Dehydration

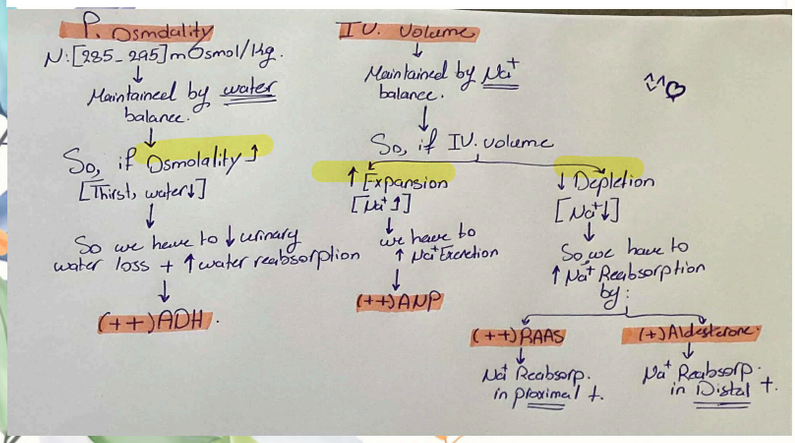
BODY COMPOSITION

Water is the most plentiful constituent of the human body. **Total body water (TBW)** as a percentage of body weight varies with age. The fetus has a high TBW, which gradually decreases to about 75% of birth weight for a term infant; TBW is higher in premature infants. During the first year of life, TBW decreases to about 60% of body weight and basically remains at this level until puberty. At puberty, the fat content of females increases more than that of males, who acquire more muscle mass than females. Because fat has low water content and muscle has high water content, by the end of puberty, TBW in males remains at 60%, but it decreases to 50% of body weight in females. During dehydration, TBW decreases and is a smaller percentage of body weight.

TBW has two main compartments: **intracellular fluid (ICF)** and **extracellular fluid (ECF)**. In the fetus and newborn, the ECF volume is larger than the ICF volume. The normal postnatal diuresis causes an immediate decrease in the ECF volume. This decrease in ECF volume is followed by continued expansion of the ICF volume because of cellular growth. By 1 year of age, the ratio of the ICF volume to the ECF volume approaches adult levels. The ECF volume is 20-25% of body weight, and the ICF volume is 30-40% of body weight (Fig. 32.1). With puberty, the increased muscle mass of males results in a higher ICF volume than in females.

The ECF is divided further into **plasma water** and **interstitial fluid** (see Fig. 32.1). Plasma water is about 5% of body weight. The blood volume, given a hematocrit of 40%, is usually 8% of body weight, although it is higher in newborns and young infants. The interstitial fluid, normally 15% of body weight, can increase dramatically in diseases associated with edema, such as heart failure, protein-losing enteropathy, liver failure, and nephrotic syndrome.

The composition of solutes in the ICF and ECF is different. Sodium and chloride are the dominant cation and anion in the ECF. Potassium is the most abundant cation in the ICF, and proteins, organic anions, and phosphate are the most plentiful anions in the ICF. The dissimilarity between the anions in the ICF and the ECF is determined largely by the presence of intracellular molecules that do not cross the cell membrane, the barrier separating the ECF and the ICF. In contrast, the difference in the distribution of cations—sodium and potassium—is due to the activity of the Na^+,K^+-ATPase pump, which extrudes sodium from cells in exchange for potassium.

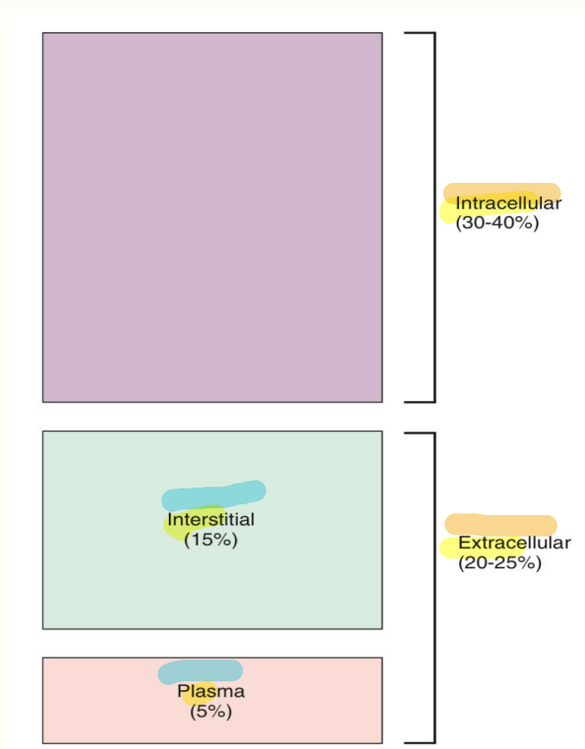


REGULATION OF INTRAVASCULAR VOLUME AND OSMOLALITY

Proper cell functioning requires close regulation of plasma osmolality and intravascular volume; these are controlled by independent systems for water balance which determines osmolality, and sodium balance which determines volume status. Maintenance of a normal **osmolality** depends on control of water balance. Control of **volume status** depends on regulation of sodium balance.

The plasma osmolality is tightly controlled between 285 and 295 mOsm/kg through regulation of water intake and urinary water losses. A small increase in the plasma osmolality stimulates thirst. Urinary water losses are regulated by the secretion of **antidiuretic hormone (ADH)**, which increases in response to an increasing plasma osmolality. ADH, by stimulating renal tubular reabsorption of water, decreases urinary water losses. Control of osmolality is subordinate to maintenance of an adequate intravascular volume. When significant volume depletion is present, ADH secretion and thirst are stimulated, regardless of the plasma osmolality.

Volume depletion and volume overload may cause significant morbidity and mortality. Because sodium is the principal extracellular cation and is restricted to the ECF, adequate body sodium is necessary for maintenance of intravascular volume. The kidney determines sodium balance because there is little homeostatic control of sodium intake, although salt craving occasionally occurs, typically in children with chronic renal salt loss or adrenal insufficiency. The kidney regulates sodium balance by altering the percentage of filtered sodium that is reabsorbed along the nephron. The **renin-angiotensin system** is an important regulator of renal sodium reabsorption and excretion. The juxtaglomerular apparatus produces renin in response to decreased *effective* intravascular volume. Renin cleaves angiotensinogen, producing angiotensin I, which angiotensin-converting enzyme converts into angiotensin II. The actions of angiotensin II include direct stimulation of the proximal tubule to increase sodium reabsorption and stimulation of the adrenal gland to increase aldosterone secretion, which increases sodium reabsorption in the distal nephron. In contrast, volume expansion stimulates the synthesis of **atrial natriuretic peptide**, which increases urinary sodium excretion.



A. **General principles**

1. The **most common cause of acute fluid and electrolyte imbalance is acute diarrhea with dehydration.**
2. Worldwide, acute diarrheal diseases are among the leading causes of childhood morbidity and mortality.

B. **Total body fluid requirement** *is the sum of a patient's maintenance fluid needs, replacement of prior fluid losses (i.e., deficits), and replacement of ongoing losses,* if any.

1. **Maintenance water and electrolyte calculations** are designed to balance the usual daily losses of water and salts that occur as a result of normal daily metabolic activities. These losses take both measurable forms (**sensible losses**), such as urinary losses, and less readily measurable but still clinically significant forms (**insensible losses**), such as losses from the skin, lungs, and gastrointestinal (GI) tract.
   a. **Maintenance water requirement is** approximately **1500 mL/m²/day** for children. Water requirements for infants and premature infants vary with the birth weight and postnatal age.
   b. **Maintenance water requirement may alternatively be calculated** from the patient's weight.
      1. **100 mL/kg/day** for the first 10 kg of body weight
      2. **50 mL/kg/day** for the second 10 kg of body weight
      3. **20 mL/kg/day** for each kg above the first 20 kg of body weight
   c. **Maintenance fluids should be increased** if the patient has **increased insensible losses,** such as **respiratory distress and fever (i.e., about a 10% increase for every degree of temperature).**
   d. **Maintenance sodium (Na^+) requirement is approximately 2–3 mEq/kg/day.**
   e. **Maintenance potassium (K^+) requirement is approximately 2 mEq/kg/day.**
2. **Deficit fluid calculations** are designed to replace **abnormal losses of water and salts** caused by pathologic states, such as diarrhea and vomiting. Deficit fluids are calculated as follows: **Fluid deficit (L) = pre-illness weight (kg) − current weight (kg).**
3. **Ongoing loss calculations** are designed to replace additional losses of water and salts after the patient's initial evaluation (e.g., ongoing vomiting or diarrhea, nasogastric tube aspirate). These ongoing losses are replaced milliliter for milliliter.

There are three sources of normal water loss—the components of maintenance water (see Chapter 32): urine (60%), **insensible losses** from the skin and lungs (35%), and stool (5%) (Table 33.1). Sweating is not insensible and, in contrast to evaporative losses, sweat contains water and electrolytes.

TABLE 33.1 Components of Maintenance Water

Urine	60%
Insensible losses (skin and lungs)	35%
Stool	5%

A variety of clinical situations modify normal maintenance water balance (Table 33.2). Evaporative skin water losses can be higher in neonates, especially premature infants who are under radiant warmers or undergoing phototherapy. Burns can result in massive losses of water and electrolytes (see Chapter 44). Fever increases insensible losses. Tachypnea or a tracheostomy increases evaporative losses from the lungs.

The gastrointestinal tract is potentially a source of considerable water and electrolyte losses. A child who has large amounts of gastrointestinal losses should have these losses measured and replaced with an appropriate **replacement solution** (Table 33.3).

Urine output is normally the largest cause of *water* loss. Diseases such as renal failure and the syndrome of inappropriate antidiuretic hormone (SIADH) can lead to a decrease in urine volume. Maintenance fluids in a patient with oliguria or anuria may produce fluid overload if the cause is acute kidney injury. In contrast, other conditions produce an increase in urine volume; these include the polyuric phase of acute kidney injury, diabetes mellitus, and diabetes insipidus. When the urine output is excessive, the patient must receive more than standard maintenance fluids to prevent dehydration.

Output from surgical drains and chest tubes, when significant, should be measured and replaced. **Third space losses** manifest with edema and ascites and are due to a shift of fluid from the intravascular space into the interstitial space. Third space losses cannot be quantitated. Nonetheless, these losses can be large and lead to intravascular volume depletion, despite weight gain from edema or ascites. Replacement of third space fluid is empirical but should be anticipated in patients who are at risk, such as children who have sepsis, shock, burns, or abdominal surgery. Third space losses and chest tube output are isotonic and usually require replacement with an **isotonic fluid,** such as normal saline (NS) or Ringer lactate. Adjustments in the amount of replacement fluid for third space losses are based on continuing assessment of the patient's intravascular volume status.

TABLE 33.2 Adjustments in Maintenance Water

SOURCE	CAUSES OF INCREASED WATER NEEDS	CAUSES OF DECREASED WATER NEEDS
Skin	Radiant warmer Phototherapy Fever Sweat Burns	Incubator (premature infants)
Lungs	Tachypnea Tracheostomy	Humidified ventilator
Gastrointestinal	Diarrhea Emesis Nasogastric suction	
Renal	Polyuria	Oliguria/anuria
Miscellaneous	Surgical drain Third space losses	Hypothyroidism

Before we talk about dehydration, let's know more about IV fluid

Summary

Intravenous fluid therapy involves the intravenous administration of crystalloid solutions and, less commonly, colloidal solutions. The type, amount, and infusion rates of fluids are determined based on the indication for fluid therapy and specific patient needs. Crystalloid solutions are used to resuscitate patients who are hypovolemic or dehydrated, correct free water deficits, replace ongoing fluid losses, and meet the fluid requirements of patients who cannot take fluids enterally. The use of colloidal solutions is controversial and should be reserved for special situations (e.g., severe cases of low oncotic pressure). All patients should be closely monitored using a combination of clinical parameters and laboratory tests to determine therapeutic endpoints, and fluid therapy should be appropriately de-escalated for patients in recovery to avoid fluid overload.

Osmolarity is indicated by electrolytes balance..
The main electrolyte here is Na+(the most extracellular fluid)..
K+(the most Intracellular fluid)..
معنى الكلام لو بدي أعطي fluid، حيكون Na+ أسرع في الcorrection من الk+..
Normal osmolarity in pediatric 275-295 mOsmol/kg
الfluid بيتحرك من الlow osmolarity لhigh osmolarity يعني من Na+ لNa+..

Crystalloid solutions [2][8]

- Aqueous solutions with varying concentrations of electrolytes
- The **most commonly** used fluids in a hospital setting
- Crystalloids increase intravascular volume; the extent to which they do this depends on their tonicity (effect on fluid compartments).
- Choose a solution based on treatment goals and patient characteristics (see "Principles of IV fluid therapy").

Isotonic crystalloids

- Best solutions for IV fluid resuscitation
- Mixed isotonic solutions (i.e., containing glucose) are preferred as maintenance fluids (see "Mixed crystalloid solutions").

Isotonic IV crystalloids [2][9][8]

	Normal saline (0.9% NaCl)	Lactated Ringer's solution (LR)
	slightly hyperosmolar ،308mOsmol/Kg تعادل Normal saline بال osmolarity ال يبقى هوا	slightly hypoosmolar يعني 272mOsmol/Kg تعادل ringer lactae بتبعت ال osmolarity ال
Composition and osmolarity	• Na^+: 154 mEq/L • Cl^-: 154 mEq/L • Osmolarity: 308 mOsm/L	• Na^+: 130 mEq/L • Cl^-: 109 mEq/L • K^+: 4 mEq/L • Ca^{2+}: 2.7 mEq/L (1.35 mmol/L) • Lactate (HCO_3^-): 28 mEq/L • Osmolarity: 273 mOsm/L
Effect on fluid compartments	• ↑ Extracellular volume • No change in intracellular volume	• ↑ Extracellular volume • Minimally elevated intracellular volume • Balanced solution: mild buffer action that counters acidosis
Clinical applications	• Fluid resuscitation • Maintenance fluid therapy • Treatment of hypovolemic hyponatremia (nonsevere cases) • Solvent for IV drugs	• Fluid resuscitation • Maintenance fluid therapy
Risks	لأنه normally ال -Cl بالجسم من 96-100 • Hyperchloremic acidosis [3] • Fluid overload (see "Complications of parenteral fluid therapy")	• Accumulation of lactate in patients with liver failure • Possibly hyperkalemia [10][11] • Contains calcium • Fluid overload (see "Complications of parenteral fluid therapy")

ال K+ ممنوع تعطيه لواحد معه anuria، وهاد k+ فينخاف من الhyperkalemia وتدخله ب dialysis
لو كان pt with meinigitis، ممنوع تعطي Ca++ with ceftriaxone ولو كان داخل ب shock فما يعطيه ringer lactate
الlactate بيتحول لbicarbonate بال liver، وبتحمي من الacidosis..

Hypotonic crystalloids

Hypotonic crystalloids can be used to correct free water deficits and as a maintenance fluid if there is free water loss. [9]

Hypotonic IV crystalloids [2][9][8]

	Dextrose solutions	Hypotonic saline solutions
	,shock therapy بال ما بينفع تستخدمه الdextrose	

Composition and osmolarity	• **5% dextrose in water** (D5W)
	  ◦ Dextrose: 5 g/dL
	  ◦ Osmolarity: 252 mOsm/L
	• **10% dextrose in water** (D10W)
	  ◦ Dextrose: 10 g/dL
	  ◦ Osmolarity: 505 mOsm/L
		• **0.45% NaCl** (½NS)
		  ◦ Na^+: 77 mEq/L
		  ◦ Cl^-: 77 mEq/L
		  ◦ Osmolarity: 154 mOsm/L
		• **0.22% NaCl** (¼NS)
		  ◦ Na^+: 39 mEq/L
		  ◦ Cl^-: 39 mEq/L
		  ◦ Osmolarity: 78 mOsm/L

Effect on fluid compartments	• ↑ Extracellular volume • ↑ Intracellular volume	• ↑ Extracellular volume • ↑ Intracellular volume
Clinical applications	• Correction of free water deficit (hypernatremia) • Maintenance fluid therapy in specific cases • **Solvent for IV drugs** (e.g., noradrenaline infusions)	• Correction of free water deficit (hypernatremia) • Maintenance fluid therapy in specific cases
Risks	• **Hyponatremia** • Cerebral edema • Pulmonary edema • Hyperglycemia • Hypokalemia [12]	• **Hyponatremia** • **Cerebral edema** • Pulmonary edema

Maintenance fluid therapy with hypotonic solutions can cause iatrogenic hyponatremia and cerebral edema. [9]

Hypertonic crystalloids

Hypertonic saline solutions must be administered with extreme caution because of the risk of rapid osmotic changes.

Hypertonic IV crystalloids (hypertonic saline)

	3% NaCl	5% NaCl
Composition and osmolarity	• Na^+: 513 mEq/L • Cl^-: 513 mEq/L • Osmolarity: 1027 mOsm/L	• Na^+: 856 mEq/L • Cl^-: 856 mEq/L • Osmolarity: 1711 mOsm/L
Effect on fluid compartments	• ↓ Intracellular volume • ↑ Extracellular volume	
Clinical applications	• Hyponatremia (usually severe) • Treatment of cerebral edema (see "ICP management") [13]	
Risks	• **Osmotic demyelination syndrome**	

When administering hypertonic saline, frequent serum sodium controls must be conducted so that treatment can be adjusted accordingly. A rapid increase in serum sodium can lead to osmotic demyelination syndrome.

Mixed crystalloid solutions

The following list is not exhaustive, but it includes some very commonly used formulations.

- **Dextrose in saline solutions**
  - Composition and osmolarity
    - **5% dextrose in 0.9% NaCl** (D5NS); **isotonic**: dextrose: 5 g/dL; Na^+: 154 mEq/L; Cl^-: 154 mEq/L; osmolarity: 560 mOsm/L
    - **5% dextrose in 0.45% NaCl** (D5½NS); **hypotonic**: dextrose: 5 g/dL; Na^+: 77 mEq/L; Cl^-: 77 mEq/L; osmolarity: 406 mOsm/L
  - Clinical applications
    - Fluid replacement therapy
    - Fluid maintenance therapy
- **Isotonic bicarbonate** (1.3% $NaHCO_3$)

Dehydration:

Summary

Hypovolemia refers to a state of intravascular volume depletion, while dehydration describes a state of reduced total body water volume, mostly affecting the intracellular fluid compartment. In clinical practice, however, these terms are often used interchangeably, as they are often encountered simultaneously. Body fluid loss (dehydration and/or hypovolemia) occurs when fluid excretion exceeds fluid intake, e.g., due to inadequate fluid intake, vomiting, and/or diarrhea. Young children and the elderly are at an increased risk of clinical dehydration because of differences in body water distribution, ...

Definition

- It is a state of -ve water balance
- It's due to *Decrease intake ,Excess loss or Both

dehydration = excessive loss of body fluid and electrolytes

⊛ Degree of dehydration : = types based on severity

	infant	child
- mild	≤ 5%	≤ 3%
- moderate	5-10%	3-6%
- severe	≥ 10%	≥ 7%

⊛ Types of dehydration : = based on type of fluid loss

depend on Na level.

- hyponatremic <130
- isonatremic 130-150 ⇒ is the most common
- hypernatremic >150

If Na level is unknown it is isonatremic until proven otherwise

⊛ Signs and Symptoms :

	moderate	severe
- level of consciousness	irritable	lethargic
- blood pressure	orthostatic hypotension	hypotension
- capillary refill	2-3 sec	≥ 4 sec
- urine output	Oliguria	anuria

Mild dehydration = Thirst , decreased tears

⊛ oliguria : ≤ 1 cc / kg / hr

anuria : ≤ 1 cc / kg / day ⇒ In infant :

≤ 0.5 cc / kg / day ⇒ In child :

Dehydration, most often due to gastroenteritis, is common in children. The first step in caring for a dehydrated child is to assess the degree of dehydration. The degree of dehydration dictates the urgency of the situation and the volume of fluid needed for rehydration. Table 33.5 summarizes the

S&S	Mild	Moderate	Severe
Thirst	+	+	+++
Level of consciousness	Alert	Lethargic	Lose, even coma
Capillary refilling	2 sec.	2-4 sec.	>4 sec , cool limbs.
Mucous membranes	Normal	Dry	Very dry
Tears	Normal	Decreased	Absent
Heart rate	Normal	Increased	Markedly increased.
Respiratory rate	Normal	Increased	Rapid & deep.
BP	Normal	Normal	Decreased
Pulse	Normal	Rapid	Weak & rapid
Skin turgor	Normal	Slow	Tenting
Fontanel	Normal	Depressed	Sunken
Eyes	Normal	Sunken	Very sunken
Urine output	Normal	Oliguria	Oliguria or anuria.
	Only thirst	Thirst + signs	Thirst + signs + shock.

Before we discuss the types of dehydration, let's know about ORS and paranteral rehydration:

D. **Parenteral rehydration** should occur in **two phases:**

1. **Emergency phase**
   a. **The goal of the emergency phase** is to restore or maintain the intravascular volume to ensure perfusion of vital organs.
   b. The emergency phase is **the same for all patients,** regardless of the patient's initial serum sodium level.
   c. **20 mL/kg boluses** of intravenous (IV) solutions with a high enough oncotic load (e.g., **normal saline** or **lactated Ringer solution**) are commonly used.
2. **Repletion phase**
   a. The **goal of the repletion phase** is a more gradual correction of the patient's water and electrolyte deficits.
   b. Patients with the **acute onset of hyponatremic or isonatremic dehydration** generally have their fluid and electrolyte deficits replaced **over 24 hours.** Chronic hyponatremia should be corrected much more slowly.
   c. Patients with **hypernatremic dehydration** generally have their fluid and electrolyte deficits replaced more slowly, usually **over 48 hours,** to minimize **the risk of cerebral edema** that may accompany rapid fluid correction.

E. **Oral rehydration therapy (ORT)**

1. **ORT may be an effective, safe, and inexpensive alternative** to IV rehydration therapy.
2. **Oral rehydration salt (ORS) solutions** are **balanced mixtures of glucose and electrolytes** for use in treating and preventing dehydration, potassium depletion, and base deficits caused by diarrhea.
3. ORT is based on the principle that the intestinal absorption of sodium and other electrolytes is enhanced by the active absorption of glucose (**coupled cotransport mechanism**). This coupled cotransport process of intestinal absorption **continues to function normally during secretory diarrhea,** whereas other pathways of intestinal absorption of sodium are impaired.
4. **ORT is inappropriate** for patients with severe life-threatening dehydration, for patients with paralytic ileus or GI obstruction, and for patients with extremely rapid stool losses or repeated severe emesis losses.

Types of dehyration and managment

لو الpt عنده معظم الsymptoms مايلة لmild dehydration وفي symptom حدة بتدل على moderate, فبنعتبره moderate dehydration

⊛ IsoNatremic dehydration :

بحال كانت Mild أو Moderate في 4 حجات لازم تعمل :

1. deficit = loss of fluids result from an illness
2. Maintenance = Normal loss of fluids
3. ongoing loss = requirement of fluids to replace ongoing loss.
4. when to return

ttt is ORal Rehydration Solution = ORS

ORS = water

- Na 90
- K 20
- CL 80
- CO_3 80
- Sugar 110 ⇒ as co-factor for Na

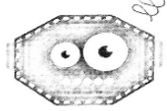
Pt comes to the ER, he was very well and active, comes with vomiting and diarrhea without any signs (it's considered mild dehydration and the ttt is ORS)

⊛ Mild isoNatremic dehydration :

1. deficit = 50 ml / kg over 4 hours
2. Maintenance = Infant → Small frequent feeding
   - Child → Smal frequent meals / simple carbs.
3. ongoing loss = after motion loss (diarrhea) replaced by 10m / kg
4. when to return = persistant vomitting
   - lethargy
   - Signs of dehydration : [sunken eyes, no tears ---

Persistant vomitting is alarming for gastroenteritis

MCC of GE is viral (rota) that cause intussusception (Rare)







⊛ Moderate isoNatremic dehydration :

1. deficit = 100 ml / kg over 6 hours
   - mild والباقي مثل الـ

ازا الطفل بالاستقبال عندو vomiting لمرة وحدة باليوم وأعطيته ORS وانا بعطيه حكالنا مش قادر يكمل، فمعنا trial of Iv normal saline 10cc/Kg/hr over 4hrs في الاستقبال.

بيعمله خلطة هان، فبيعطعه:

D5 0.45 Normal Saline 10cc/kg/hr + HCO3 15% +KCL 5mEq.

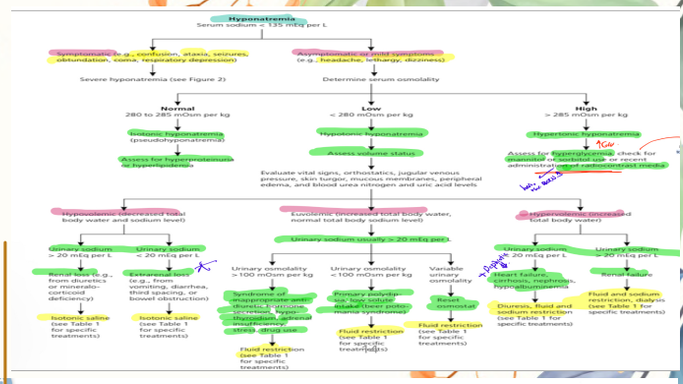
لكن هان بنكون حذرين وبنمشي المحلول slowly, لأنه فيه بوتاسيوم ف fatal mistake انه اعطيه acutely and rapidly.

نوع الfluid الي بنستخدمه في حالات الmild and moderate dehydration بيعتمد على الage:

<2years: Give D5 0.45 Normal saline (محلول 1:1)

>2years:Give D5 0.9 Normal saline.

Severe dehydration:



⊛ Severe isoNatremic dehydration : = shock

وبسرعة 1st treatment is shock therapy = 20 ml/kg during 20-30 mint

Normal Saline, Ringer lactate can be repeated up to 3-4 times

Ringer lactate	Normal Saline
Lactate بتحول لـ bicarb	بيعمل acid
which exacerbate alkalosis	alkalosis
∴ given in Acidosis	given in vomitting
بسبب = diarrhea	
Na content = 130	Na content = 154

after shock therapy ⇒ re-evaluation by :

- urine output
- level of consciousness
- capillary refill
- pulse & blood pressure

If Not respond ⇒ I.C.U + given vasopressor

Replacement :

1. deficit = 10 X wt X shock النسبة

10% يعني النسبة severe وبما إنه وزنه 10 واحد

deficit = 10 x 10 x 10 = 1000 ml

. shock therapy في fluid يعني أثناء العطية 1000 مش بتعطى

Net deficit = deficit - shock

calculated Therapy

في ال isonatremia dehydration بتعتبر normal level of Na+ in the body is 125-157, احنا بنعرف انه ال normal Na level is 135 to 145 وبتعتبر من 145to 157 is considered mild hypernatremia, 125 to 135 is considered mild hyponatremia لكن كله بتعتمده ع إنه isonatremia.

لو اجى severe dehydration وزنه 10kg ،هان لازم نحسب:

1.Shock therapy=20ml/kg during 20-30miunte
So, 10*20= 200
2.Deficit: 10*wt*shock% (10 perecent in severe dehydration)
So,10*10*10=1000
3.Net deficit= deficit-shock therapy
So,1000-200=800.

فهان بنعطيه 800 على مدار 16 ساعة ونوع الfluid according to age.

<2years: Give D5 0.45 Normal saline (1:1) محلول

>2years:Give D5 0.9 Normal saline.

⊛ hyponatremic dehydration :

Fluid replacement + Na replacement

1. Fluid = زي قبل

2. Na =

∴ Na deficit أول شيء أحسب الـ

Na deficit = 0.6 x wt x [desired Na - measured Na]

12 mEq/day بعطي Rate بعطي 12 mEq أحتاج شيء بأعوضه بيعطيني ليش؟

بالشين يدخل Central pontine myelinolysis ⇒ delirium & coma

⊛ pt with brain edema symptom as convulsion

or Na level < 120

∴ Na shock therapy should be given.

4-6 ml/kg of 3% Na solution.

؟ Na كمية المحلول في

NS = 0.9/NaCl ⇒ Na = 154

0.9% 1 L NS ⟶ 154 Na

3% ⟶ ؟

بطلع فيه صوديوم 513 .

⊛ Na shock therapy if pt wt = 10 kg

5 x 10 = 50 ml

1 L 3% Nacl ⟶ 513

50 ml ⟶ ؟

بطلع صوديوم 25 .

تعامل معاملة الisonatremia، بحيث فيه اختلافات:

1.Shock therapy
give shock therapy if the pt is symptomatic hyponatremia(convulsion, seizure...)
- it's 4-6 mEq of 3%NS
- طقيت الدكتور لو أعطاه shock therapy "اممات، يعني عمل rapid correction of osmotic demyelination يدخل الpt ب syn hyponatremia.

2.Deficit
Deficit Na+ لكن هان بنضيف الصوديوم، يعني ال Deficit حسب معادلته وبنضيف عليها معادلة ال 0.6*wt* (desired Na+ = 125 - measured Na+)
فمثلاً عنا pt وزنه 10kg، Na+=120 فهان Deficit Na+= 0.6 *10*(125-12)=30,0
وبنحول الmEq بالتقسيم على 4 يعني بتعادل 7.5=30/4 cm
Deficit fluid = 1000,0 ml

3.Maintenance
هان بنستخدم D5 0.45NS .

Net deficit given over first 8hr of 1/2 NS. Dextrose 5% solution

2. maintenance :

1st 10 kg ⟶ 100 ml	solution type :
2nd 10 kg ⟶ 50 ml	- child : 1/2 NS. dextrose 5%
then ⟶ 20 ml	- infant : 1/2 NS. 18%
given over 16 hr	

3. ongoing loss = 10 ml / kg

⊛ طريقة أخرى :

بأحسب كم بدي deficit وكم بدي maintenance وبأعملهم اياهم كالتالي :

في أول 8 ساعات 1/2 deficit + 1/3 maintenance

والباقي بأكملها في 16 ساعة

	8 hr.	16 hr.
deficit	1/2	1/2
maintenance	1/3	2/3

⊛ كيف أحضّر المحلول ؟

بحسب الـ Na & fluid deficit كل واحد لحاله

مش ممكن محلول جاهز بالشنجة إلي لحالي فبأجمع من الموجود

بأستخدم محلول معلوم التركيز من الـ Na

ولازم يكون تركيزه عالي [23% Na]

ومحلول ميّة [5% D]

. صارلي صوديوم 4mEq في كل 1 ml ما بداخل المحلول

1 cc ⟶ 4 mEq Na

بأحضّر التركيز إلي بدي إياه من الصوديوم وبأضيف الباقي ميّة [5% D]

نوع الfluid الي بنستخدمه في حالات الdeficit بيعتمد على الage:

<2years: Give D5 0.45 Normal saline (1:1) محلول

>2years:Give D5 0.9 Normal saline.

هاد خاص بال deficit, أما الmaintenance بيختلف:

<2year:Give PDS,0.18 Normal saline

>2year:Give D5 0.45 Normal saline

⊛ hyperNatremic dehydration :

↳ mild	145-157 mmol/dL
moderate	158-170
severe	171-183
profound	> 184

لماذا تعتبر خطيرة ؟

1. hyperNatremia is underestimated

because intravascular volume is maintained

لأنه بيكون في hyper Na بيرجع الجسم يسحب الميّة من الخلايا فبصير كأنه ما في Na ، intravasular بال ↑ Na، أما الخلايا بيصير shrinking

الأعراض بيشوف منها جفاف طبيعي والباقي كله

- woody tongue
- doughy skin

2. Intracranial hemorrhage

الموجودة بين الخلايا Briding veins بتتمدد، لما بصير انكماش بالخلايا

وبصير فيها bleeding & tear

المريض بيجي بـ convulsion

3. Rapid correction cause brain edema

⊛ managment : - Mild ⟶ as isoNatremic

- moderate ⟶ 1.5 maintenance for 2D.
- Severe ⟶ 1.33 maintenance for 3D.
- profound ⟶ 1.25 maintenance for 4D.

ختمت الـ Na shock therapy وأعطيته إياه

لما أحسب الـ deficits بنقص منه

The most common cause of Brain edema in hypernatremic pt is: ideogenic Osmol

ال*water* بيتحرك من ال*low osmolarity to high one*، فواحد كان ال*Na+* بتبعه عالي الدكتر اجى وزبذله الصوديوم وال*osmolarity* ورجعهم للنورمال، وما حكى للأهل *when to return*، وفجأة الطفل دخل ب *vomiting and diarrhea*, فلقى ال*160 +Na*و ال*300 osmolarity!*

هلقيت الي صار انه الbrain cells فيها أقل Na+ وبرا فيه Na+ عالي، فصار يسحب الميا من الbrain cells للcirculation, فبيصير shrinkage of these cells مع vessels rupture وهاد lead to brain hemorrhage، هلقيت الbrain cells بتحاول تعمل compensation الي هيا ideogenic osmole، فبتصل الcells لهاي المرحلة لما تتساوى الosmolarity بتبعتها مع الدم، فهلقيت الطرفين فيهم high osmolarity، فهان بتتوقف حركة الfluid ما بين الخلايا والدم، يبقى هان لما نعطي هان shock therapy وننزل الNa+ لل normal level، فال fluid حينتقل من الlow osmolar area الي هيا الدم للhigh osmolar area الي هيا الbrain cells فبيحدث Edema.....

⊛ Rapid correction if >12 mEq/l/day

⊛ لما زاد الصوديوم ← سحب المية من الخلايا ←
مفروض لما أعوّض ترجع المية الخلايا
لما يصير انكماش الخلية بهاد تحمي حالها فبتكوّن
idiogenic osmoles
بتزوّد الـ oncotic pressure وبتصير تسحب مية عشان تحافظ على شكلها .
فلو عوّضنا بعد تكوّن الـ idiogenic osmoles هاي
بيصير زيادة في المية فبيصير Brain edema بتعمل Convulsion

How treats it ? ① ABC
② oxygen
③ anticonvulsant ⇐ midazolam
④ 4-6 ml/kg of 2% NaCl

لو عالجت الـ hyperNatremia فنزل الصوديوم سريع ← هاذا أفعل ؟

[فيست ساعات 6 / لازم ينزل 3] ↓ Rate of fluid
OR ↑ Na concentration

وبالعكس لو بنزل ببطء شو أعمل ؟ ←
↑ Rate of fluid
↓ Na concentration

ال*Na+* بعد 4ساعات من الcorrection مفروض ينزل فقط 2mEq، لا أكثر ولا أقل:
هلقيت لو نزل الصوديوم بعد ساعتين 2mEq وليس 4mEq، فهاد rapid correction، فلازم نقلل الrate ونزود نسبة الصوديوم فينعطي D5 0.9Normal Saline.

لو الNa+ كان 180 وبعد 4ساعات لقته 179، فهاد معناه انه لازم نزود الrate ونقلل من نسبة الصوديوم، يعني لازم نعطي محلول تكون فيه نسبة الNa+ قليلة متل الD5 0.18NS.

⊛ managment :
- Mild → as IsoNatremic
- moderate → 1.5 maintenance for 2D.
- Severe → 1.33 maintenance for 3D.
- profaund → 1.25 maintenance for 4D.

هلقيت طفل وزنه 10Kg والNa+=160، وطلبو منا الmaintenance حنحسب ال10*100=1000ونضربه بعد كدا ب 1.5، لإنها moderate hypernatremia، يعني الmaintenance is 1000*1.5=1500 وبنقسمه على 24 عشان نعرف قديه نعطيه باليوم لمدة يومين...
ونوع الFluid بيكون D5 0.45NS