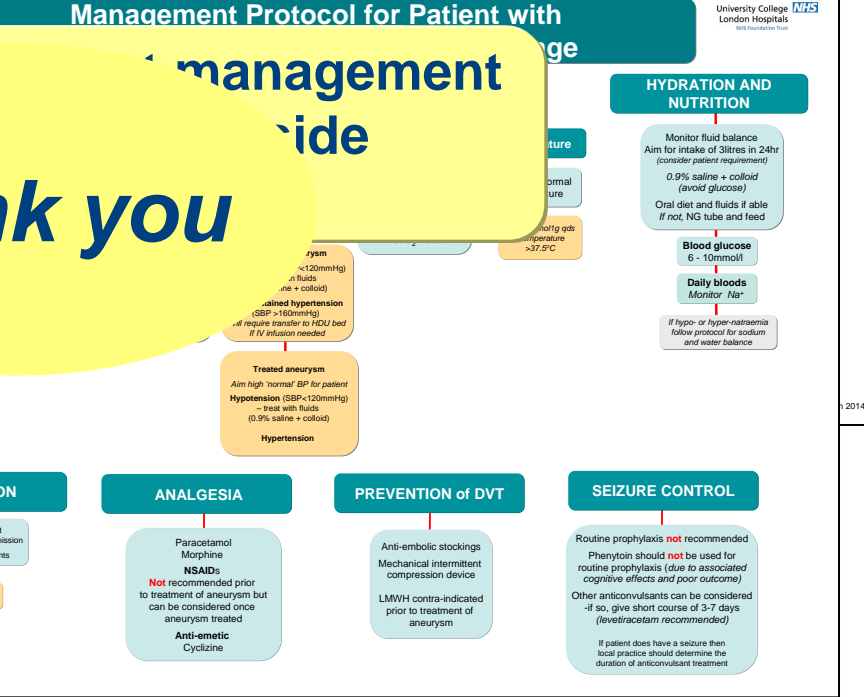
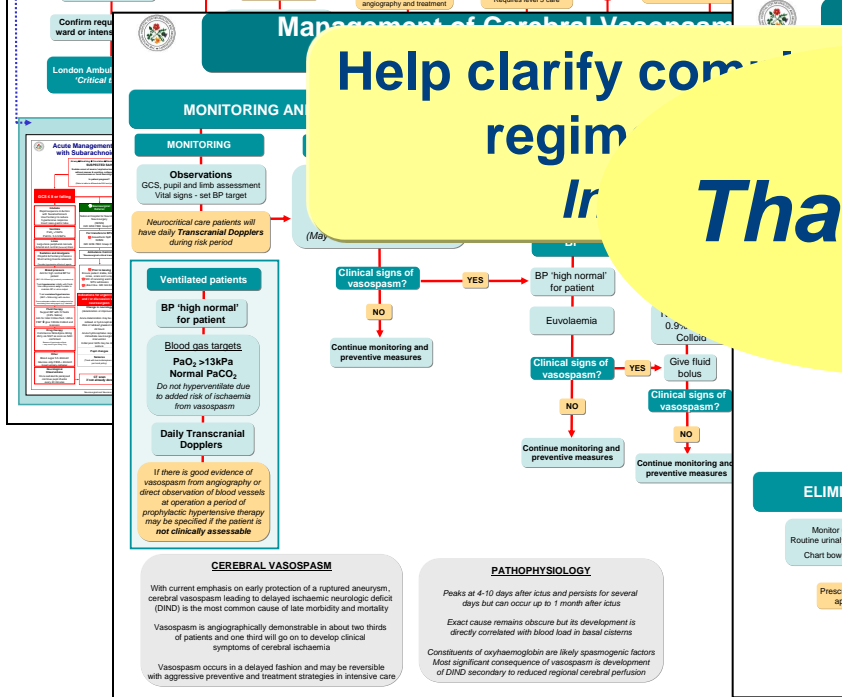
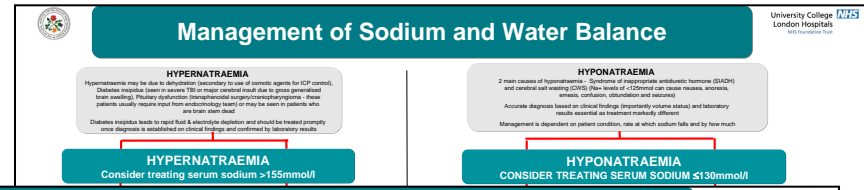
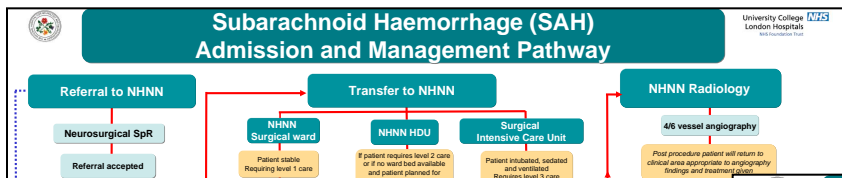
Peaks at 4-10 days but can persist

Exact cause remains unclear but directly correlated with SAH

Constituents of oxyhaemoglobin are likely spasmogenic factors
Most significant consequence of vasospasm is development of DIND secondary to reduced regional cerebral perfusion

When to stop induced hypertension

In summary



Help clarify complex management regime
 Thank you