

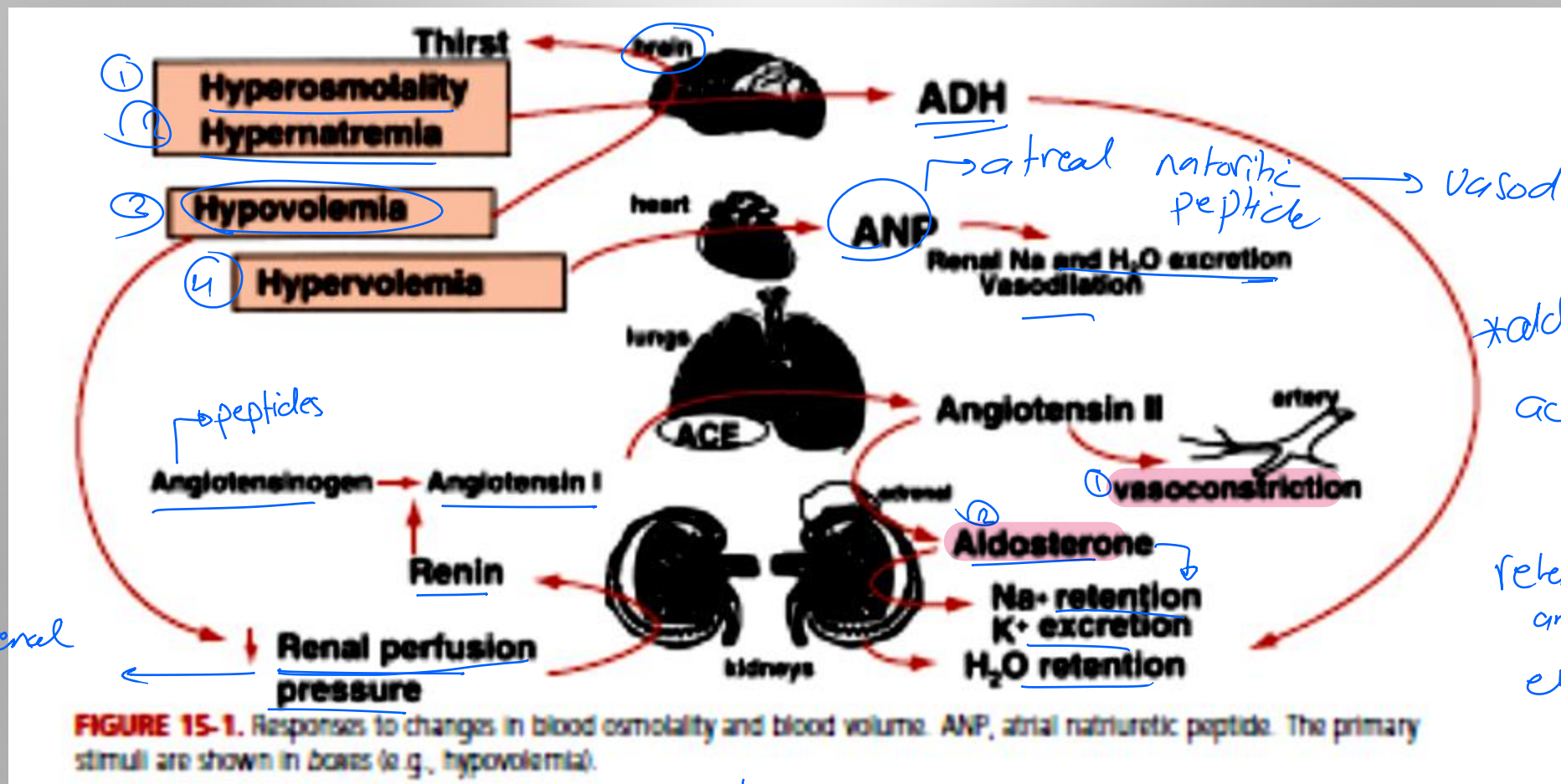
* ADH releases
Thirst center

- 1. hypernatremia
- 2. hyperosmolarity
- 3. hypovolemia

→ reabsorption water

* ANP → Hypervolemia
↓
excretion water + Na⁺

REGULATION OF SODIUM



decrease renal
perfusion
will
activate
renin

→ Angiotensin I → Angiotensin II → aldosterone

* aldosterone
↓
activated by
hypovolemia
↓
retention water
and Na⁺
excretion of
K⁺

$\uparrow \text{Na}^+$ \rightarrow \uparrow amount \rightarrow \downarrow volume of water

CAUSES OF HYPERNATREMIA

\rightarrow increase concentration of sodium in blood.

☐ Excess water loss (other than kidney).

- ☐ Diabetes insipidus
- ☐ Renal tubular disorder
- ☐ Prolonged diarrhea
- ☐ Profuse sweating
- ☐ Severe burns

☐ Decreased water intake

- ☐ Older persons
- ☐ Infants
- ☐ Mental impairment

☐ Increased intake or retention

- ☐ Hyperaldosteronism
- ☐ Sodium bicarbonate excess
- ☐ Dialysis fluid excess

Concentrated urine + low volume

في البداية يكون فقدان الماء عبر العرق

Urine is maximally concentrated. Low volume

concentrated urine low volume

فقدان الماء

من البول

في حالة

فقدان الماء

من البول

في حالة

فقدان الماء

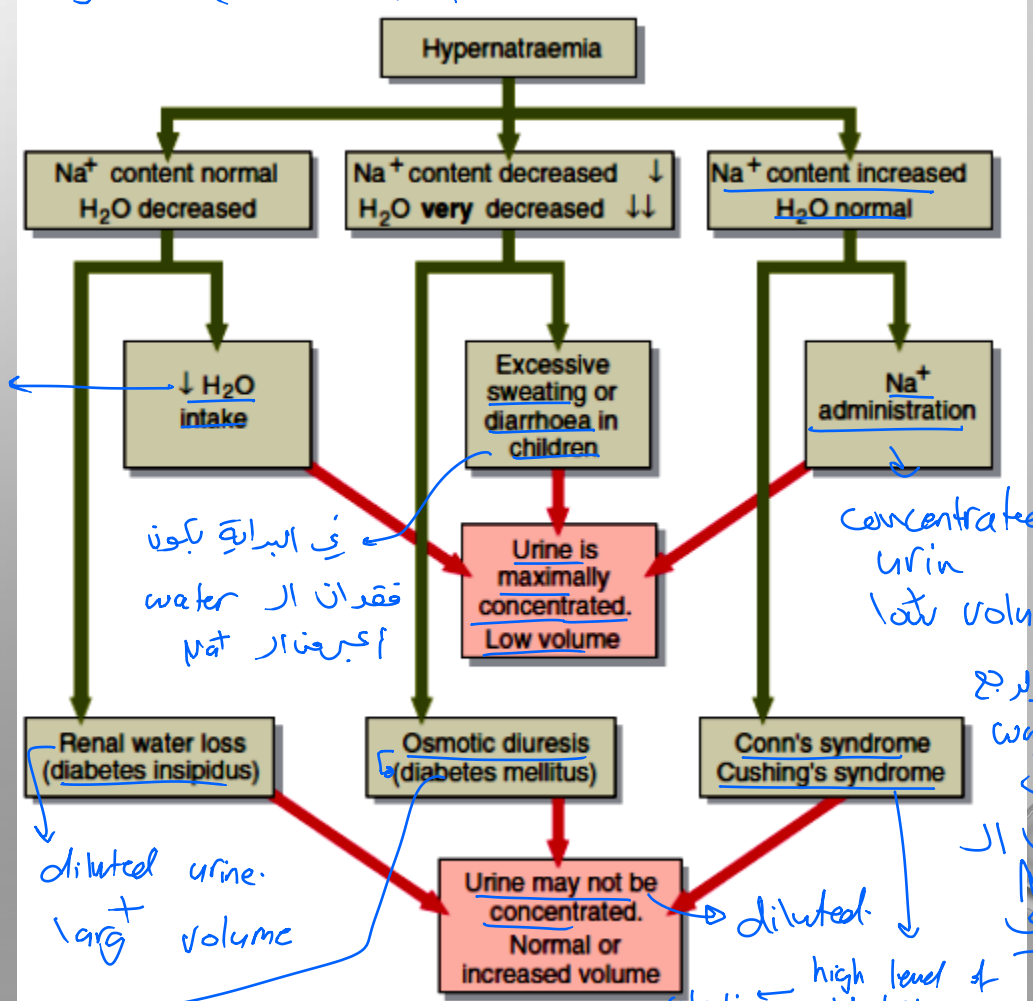


Fig 10.1 The causes of hypernatraemia.

retention of $\text{H}_2\text{O} + \text{Na}^+$ high level of aldosterone

No ADH

في حالة نقص ADH في عملية إعادة امتصاص الماء في الكلى

low sensitivity of osmo receptors.

cause water and Na^+ retention.

diluted urine \rightarrow \uparrow osmolality

في حالات الحماض الكيتوني

urine is glycosuric \rightarrow \uparrow osmolality

HYPERNATREMIA (150 MMOL/L) RELATED TO URINE OSMOLALITY

- ☐ Urine osmolality <300 mosm/kg (diluted, urine)
 - ① ☐ Diabetes insipidus (impaired secretion of ADH ^① respond to ADH) or kidneys cannot ^②)
- ☐ Urine osmolality 300-700 mosm/kg
 - ① ☐ Partial defect in ADH release or response to ADH
 - ② ☐ Osmotic diuresis (diabetes mellitus / high calcium level → ^{بسط مزاجي} الجسم تفسف , manitol. H₂O loss
- ☐ Urine osmolality >700 mosm/kg (concentrated urine).
 - ① ☐ Loss of thirst ← ^{عدم الشعور بالعطش}
 - ☐ Insensible loss of water (breathing, skin) ^{خف}
 - ☐ GI loss of hypotonic fluid (vomiting, diarrhea)
 - ☐ Excess intake of sodium
 - ② ☐ low level of water in urine.

SYMPTOMS OF HYPERNATREMIA → CNS symptoms.

Normal rang (135 to 145) → 150 and more → symptoms will appear.
145 to 150 → حافى اعراض

❑ Involve the central nervous system (CNS) hyperosmolar state which include: as a result of the

1 ❑ Altered mental status → حشوش

2 ❑ Lethargy → ارقاع

3 ❑ Irritability

4 ❑ Restlessness. → عدم الشعور بالراحة

5 ❑ Seizures

6 ❑ Muscle twitching, hyperreflexes → شدي جزء من العضلة حش
العضلة كاملة (ليكان حذر)

7 ❑ Fever, nausea or vomiting

8 ❑ Difficult respiration, and increased thirst.

❑ Serum sodium of more than 160 mmol/L is associated with a mortality rate of 60-75%

TREATMENT OF HYPERNATREMIA

لے بالبدایہ لازم اتوز شو السبب یلے عل زیادہ للموریوم وأعالجه

- ❑ Treatment is directed at correction of the underlying condition that caused the water depletion or sodium retention.
إذا كانت زیادہ الموریوم مثل کثیر کبیرہ ے
الحل، انه یشرب water وسبب دالہ.
- ❑ The speed of correction depends on the rate with which the condition developed
- ❑ Hyponatremia must be corrected gradually because too rapid a correction of serious hyponatremia (>160 mmol/L) can induce cerebral edema and death.
The maximal rate should be 0.5 mmol/L per hour

Cerebral edema

rate کای جتا بعد

لے اذا ار

↓
IV solution
without Na⁺

HYPONATREMIA

↳ low concentration of Sodium in blood.

❑ Hyponatremia is defined as a serum or plasma level <135 mmol/L.

↳ بتدليس الأعراض بعد ما يقل عن 135

❑ Levels below 130 mmol/l are clinically significant.

❑ Hyponatremia can be assessed by the cause for the decrease or with the osmolality level.

له لازم ايرف شو
المسبب

المفوض بين يقل level Nat
في الدم ال osmolality
نقل للدم

* we can measured the concentration of Nat
in serum. and plasma or urine

CAUSES OF HYPONATREMIA

secretion. Na^+ و K^+ excretion Na^+ و K^+ aldosterone Na^+ و K^+

high level of Na^+ in urine.

low level of aldosterone.

excretion in urine

Na^+ و K^+

keton bodies \downarrow anion

☐ Increase sodium loss

☐ Hypoadrenalism

☐ Potassium deficiency (exchange in kidney)

☐ Diuretic use (thiazide)

☐ Ketonuria (sodium lost with ketones)

☐ Salt losing nephropathy (with some renal tubular disorders)

☐ These factors will increase the conc. of Na^+ in urine to $>20 \text{ mmol/L}$

☐ Prolong vomiting or diarrhea

☐ Severe burns

☐ Increased water retention

☐ Renal failure

☐ Nephrotic syndrome (Kidney problem)

☐ Hepatic cirrhosis (liver problem).

☐ Congestive heart failure

Na^+ + water \rightarrow excretion.

K^+ \rightarrow retention.

decrease aldosterone secretion \rightarrow Na^+ + water excretion.

hyponatremia and hypokalemia ($\downarrow \text{Na}^+$ + $\downarrow \text{K}^+$)

problem in tubules \rightarrow reabsorption Na^+ و K^+

loss of Na^+ + water \rightarrow the body. Na^+ و K^+ water \rightarrow reabsorption

diluted for ions in the body.

low volume \leftarrow urine

low level of Na^+

kidney fluid \rightarrow kidney

CAUSES OF HYPONATREMIA

① Water imbalance

يكون عند مشكلة ثانية

- ❑ Excess water intake (polydipsia, increased thirst): may cause mild or severe hyponatremia if water intake was chronic. In a normal individual, excess intake will not affect Na levels.

→ syndrome inappropriate antidiuretic hormone.

- ❑ SIADH causes an increase in water retention because of increased ADH production which is associated with pulmonary disease, malignancies, CNS disorders, infections.

① → retention for water (edema).
→ diluted for Na⁺
↓
hyponatremia.

في حال وجود بروتين أو دهون كثيرة ← رالة تسمى ليجند
أو electrode ← يقيس الـ Na⁺ أنه يقيس له قياس → يقيس الفية
hypo و هو مش
hypo.

- ❑ Pseudohyponatremia by measuring Na using indirect ISE (which dilutes sample prior to analysis), in a patient with hyperproteinemia or hyperlipidemia.

ion selective electrode
→ selective for sodium.

①

②

③ lymolysis of sample

بعضه لقيس الفية

الهيموليز ← ال water يتطلع من داخل الخلايا إلى interstitial fluid ← فبتقل dilution لـ Na^+ ← بسبب إنه عنده

fluid

CLASSIFICATION OF HYPONATREMIA BY OSMOLALITY

بالإضافة إلى K^+ إنه يكون K^+ الموجود جها الخلايا K^+ يتطلع ليبراً ← pseudo-hyperkalemia

الموجود جها الخلايا K^+ يتطلع ليبراً ← pseudo-hyperkalemia

pseudo-hyperkalemia

or increase water volume. Na^+ تنزل أو osmolality تنزل معها

□ With low osmolality

1. □ Increased sodium loss
2. □ Increased water retention

□ With normal osmolality increased nonsodium cations

1. □ Lithium excess
2. □ Increased γ -globulins-cationic (multiple myeloma)
3. □ Severe hyperkalemia
4. □ Severe hypermagnesemia
5. □ Severe hypercalcemia, pseudohyponatremia
6. □ Hyperlipidemia
7. □ Hyperproteinemia
8. □ Pseudohyperkalemia as a result of in vitro hemolysis

في الماشي ثاني ارتفاع Na^+ دعوف فعل ال osmolality في ال

□ With high osmolality

1. □ Hyperglycemia
2. □ Mannitol infusion

ارتفاع glucose or urea → زياد ال osmolality

SYMPTOMS OF HYPONATREMIA

❑ Symptoms depend on the serum level.

❑ Between 125 and 130 mmol/l: symptoms are gastrointestinal (Nausea and vomiting)

❑ Below 125 mmol/l: more severe neuropsychiatric seen including nausea and vomiting, muscular weakness, headache, lethargy, and ataxia.

(1) (2) (3) (4) (5) (6)

❑ More severe symptoms also include seizures, coma, and respiratory depression

↓
death.

TREATMENT OF HYPONATREMIA

لأنه برناش نفقي
للوائك كثير
لأنه لازم اعرف شوا السبب يلي على النقص

❑ Treatment is directed correction of the condition that caused either water loss or sodium loss in excess of water loss. ⁽²⁾ → give hypertonic solution.

❑ Correcting severe hyponatremia too rapidly can cause cerebral myelinolysis while too slowly can cause cerebral edema.

خاصة الأسفاه يلي عندهم edema

❑ Appropriate management of fluid administration is critical. Fluid administration and monitoring is required during treatment of the underlying cause of the hyponatremia.

❑ The measurement of urine osmolality is necessary to evaluate the cause of hypernatremia.

❑ Chronic hyponatremia in an alert patient is indicative of hypothalamic disease.

DETERMINATION OF SODIUM

- ❑ Sodium can be measured in serum, plasma, and urine.
① ② ③ → 24 hour collection.
Sodium. زینکا کا تجزیہ علی
- ❑ When plasma is used, lithium heparin, ammonium heparin, and lithium oxalate are suitable anticoagulants.
④ ⑤
- ❑ Hemolysis does not cause significant change in serum or plasma values as a result of decreased levels of intracellular sodium. however, with marked hemolysis, levels may be decreased as a result of a dilutional effect
→ ہشکر جیسے water بظاہر سے اخراج لیا
→ رازہ اور Nat فیصد dilution level.
- ❑ Whole blood samples may be used with some analyzers.
- ❑ The specimen of choice in urine sodium analyses is a 24-hour collection.
- ❑ Sweat is also suitable for analysis.

عليها سوال بالإعتقان وهرنا حاكين الفقرة.

POTASSIUM — major intracellular cation.

- ❑ Potassium is the major intracellular cation in the body with a concentration 20 times greater inside the cells than outside
- ❑ Many cellular functions requires that the body maintains a low ECF concentration of K.
As a result, only 2% of the body's total potassium circulates in the plasma.
- ❑ Function of potassium in the body include
 - 1-❑ Neuromuscular excitability
 - 2-❑ Contraction of the heart
 - 3-❑ ICF volume (intracellular fluid volume) → prevent swelling or shrinking of cells.
 - 4-❑ Hydrogen ion concentration.

الجسم يروج بسببه لجوا الخلية
وعشان يتعادل بروج 2 يطلع مكانها H^+ لـ ECF ← إذا نسبة عالية تهب
high level of K^+ ECF →
acidosis.

normal level (3.5 to 5)

POTASSIUM

↑ K⁺ cell → uptake by cell
→ يتدفق داخل الخلية
→ H⁺ في الخلية
→ acidosis

↓ K⁺ → يخرج من الخلية
→ عشان يكون بيترجع H⁺ للخلية
→ alkalosis

(such as cancer) alkalosis ← H⁺ لا الخلية

❑ The potassium ion concentration has a major effect on skeletal and cardiac muscles. A lower than normal difference increases cell excitability leading to muscle weakness.

❑ Severe hypokalemia can cause muscle excitability which may lead to paralysis or fatal cardiac arrhythmia

❑ Hypokalemia decreases cell excitability resulting in an arrhythmia or paralysis

❑ the heart may cease to contract in extreme case of hypokalemia or hyperkalemia

❑ Potassium concentration affects hydrogen ion concentration in the blood. In hypokalemia, when potassium ion is lost from the blood, sodium and hydrogen ions move to into the cells. The hydrogen ion concentration decreases in ECF resulting to alkalosis.

heart block.
↓
level of K⁺ more than 10.

problem in ATPase → ↑K⁺ in blood
dependance ion pump.

kidney problem → hyper
normal kidney → normal → excreted
K⁺ in urine.

FACTORS AFFECT K LEVEL IN ECF

insulin → increase uptake of K⁺ → diabetes patient
No insulin → No K⁺ intake

kidney problem
→ hyper
normal
kidneys
↓
normal.

Three factors that influence the distribution of potassium between cells and ECF are:

- (1) **Potassium loss** frequently occurs whenever the NaK ATPase pump is inhibited by conditions such as:
 - (1) hypoxia → ↓Mg
 - (2) hypomagnesemia → because its a cofactor of these pump
 - (3) or digoxin overdose → digoxin competition with K⁺.
 - ↑K_a of digoxin → no effect
 - ↓K_a → digoxin toxicity.
- (2) **Insulin** promotes acute entry of K ions into skeletal muscle and liver by increasing NaK ATPase activity.
- (3) **Catecholeamines** such as epinephrine (β2-stimulator), promotes cellular entry of K whereas propranolol (β-blocker) impairs cellular entry of potassium.
- With preexisting condition such as dietary deficiency (or excess) can enhance the degree of hypokalemia (or hyperkalemia) but rarely the primary cause.