Whittington Health NHS

Hyponatraemia - Investigation and Management

Subject:	Investigation and Management of Hyponatraemia
Policy Number	N/A
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Policy Executive Owner:	Divisional Director ICAM
Designation of Author:	R Kaiser, M Rossi, H Marshall, D Troukades, M Parsons, H Montgomery.
Name of Assurance Committee:	As above
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Target Audience:	All clinicians with responsibility for direct patient care
Key Words:	Hyponatraemia, SIADH, seizures, fitting, ICU, HDU, Critical Care Outreach

Version Control Sheet

Version	Date	Author	Status	Comment
1.0	11/4/12	H Marshall		Initial draft
	19/09/12	M Rossi		Further consultation and amendments
	19/09/12-01.01.13	M Rossi, R Kaiser, M Parsons		With multiple other inputs sought from ICU staff and others

List of abbreviations sited :

ADH – antidiuretic hormone

SIADH – syndrome of inappropriate ADH secretion

TBW – total body water

TB Na+ - total body sodium

TFTs – thyroid function tests

LFTs - liver function tests

SSRI – selective serotonin reuptake inhibitor

NSAIDs – nonsteroidal anti-inflammatory drugs

IV - intravenous

➢ Criteria for use

For use when a patient has a serum Na concentration ([Na^+]) < 130 mmol/L

➢ Background/ Introduction

Hyponatraemia (serum sodium concentration <135mmol/L) is common in hospitalised patients, and represents a relative excess of water in relation to sodium.

! Whatever its cause, the severity of hyponatraemia correlates with increased mortality !

➢ Inclusion criteria

- Adult patients aged >16 years
- Serum sodium <130 mmol/L

➢ Clinical management

CLINICAL FEATURES

Hyponatraemia may:

- be asymptomatic
- cause subtle signs (cramps, altered gait, falls, mild cognitive impairment)
- cause **cerebral oedema**, leading to headache, irritability, confusion, decreased consciousness, nausea, vomiting, convulsions, cerebellar herniation and death.

Symptoms will depend on both the degree of hyponatraemia and the rate of change in serum sodium concentration ([Na^+]): a patient who has had a slow drift to [Na^+] of 110mmol/L may appear quite well, whilst a sudden fall to this level over hours may prove fatal. In general, [Na^+] >120 mmol/L is less likely to be associated with severe symptoms unless developed rapidly, and **seizures and coma are more common as the sodium reaches 110 mmol/L.**

Hyponatraemia may be:

Dilutional: too much water for the total body sodium, whether the total sodium is low, normal or even high. The **patient may be euvolaemic or hypervolaemic** eg high aldosterone levels in cirrhosis and renin-angiotensin system activation in heart failure contribute to water retention in excess of salt retention..

Hypovolemic: body water and sodium are depleted, with more salt lost than water.

Hyponatraemia Diagnostic and Treatment Algorithm

STEP 1: EVALUATE

1. Assess for symptoms & signs of hyponatraemia.
2. Is patient on drugs that can cause hyponatraemia
3. RV fluid balance esp post op
4. History of or symptoms/signs suggesting : endocrine dx, cardiac/lung/liver/renal disease, SIADH or its causes.
5. Perform Investigations : (U&Es, Mg, Glu, LFTs, Paired Osmolalities, Urine Na, TFTs, 9 am Cortisol)

Check Serum Osmolality

Normal Osmolality (275-295 mOsmol/Kg)
Pseudohyponatraemia from :
Hyperlipidaemia
Hypeproteinaemia

High Osmolality (>295 mOsmol/Kg))
Hyperglycaemia
Unmeasured Osmoles (eg glycine, mannitol)

Low Osmolality (< 275 mOsmol/Kg)

STEP 2: ASSESS VOLUME STATUS

Check postural BP and Pulse, JVP, Oedema, Ascites, Skin turgor

Hypovolaemic Hyponatraemia (TBW ↓. TB Na ↓↓)	Euvolaemic Hyponatraemia (TBW ↑. TB Na ↔)	Hypervolaemic Hyponat (TBW ↑↑. TB Na ↑)

Check Urine Na and Osmolality

Hypovolaemic Hyponatraemia

Extrarenal Causes of Na loss
Urine Na < 20 mmol/l
Urine Osmol > 100 mOsmol/Kg
- Vomiting
- Diarrhoea
- Third Spacing (Pancreatitis, Bowel Obstruction, Burns)

Renal Causes of Na loss
Urine Na > 20 mmol/l
Urine Osmol > 100 mOsmol/Kg
- Diuretics
- Addisons disease
- Salt wasting nephropathy
- Proximal RTA

Euvolaemic Hyponatraemia

Urine Na > 20 mmol/l
Urine Osmol < 100 mOsmol/Kg
- Water Intoxication due to e.g Psychogenic Polydipsia, Ecstasy Intoxication, Marathon runners, Beer drinkers Potomania)

Urine Na > 20 mmol/l
Urine Osmol > 100 mOsmol/Kg
- SIADH
- Drugs (e.g. antidepressants, antipsychotics, carbamazepine, chlorpropamide, opiods, vincristine, NSAIDs)
- Glucocorticoid deficiency
- Hypothyroidism

Hypervolaemic Hyponatraemia

Urine Na < 20 mmol/l
Urine Osmol > 100 mOsmol/Kg
- Cardiac Failure
- Cirrhosis
- Nephrotic Syndrome

Urine Na > 20 mmol/l
Urine Osmol > 100 mOsmol/Kg
- Chronic Renal Failure

STEP 3: TREAT

In ANY patient with significant neurological symptoms believed to be due to hypnotraemia (seizures, severe reduced conscious level)

→ RAPIDLY RAISE [Na]: By no more than 1-2 mmol/hr for first 2-3 hours until serious symptoms resolve

Use 1.8% Hypertonic Saline at initial dose of 300 ml over 30 min, repeated again if necessary `to achieve aboverise.`

If water overload also present, co-administer frusemide 20 mg IV

TREATMENT	TREATMENT	TREATMENT
Treat cause (e.g. stop diuretics, steroid replacement in Addisons) Restore intravascular volume with IV crystalloids: If symptomatic, e.g give fluid challenge of 1 L 0.9% N Saline over 2-4 hours. Monitor Na 1-2 hourly. If asymptomatic, restore volume with 0.9% Saline more gradually.	Stop offending drugs and hypotonic fluids If significant symptoms, or rapid onset (< 24-48 hours) causing significant hyponatraemia, consider use of Hypertonic Saline +/- Frusemide If asymptomatic or mild symptoms → Water Restrict to < Urine Output (usually 750-1000 ml/day) Treat the underlying cause of SIADH, and in resistant cases , consider Demeclocycline or ADH Receptor Antagonists	Treat the underlying disease Water and Salt Restriction If severe water overload, co-administer loop diuretic

! In all cases [Na] should not increase by > 10-12 mmol/l in 24 hours

ASSESSMENT OF THE PATIENT
How to diagnose the cause of the hyponatraemia

1. Seek a **history of** (or signs/symptoms suggesting):

- Fluid and/or salt loss through vomiting, diarrhoea, stoma or fistula
- Drug effects: fluid &/or salt loss (diuretics), SIADH/↑ADH sensitivity (e.g. antidepressants [esp SSRIs]; antiepileptics [especially carbamazepine]; fluid retention [NSAIDS]
- Administration of IV fluids: what type, in what quantity, over what timescale?
- Missing relevant routine medications (thyroid hormones, steroid hormones)
- Adrenal insufficiency/hypothyroidism
- SIADH or its causes (e.g. small cell carcinoma)
- Cardiac, lung, liver, or renal disease
- Possible symptoms of hyponatraemia NB get collateral history from family and/or carers/nursing staff regarding new onset confusion not otherwise explained

2. Assess and record volume status

- Jugular venous pressure - will be elevated if intravascular volume is high.
- Peripheral oedema +/- ascites generally occur when total body water is raised (e.g. right heart failure, oliguric renal failure, hypoalbuminaemia).
- Skin turgor will be low if total body water is reduced.
- Lying and sitting BP and pulse (or standing, if safe) – postural drop indicates intravascular volume depletion.

! REMEMBER !

- **BE ESPECIALLY WORRIED if hyponatraemia occurs in groups at greater risk of poor outcome.** These include postoperative or malnourished patients; those with a history of excess alcohol intake; the elderly; premenopausal women; and those with liver/cardiac/ other endocrine/ renal/ neurological disease.
- **CALL URGENTLY FOR SENIOR HELP where there is neurological decline**
- **CALL THE ICU OR RESUS TEAM if seizures are present.**
- **THINK OF ADRENAL INSUFFICIENCY/ADDISONS (below).**

3. Investigations and their Interpretation (refer to algorithm):

- U&Es, Mg, bicarbonate, LFTs, glucose
- Paired serum & urine osmolality (but unhelpful if diuretics have been given)
- Urine Spot Na+
- TSH, FT4
- Random Cortisol (if Adrenal insufficiency is suspected – refer to '*Steroid dependent patients who are undergoing surgery or are acutely unwell – guideline for management' p5 'Patients with Adrenal Insufficiency admitted acutely unwell'*].
- LFTs

Serum osmolality will be normal or high (>275 mOsm/kg) only if :

(i) hyperglycaemia is present
(ii) there is pseudohyponatraemia (e.g. due to lipaemia, above, or rare hyperproteinaemic states/ paraproteinaemias>10g/dl)
(iii) urea is very high.
(iv) on the very rare occasions when other osmotically-active agents (e.g. ethanol, ethylene glycol or medically-administered mannitol) are present. Measure osmolar gap: [2x(Na^+ + K^+)+urea+glucose]

Diagnosis of SIADH

Should be a diagnosis of exclusion. Criteria for diagnosis include:

- Normal renal, adrenal, thyroid function, and not on diuretics
- Absence of clinical evidence of hypovolaemia or volume overload (oedema)
- Serum Osmol <275 mOsmol/kg, Urine Osmol >100 mOsmol/kg,
  Urine [Na] > 20 mmol/l

MANAGEMENT

Treatment depends on the severity of symptoms, rapidity of development and duration of the existing hyponatraemia.

Hyponatraemic patients should be referred for possible ICU admission if they have:

- reduced level of consciousness
- fits
- need for treatment with Hypertonic Saline
- [Na^+] is <115 mmol/l, where it is not apparent that this is chronic. These patients may not have serious neurological symptoms as above but it may still be desirable to raise [Na] by initially by 0.5 mmol/hr, but no more than 10 mmol/24 hours

If the patient has a severe reduction in conscious level or is having seizures related to hyponatraemia (of any cause), then this is an emergency.
Serum sodium must be raised urgently (but by no more than 1-2 mmol/L per hour in first 2-3 hours) until serious symptoms resolve:

- Use 300 ml of 1.8% Hypertonic Saline over 30 mins. If water overload is also present, a loop diuretic (e.g. furosemide 20 mg IV) may be co-administered.
- The aim is to increase serum [Na] by around 4-6 mmol/l over the first 2-3 hours which is usually adequate to terminate seizures. The dose of Hypertonic Saline can be repeated again if necessary to achieve this rapid initial rise, but must be stopped once severe symptoms resolve. Thereafter, aim for a more steady rise in serum [Na], to ensure a total rise of no more than 10-12 mmol/l over the first 24 hour period. (see formula p 9)

! IF SODIUM IS TO BE RAPIDLY RAISED (administration of hypertonic saline) this can be dangerous. It must be authorised by an experienced senior clinician (Medical/ITU/Anaesthetic SpR or Consultant) and the patient will need transfer to the ICU!

Once severe symptoms have resolved, and in all other situations, correcting [Na+] beyond 10-12 mMol/l (about 0.5mMol/hr) should be avoided in the first 24-hour period, and 18mMol/l in the first 48 hours.

Rapid rises in serum sodium causes excessive cell shrinkage and osmotic demyelination. This can cause the syndrome of central pontine myelinolysis ***with possible irreversible debility or death.*** Patients with hypokalaemia, burns or malnutrition, and elderly women taking thiazide diuretics, are especially at risk.

Specific Management

Hypervolaemic Hyponatraemia
Treat underlying cause. Stop offending drugs and fluids. Fluid restrict to below level of urine (usually restricted to 750-1000 ml/day). Where water overload is severe, a loop diuretic may be co-administered.

The Patient with Cirrhosis and Hyponatraemia
Water and salt restriction are the mainstay of treatment, with use of aldosterone antagonists as required. Diuretics should be withheld if severely hyponatraemic. Treatment is often difficult and special expertise should be sought.

Euvolaemic Hyponatraemia
Treat underlying cause. Stop offending drugs and fluids. Fluid restrict to below level of urine (usually restricted to 750-1000 ml/day).

Syndrome of Inappropriate Antidiuretic Hormone Secretion (SIADH)
Find and treat the cause. Remove medications which may cause SIADH (e.g. thiazides, opiates, haloperidol, tricyclic antidepressants, carbamezepine). Seek and treat pneumonia, lung carcinoma, CNS disease.
Fluid restriction is the mainstay for correction. Demeclocycline (150 - 300 mg 6 hourly) may be indicated in cases of SIADH resistant to fluid restriction – it induces a nephrogenic diabetes insipidus reversing ADH effects but expert advice should be sought before initiation.

Hypovolaemic Hyponatraemia

Ensure diuretic medications have been stopped. Consider administration of appropriate crystalloids. Isotonic (0.9%) saline is generally sufficient. NB careful monitoring is needed to avoid overcorrection.
For symptomatic hypovolaemic patients, an appropriate fluid challenge should be given with a crystalloid and sodium concentration should be repeated within 1-2 hours of treatment. For asymptomatic hypovolaemic patients, restore volume gradually with 0.9% saline.

Primary Adrenal deficiency
This should be suspected if hyponatraemia is associated with postural hypotension and significant volume depletion (without an obvious alternative cause of sodium loss). Hyperkalaemia and hypoglycaemia can also be present.

[refer to '*Steroid dependent patients who are undergoing surgery or are acutely unwell – guideline for management' p5 'Patients with Adrenal Insufficiency admitted acutely unwell'*].

Further information regarding management:

1. Sodium content and tonicity of IV fluid preparations

Type of Fluid	Sodium concentration (mmol/L)	Tonicity
0.9% Saline (normal saline)	154	Close to isotonic
Hartmann's	130	isotonic
0.45% Saline (Half normal saline)	77	Hypotonic
5% Dextrose	0	Hypotonic
1.8% Saline	308	Hypertonic

2. Calculating rate of IV saline

The mMol/l response to 1litre of any intravenous fluid can be estimated from adding the mMol/l concentration of sodium and potassium in the fluid, subtracting the serum sodium concentration from this total, and dividing this result by (1+total body water). Total body water is estimated as weight in kg of the patient x 0.6 (if young male), 0.5 (if young female or elderly male), or 0.45 (for an elderly female).

For example: for 70 kg male with serum [Na+] of 110 mmol/l :

Change in [Na] with 1.8% Hypertonic saline = $\frac{308 - 110}{1 + (70 \times 0.6)}$ = 4.6 mmol/l

So 1 L of 1.8% Hypertonic saline administered will increase serum [Na] by 4.6 mmol.

Therefore to increase [Na] by 6 mmol/l over 3 hours (i.e. by 2 mmol/hr if fitting), you may need to infuse

= (6/4.6) x1000ml = 1300 ml.

To achieve this over 3 hours, the infusion rate is thus ~ 433 ml/hr.

To achieve the same increase in [Na] for a 60kg elderly female, you only need to infuse 840 ml over 3 hours, the infusion rate in this case would be 280 ml/hr

➢ Contacts (inside and outside the Trust including out-of-hours contacts)

- Medical SpR (+/- Medical Consultant) on call for symptomatic patients (bleep 3300)
- Endocrine SpRs (bleep 3147 or 3086)
- Endocrine Consultants Drs M Rossi, K Anthony, M Barnard (x5219 or 5218)
- Critical Care Outreach Team: bleep 2837
- Intensive Care: x5470, or via bleep for SpR. Consultant via switchboard (or senior ICU nurse) if not on ICU.

➢ References (evidence upon which the guideline is based)

GAIN: Guidelines and Audit Implementation Network (Northern Ireland). Hyponatraemia in Adults (On or After 16th Birthday), Published February 2010 available from: http://www.gain-ni.org/images/Uploads/Guidelines/Hyponatraemia_guideline.pdf

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Chubb, SA (2009) Hyponatremia Treatment Guidelines 2007: Expert Panel Recommendations. Clin Biochem Rev 30 (1) p 35-38.

Lauriat SM, Berl T (1997) The hyponatremic patient: practical focus on therapy. J Am SocNephrol 8 (10) p 1599–1607.

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Ellis SJ (1995) Severe hyponatraemia: complications and treatment. QJM 88 (12) p 905–909.

To be completed and attached to any procedural document when submitted to the appropriate committee for consideration and approval

		Yes/No	Comments
1.	**Does the procedural document affect one group less or more favourably than another on the basis of:**		
	• Race	No	
	• Ethnic origins (including gypsies and travellers)	No	
	• Nationality	No	
	• Gender	No	
	• Culture	No	
	• Religion or belief	No	
	• Sexual orientation including lesbian, gay and bisexual people	No	
	• Age	No	
	• Disability - learning disabilities, physical disability, sensory impairment and mental health problems	No	
2.	**Is there any evidence that some groups are affected differently?**	No	
3.	**If you have identified potential discrimination, are any exceptions valid, legal and/or justifiable?**	No	
4.	**Is the impact of the procedural document likely to be negative?**	No	
5.	**If so can the impact be avoided?**	N/A	
6.	**What alternatives are there to achieving the procedural document without the impact?**	N/A	
7.	**Can we reduce the impact by taking different action?**	N/A	

If you have identified a potential discriminatory impact of this procedural document, please refer it to the Director of Human Resources, together with any suggestions as to the action required to avoid/reduce this impact.

For advice in respect of answering the above questions, please contact the Director of Human Resources.

Checklist for the Review and Approval of Procedural Document

To be completed and attached to any procedural document when submitted to the relevant committee for consideration and approval.

	Title of document being reviewed:	Yes/No	Comments
1.	**Title**		
	Is the title clear and unambiguous?	Yes	
	Is it clear whether the document is a guideline, policy, protocol or standard?	Yes	
2.	**Rationale**		
	Are reasons for development of the document stated?	Yes	
3.	**Development Process**		
	Is it clear that the relevant people/groups have been involved in the development of the document?	Yes	
	Are people involved in the development?	Yes	
	Is there evidence of consultation with stakeholders and users?	Yes	
4.	**Content**		
	Is the objective of the document clear?	Yes	
	Is the target population clear and unambiguous?	Yes	
	Are the intended outcomes described?	Yes	
5.	**Evidence Base**		
	Are key references cited in full?	N/A	
	Are supporting documents referenced?	N/A	
6.	**Approval**		
	Does the document identify which committee/ group will approve it?	Yes	
7.	**Dissemination and Implementation**		
	Is there an outline/plan to identify how this will be done?	Yes	
8.	**Document Control**		
	Does the document identify where it will be held?	Yes	
9.	**Process to Monitor Compliance and**		

	Title of document being reviewed:	Yes/No	Comments
	Effectiveness		
	Are there measurable standards or KPIs to support the monitoring of compliance with and effectiveness of the document?	Yes	
	Is there a plan to review or audit compliance with the document?	Yes	
10.	**Review Date**		
	Is the review date identified?	Yes	
	Is the frequency of review identified? If so is it acceptable?	Yes	
11.	**Overall Responsibility for the Document**		
	Is it clear who will be responsible for co-ordinating the dissemination, implementation and review of the document?	Yes	

Executive Sponsor Approval			
If you approve the document, please sign and date it and forward to the author. Procedural documents will not be forwarded for ratification without Executive Sponsor Approval			
Name		Date	
Signature			
Relevant Committee Approval			
The Director of Nursing and Patient Experience's signature below confirms that this procedural document was ratified by the appropriate Governance Committee.			
Name		Date	
Signature			
Responsible Committee Approval – only applies to reviewed procedural documents with minor changes			
The Committee Chair's signature below confirms that this procedural document was ratified by the responsible Committee			
Name		Date	
Name of Committee		Name & role of Committee Chair	
Signature			

Tool to Develop Monitoring Arrangements for Policies and guidelines

What key element(s) need(s) monitoring as per local approved policy or guidance?	Who will lead on this aspect of monitoring? Name the lead and what is the role of the multidisciplinary team or others if any.	What tool will be used to monitor/check/observe/Assess/inspect/ authenticate that everything is working according to this key element from the approved policy?	How often is the need to monitor each element? How often is the need complete a report ? How often is the need to share the report?	What committee will the completed report go to?
Element to be monitored	**Lead**	**Tool**	**Frequency**	**Reporting arrangements**
1. Management of patients with Na<130 mmol/L	MAU Consultant	Adherence to guideline	20-30 cases every 1-2 years	Clinical Governance Dept