# Hyponatremia:
# An underestimated clinical challenge


**Presented by-**

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# Learning objectives

- Definition & types of hyponatremia
- Pathophysiology & causes of hyponatremia
- Clinical features & diagnosis of hyponatremia
- Complications & clinical consequences of hyponatremia
- Management of hyponatremia

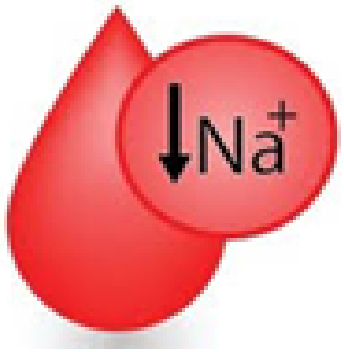
# Case scenario:

**A 62 year old man, chronic smoker, comes to the OPD with the complaints of lethargy, nausea, dizziness** and **drowsiness**.

**He had also history of cough with sputum, significant weight loss** and **hemoptysis**.

- **What is the probable diagnosis?**

# Introduction of hyponatremia



## Definition:

**Hyponatremia** is a clinical condition when **serum sodium concentration** is **<135mmol/L.**

It is frequently

associated with **hypoosmolarity**,

but not always.

# Classification of Hyponatremia

## According to duration:

i. Acute (< 48 hours)

ii. Chronic (> 48 hours)

## According to Severity:

i. Mild (130-135 mmol/L)

ii. Moderate (125-129 mmol/L) and

iii. Severe (<124 mmol/L)

# Pathophysiology

**Hyponatremia** is mostly due to **positive water balance** rather than **sodium deficit.**

So, it is usually **mean water retention** in **ECF volume.**

(relative water excess than sodium)

According to the **changes of the ECF volume-**

- **Hyponatremia with hypovolaemia**
- **Hyponatremia with euvolaemia**
- **Hyponatremia with hypervolaemia**

# Hyponatremia with hypovolaemia

Here, **depletion** of

**both sodium and water**

but

the **sodium deficit exceeds** the **water deficit.**

# Hyponatremia with euvolaemia

There are **no major**

**disturbances of body sodium**

and

**the patient is clinically euvolaemic.**

# Hyponatremia with hypervolaemia

Here,

**excess water retention**

is associated with

**sodium retention.**

# Causes of hyponatremia

| Volume status | Examples |
| --- | --- |
| Hypovolaemic | **Renal sodium losses:**<br>Diuretic therapy (especially thiazides)<br>Adrenocortical failure<br>**Gastrointestinal sodium losses:**<br>Vomiting, Diarrhoea<br>**Skin sodium losses:**<br>Burns |

| Volume status | Examples |
| --- | --- |
| Euvolaemic | Primary polydipsia<br>Excessive electrolyte-free water infusion<br>Syndrome of inappropriate secretion of antidiuretic hormone (SIADH)<br>Hypothyroidism |

| Volume status | Examples |
| --- | --- |
| Hypervolaemic | **Congestive cardiac failure**<br>**Liver cirrhosis**<br>**Nephrotic syndrome**<br>**Chronic kidney disease**<br>(during free water intake) |

# Syndrome of inappropriate secretion of antidiuretic hormone (SIADH)

In **Syndrome of inappropriate secretion of antidiuretic hormone (SIADH),**

there is **excess**

**ADH secretion**

and

ADH is **inappropriately high**

despite of

**low plasma osolarity** and **euvolemia.**

This **endogenous** source of

**ADH or vasopressin**

**(either cerebral or tumour-derived)**

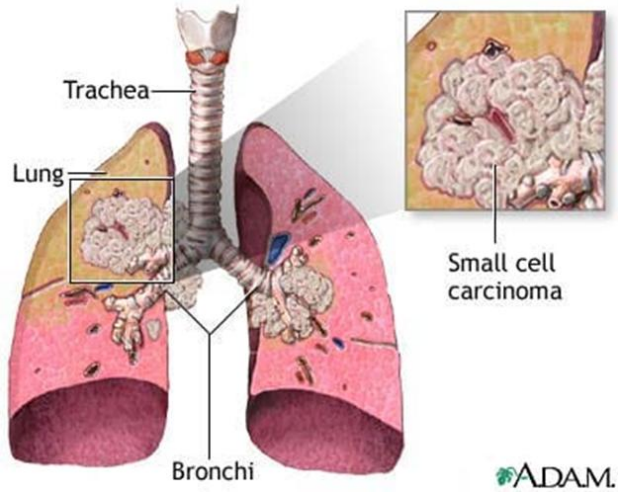
promotes **water retention** by the **kidney**

in the **absence** of

an appropriate **physiological stimulus**.

# Causes of SIADH

1. **Tumours** (Small cell lung cancer)
2. **Central nervous system disorders:**
    - Stroke
    - Trauma
    - Infection
    - Psychosis
    - Porphyria



## 3. Pulmonary disorders:

- Pneumonia
- Tuberculosis
- Obstructive lung disease

## 4. Drugs:

- Anticonvulsants
- Psychotropics
- Antidepressants
- Cytotoxics
- Oral hypoglycaemic agents
- Opiates

## 5. Idiopathic

# Diagnosis of SIADH

- Low plasma sodium concentration (<130 mmol/L)
- Low plasma osmolality (<275 mosm/L)
- High urine osmolarity (>100 mosm/L)
- High urine sodium concentration (>30mmol/L)
- Low / normal plasma urea, creatinine & uric acid

- **Absence of adrenal, thyroid, pituitary** and **renal insufficiency**
- **No recent use of diuretics**
- **Clinical euvolaemia**
- Exclusion of other causes of **hyponatremia**

# Other conditions of hyponatremia

## 1. Hypothyroidism with hyponatremia:

**Hypothyroidism**

↓

**↓ cardiac output**

↓

**↓ GFR**

↓

**↑ ADH**

Impaired free water excretion

↓

water retention

↓

diluted sodium

↓

hyponatremia

## 2. Primary polydipsia:

**Excess body water**

may be the result of

**abnormally high intake**

of either

**orally** or **medically infused fluids**

**(as intravenous dextrose solutions)**

## 3. Post operative hyponatremia:

- ✓ **Common** in **hospitalized patients**
- ✓ Mostly happens due to **Infusion of hypotonic fluids**
- ✓ **Non-osmotic release of ADH** due to **pain** and **stress**
- ✓ **ADH** induced **renal retention** of **water**

## 4. Oxytocin induced labour with dextrose solution:

Stress during labour

↓

causes non-osmotic release of ADH

↓

After infusion of **dextrose solution** without **NaCl**,

cells utilize **dextrose** and only **water** is remained in **ECF**

↓

aggressive **water retention**

↓

causes **severe hyponatremia** & reduction of **ECF osmolarity** compared to **ICF osmolarity**

↓

This causes **water entry** into **ICF** from **ECF**

↓

**cerebral edema** may occur

↓

**convulsion, coma,** and even **death**

So, induction of labour

with 5% DA

or

hypotonic saline

must be avoided.

## 5. Irrigation fluid absorption syndrome (TURP syndrome):

Occurs when

**excessive irrigation fluid**

is absorbed during

**endoscopic surgeries** like

**Transurethral Resection of the Prostate (TURP)** &

**endoscopic cholecystectomy.**

**Irrigation fluids** is **isotonic**

(containing **glycine** or **sorbitol** but **no electrolytes**)

are used to

clean the

**operation field.**

**During surgery,**

this fluid is **absorbed**

into the

**bloodstream.**

As the body **metabolizes**

**only**

**plain water**,

that **dilutes the ECF** and

leads to

**hyponatremia**.

# Clinical features of hyponatremia

The **symptoms** occurring is

related to the **duration**

rather than

the **severity** of

**hyponatremia**.

## Clinical features:

- Often **asymptomatic**
- **Anorexia, nausea, vomiting**
- **Lethargy, fatigue**
- **Delirium, dizziness, vertigo**
- **Seizures** and
- **Coma**

## Clinical features...

### MNEMONIC : SALT LOSS

Stupor / coma
Anorexia
Lethargy
Tendon reflexes dec

Limp muscles
Orthostatic hypotension
Seizures
Stomach cramping

# Diagnosis of hyponatremia

## Diagnosis of hyponatremia...

- Clinical assessment of volume status
- Serum and urine sodium concentration
- Serum and urine osmolality
- Serum Vasopressin (ADH) level

**Plasma ADH** measurements are

**not used**

in routinely because it is

**unstable**

and have been **replaced** by measurement of

**copeptin.**

## Copeptin:

**Peptide** derived from the **carboxyl terminal** of the **vasopressin precursor** and acts as a **surrogate** for **vasopressin.**

It is useful in the **differential diagnosis** of the **combination** of **hyponatraemia** and **polyuria.**

- **Artefactual causes** should be **considered** in all cases…

**severe hyperlipidaemia**

or

**hyperproteinemia.**

**Here,**

**Serum** sodium is **reduced**

because of the **volume** is

occupied by the

**macromolecules.**

**(this is called dilutional hyponatremia)**

## ❖ Transient hyponatremia:

Occurs due to

osmotic shifts of **water** out of **cells**

**(acute hyperglycemia or by mannitol infusion)**

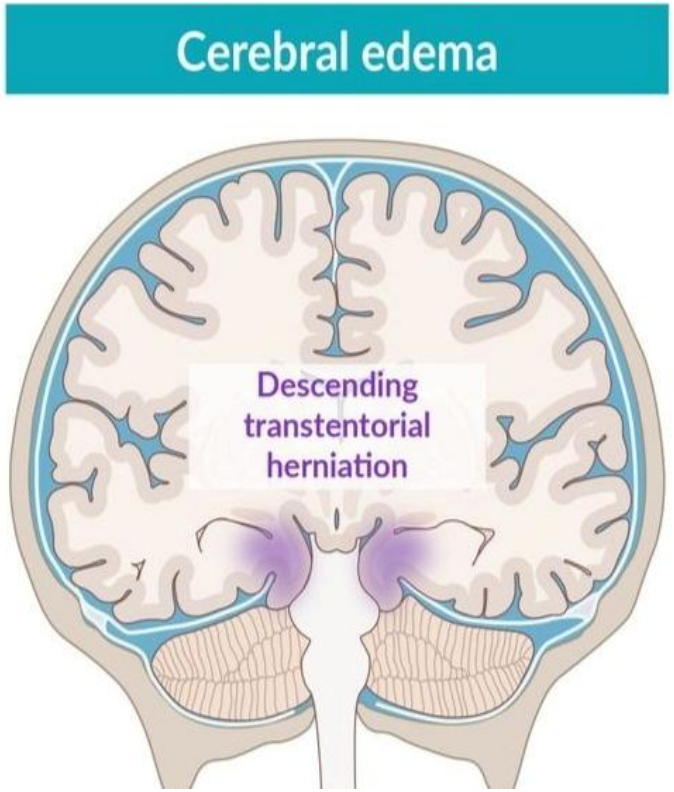
but in this cases

**plasma osmolarity** is **normal**.

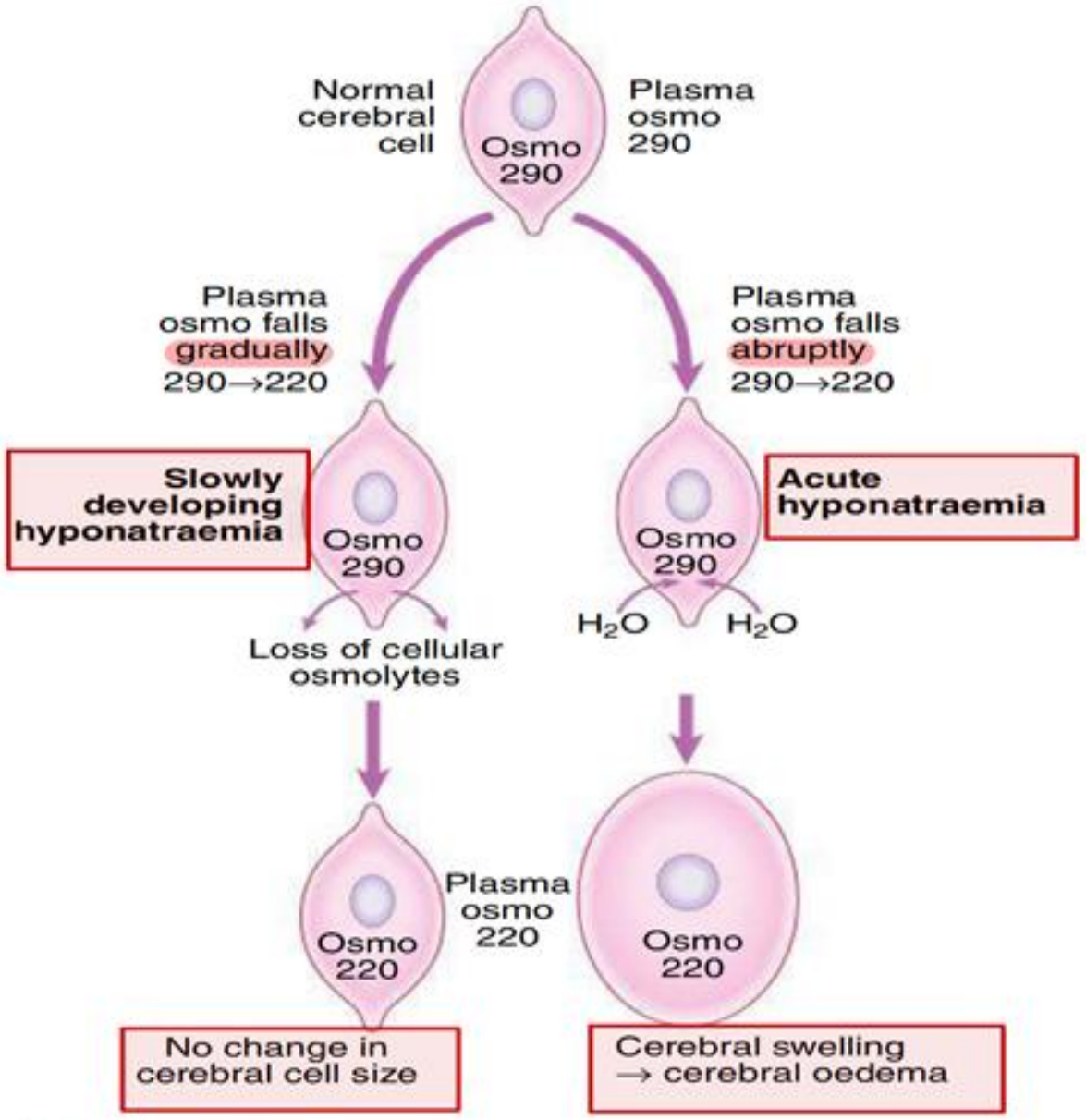
# Complications & clinical consequences of hyponatremia

## Complication of hyponatremia...

Most of the **clinical effects** of **hyponatremia** occur due to **cellular overhydration** & **cerebral oedema.**



# Hyponatremia and the brain



## Clinical consequences...

| Severity | Mild | Moderate | Severe |
|---|---|---|---|
| Symptoms | Asymptomatic | Nausea<br>Delirium<br>Headache | Vomiting<br>Somnolence<br>Seizures<br>Coma<br>Cardiorespiratory arrest |

❖ **Acute Development of hyponatremia (within 2 days):**

more **serious** and **death** may

occur at plasma sodium **<120 mmol/L**

❖ **Chronic Development of hyponatremia (≥ 3 days):**

**more tolerable.**

# Management of hyponatremia

## The treatment depends on:

- ✓ Rate of development (duration)
- ✓ Severity
- ✓ Presence of symptoms and
- ✓ Underlying causes

## 1. In hypovolemic hyponatremia:

### a. Acute hyponatraemia:

If hyponatremia has developed **rapidly (< 48hrs)** and there are **signs of cerebral oedema**, then-

infusion of

**hypertonic (3%) sodium chloride**

**(initial bolus of 150mL over 20 minutes)**

Which may be

**repeated once** or **twice**

depending on

the **neurological response**

and rise in

**plasma sodium.**

## b. In chronic hyponatremia:

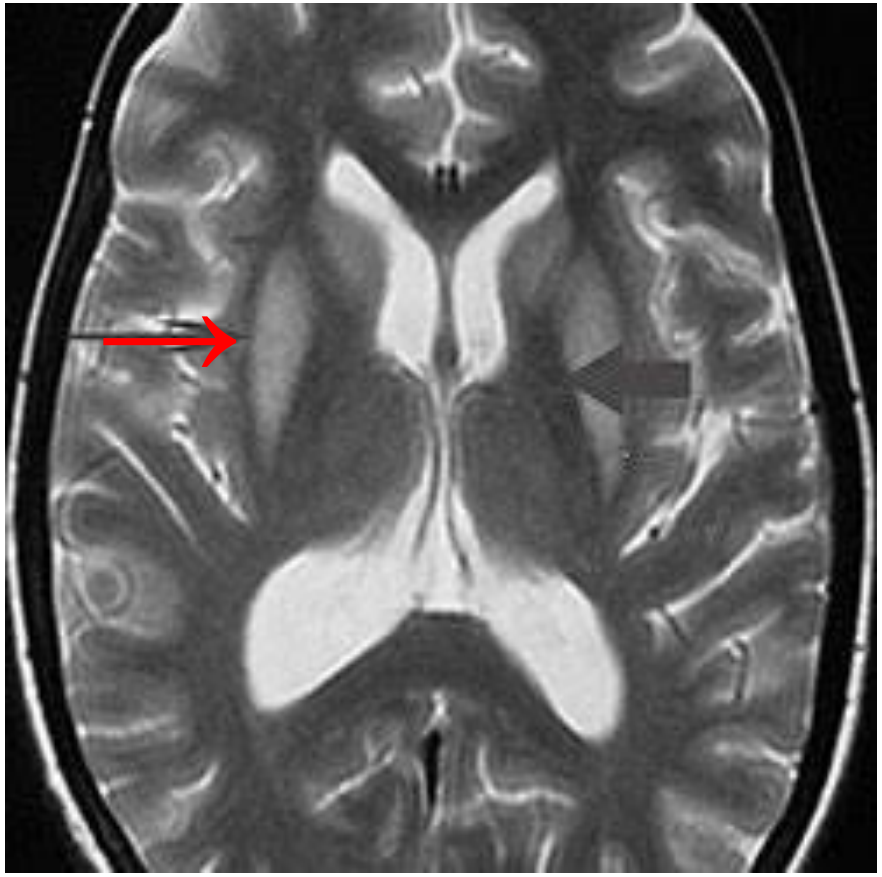
If hyponatremia has developed **slowly (> 48hrs)** and **asymptomatic, then-**

**should not** use **more than 10 mmol/L/24hrs**

(even **slower rate** is generally **safer**)

**If rapidly corrected:**

**‘Myelinolysis’** may occur,
that causes
**permanent structural &**
**functional damage**
to **mid-brain structures,**
which is
**fatal.**



## 2. In euvolemic hyponatremia:

- ✓ **Fluid restriction (600-1000 mL/24hrs)**
- ✓ **Withdrawal** of the **precipitating stimulus**

- **In persistent hyponatremia (due to prolonged SIADH):**
  - **Oral urea therapy (30 – 45 g/day)**

    (which provides a solute load to promote **water excretion**)
  - **Oral vasopressin receptor antagonists- Tolvaptan**

    (block the **vasopressin-mediated water retention**)
  - **Oral demeclocycline**

# Management...


R
Tolvaptan Tablets
Tolvaptoris 15
Tablets
STERIS Healthcare
10 x 1 x 4 Tablets


Demeclocycline
150mg


UreaTabs™
by
UreaAide™
Medical Food
for the management
of Hyponatremia
Premium USP Grade
Urea Tablets
240 Tablets
NET WT. 454g (1lb)
1.875 Gram Tablets
(30 doses)

## 3. In hypervolemic hyponatremia:

- **Diuretics** in conjunction with strict **fluid restriction**
- **Treatment of the underlying condition**

- **In mild to moderate hyponatremia:**

  **Oral sodium chloride (tablets/ table salt)**

  **Infusion of isotonic (0.9%) sodium chloride**


- **In severe hyponatremia:**

  **Infusion of hypertonic (3%) sodium chloride**

# Case scenario:

**A 62 year old man, chronic smoker, comes to the OPD with the complaints of lethargy, nausea, dizziness** and **drowsiness**.

**He had also history of cough with sputum, significant weight loss** and **hemoptysis**.

- **What is the probable diagnosis?**

# Take home message

1. **Maintain** a **balanced diet** with adequate **salt** and **protein**.
2. Avoid **excessive** **water intake**.
3. Take **water** and **electrolytes** during prolonged exercise, heavy sweating, vomiting, or diarrhea.

4. Take **diuretics** and other **medications** only as **prescribed**.

5. Manage **underlying diseases** such as **heart failure, liver disease, kidney disease,** and **endocrine disorders.**

6. Seek **medical attention early** if symptoms such as **nausea, headache, confusion, drowsiness,** or **seizures** develop.


Thank you