Patient

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Hyponatraemia

Hyponatraemia is a low level of sodium in the blood. Sodium levels in the blood have to be tightly controlled. Various chemical messengers (hormones) and organs are involved in this process. For example, hormones involved include antidiuretic hormone and cortisol, and organs involved include the brain and kidneys. There is a very close relationship between body sodium and body fluid levels.

What is it hyponatraemia?

Hyponatraemia can be classified in various ways, such as:

- Timing of the fall in blood sodium into acute (usually hours) or chronic (days to weeks).
- Level of body fluid (due to water intake) as either low body fluid (hypovolaemia), excess body fluid (hypervolaemia) or no change in body fluid (euvolaemia).

What causes hyponatraemia?

Levels of sodium in the blood are tightly controlled. This involves a number of factors including:

- Kidneys - which can remove or retain sodium in the blood.
- Antidiuretic hormone (also known as vasopressin) - a hormone which works to retain body fluid.
- Renin angiotensin and aldosterone system - regulates sodium excretion by the kidneys and levels of fluid in the body, and maintains blood pressure.

Sodium levels are measured in the blood and an example of the normal range of blood sodium is 135-145 mmol/L. The normal range will vary slightly between different laboratories. Mild hyponatraemia occurs when the level is less than 135 mmol/L. Severe hyponatraemia is a level less than 120 mmol/L.

Hyponatraemia usually occurs with changes in the body fluid levels and can be divided into three groups:

1. Euvolaemic - body fluid levels are normal.
2. Hypovolaemia - reduced body fluid levels, the most common cause of which is dehydration.
3. Hypervolaemic - increased body fluid levels, an example of which is heart failure leading to fluid retention.

The levels of sodium in the urine may be used to help determine the underlying cause.

No abnormalities of body fluid (euvolaemia) - resulting in excess antidiuretic hormone

- Medications: selective serotonin reuptake inhibitors (SSRIs), proton pump inhibitors, angiotensin-converting enzyme (ACE) inhibitors.
- Behavioural - high intake of water, often related to mental health conditions such as anorexia.
- Neurological: brain tumour, brain trauma, multiple sclerosis, systemic lupus erythematosus, brain haemorrhage.
- Lung disorders: lung cancer, pneumonia, asthma, tuberculosis.
- Other cancers: stomach cancer, pancreatic cancer, leukaemia and lymphoma.
- Medications: selective serotonin reuptake inhibitors (SSRIs), proton pump inhibitors, angiotensin-converting enzyme (ACE) inhibitors.

- Other causes: pain, following surgery, stress, endurance exercise and marathon running.

Low body fluid (hypovolaemia)

- Medications such as diuretics - for example, thiazide diuretics such as bendroflumethiazide or loop diuretics.
- Being sick (vomiting).
- Diarrhoea.
- Addison's disease: adrenal glands fail to produce the necessary steroid hormones.
- Burns.
- Excessive sweating.

Increase in body fluid (hypervolaemia)

- Heart failure.
- Diseases of the liver such as fibrosis or cirrhosis.
- Kidney failure.

Falsely low sodium levels

- Very high cholesterol levels.
- Very high blood sugar levels.
- Too much protein in the blood, sometimes caused by a cancer called multiple myeloma.

In these cases the result for the blood sodium will be low but the actual blood sodium level is normal.

Who's most at risk of hyponatraemia?

Hyponatraemia is very common - especially mild hyponatraemia. It occurs equally in men and women.

Some patients are more at risk of hyponatraemia. These include infants who are taking formula which has not been made up correctly, and elderly people who may be less likely to express thirst and who may be taking medicines which cause hyponatraemia as a side-effect, or suffer from medical conditions associated with hyponatraemia (eg, kidney or liver disease and heart failure).

What are the symptoms of hyponatraemia?

The symptoms and severity of hyponatraemia depend on the following two factors:

- The level of the blood sodium.
- How quickly the sodium level falls - hyponatraemia can be divided into acute or chronic. In acute there is usually a sudden fall in blood sodium levels (over hours), whereas a chronic fall occurs over days to weeks.

If the levels are only mildly abnormal you may feel completely fine, or only have mild symptoms.

The clinical picture can be confusing, as mild hyponatraemia can cause significant symptoms if the drop in sodium level is sudden. On the other hand severe chronic hyponatraemia can cause no symptoms, due to the body (especially the brain) adapting over time to the lower levels. Symptoms include:

- Mild hyponatraemia - lack or loss of appetite (anorexia), headache, feeling sick (nausea), being sick (vomiting), and lack of energy and enthusiasm (lethargy).
- Moderate hyponatraemia - personality change, muscle cramps and weakness, confusion, and lack of muscle co-ordination (ataxia).
- Severe - drowsiness and fits (seizures).

Signs

A healthcare professional may pick up on the following features:

- **Neurological signs**:
  - Reduced level of consciousness.
  - Problems with thinking such as short-term memory loss, disorientation, confusion, depression).
  - Fits (seizures).
- **Signs of low body fluid (hypovolaemia)**:
  - Dryness of the mouth and tongue.
  - Sunken eyes.
  - Fast heart rate.
  - Low blood pressure.
  - Dry skin or reduced elasticity of the skin.
- **Signs of an increase in body fluid (hypervolaemia)**:
  - Crackles when listening over the lungs.
  - Extra heart sounds as the heart is having to work harder.
  - Increased pressure in the veins seen at the neck.
  - Swelling of the tummy (abdomen).
  - Swelling of the legs.

You may also have symptoms relating to the underlying cause and from loss of body fluid or from excess body fluid. For example, loss of body fluid may make you thirsty and you may pass less urine. Too much body fluid on the other hand, may cause you to develop leg and tummy (abdominal) swelling. Or, if you have a thyroid disorder, you may have an enlarged thyroid gland.

How is hyponatraemia diagnosed?

Hyponatraemia is shown on a blood test. However, this might not tell you why the hyponatraemia has occurred. This is why a full assessment has to be undertaken by a healthcare professional. They will be trying to determine whether the hyponatraemia is acute or chronic and be looking for clues as to the underlying cause.

Your doctor will also decide on whether urgent admission to hospital is required. They will be particularly assessing you for levels of body fluid, which is crucial in determining the cause. The assessment will then help guide them as to the next appropriate tests.

Some of the tests requested include:

- **Blood tests**: checking sodium and potassium levels and kidney function. Thyroid function tests and the cortisol hormone (released from the adrenal glands) will also be checked. Blood inflammatory markers, such as C-reactive protein, may also be checked - for example, if there are other features of infection. B-type natriuretic peptide will be checked if heart failure is suspected and liver enzyme tests will be checked if a liver problem is possible. Sodium levels will need to be checked frequently, especially within the first 24-48 hours.
- **Urine sample**: looking for sodium levels which are useful in determining the cause.
- **Urine and blood osmolality levels**: osmolality is a measure of the solute concentration and may help to determine the cause.
- **Imaging**: this depends on the suspected cause and the presentation - for example, a chest X-ray may be required in suspected heart failure, or a computerised tomography (CT) brain scan may be necessary in patients with confusion.

- **Other investigations**: some other tests which may be undertaken include a 12-lead heart tracing (electrocardiogram, or ECG), an ultrasound scan of the heart (echocardiogram, or echo) in cardiac failure and, in kidney disease, a renal ultrasound scan.

Treating severe hyponatraemia

Patients need to be immediately stabilised and resuscitated. Patients can present after their breathing has stopped (respiratory arrest) and may require cardiopulmonary resuscitation and may need to have a tube inserted into the trachea and be connected to an artificial ventilator. Patients having fits (seizures) will need medications to help with this, and medications such as benzodiazepines (for example, diazepam or lorazepam) are used in the short-term before specific anti-seizure medication is given (for example, phenytoin).

Patients may need to be monitored very closely and be on high-dependency units or sometimes in an intensive care unit. They will need regular observations, including pulse rate and blood pressure checks. They may also need a urinary tube (catheter) to determine their fluid output.

Once the patient is stabilised, treatment is usually directed towards the underlying cause - for example:

- Intravenous fluids in lack of fluid in the body (dehydration).
- Stopping medications which may have caused the low blood sodium.
- Diuretics for cardiac failure.
- Antibiotics for pneumonia.
- In the syndrome of inappropriate antidiuretic hormone, the patient's fluid intake is restricted.

The speed with which the blood sodium is corrected is vital, as too rapid correction in a patient where low blood sodium has been present for several days or weeks, can lead to convulsions and may even be fatal.

Once the hyponatraemia has resolved and patients are ready for discharge, a clear plan regarding medication and prevention of further hyponatraemia is required. Some patients may also require further investigations as outpatients. Some patients will also need to be warned that episodes of intercurrent illness, especially diarrhoea and/or being sick (vomiting), may bring on a further bout of hyponatraemia, so they would need to seek medical help early.

Hyponatraemia complications

Mild hyponatraemia leads to walking abnormalities in the elderly with a risk of falls and fractures. It can also lead to weaker bone structure making fractures more likely to occur after a fall. Mild hyponatraemia can also lead to memory problems and difficulty concentrating.

Sudden hyponatraemia can result in life-threatening complications as a result of sudden swelling of the brain (cerebral oedema), which can lead to coma and to fits (seizures), and which can be fatal.

Chronic hyponatraemia can also lead to cerebral oedema and permanent neurological changes - for example, seizures. The brain usually adapts to the slower fall in sodium so that brain swelling is not usually seen.

Too rapid correction of hyponatraemia can cause a condition called central pontine myelinolysis. Symptoms occur 2-4 days after onset and may present with paralysis of all four limbs (quadriplegia).

This has been seen more often in those with alcohol dependency, female patients, those with low blood potassium levels (hypokalaemia), and patients who have had a liver transplant. If hyponatraemia is corrected at the appropriate rate these complications can be minimised.

Prevention of hyponatraemia

Advice to remain well hydrated and on use of electrolyte replacement solutions may help prevent hyponatraemia occurring in the setting of acute diarrhoea and/or being sick (vomiting), especially in the elderly and young.

Diuretics can lead to varying degrees of hyponatraemia. Patients should be warned of this potential side-effect and the symptoms that may occur. Also some patients may require blood tests to check sodium levels a few weeks after starting diuretics - for example, a patient who has had hyponatraemia before.

Further reading

- Hyponatraemia; NICE CKS, November 2020 (UK access only)
- Nagler EV, Haller MC, Van Biesen W, et al; Interventions for chronic non-hypovolaemic hypotonic hyponatraemia. Cochrane Database Syst Rev. 2018 Jun 28;6(6):CD010965. doi: 10.1002/14651858.CD010965.pub2.
- Nowak KL, Yaffe K, Orwoll ES, et al; Serum Sodium and Cognition in Older Community-Dwelling Men. Clin J Am Soc Nephrol. 2018 Mar 7;13(3):366-374. doi: 10.2215/CJN.07400717. Epub 2018 Feb 8.

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