

# Fluid balance

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# Objectives




## To know

- 1. How fluids distributed in the body compartments?**
- 2. What are the sources of fluid intake?**
- 3. How the fluid excreted from the body?**
- 4. Diseases related to fluid imbalance?**

# Fluid Compartments in the Body

The body's water is effectively compartmentalized into several major divisions.

 **Intracellular Fluid (ICF)** comprises  $2/3$  of the body's water.

-  If your body has 60% water, ICF is about 40% of your weight.
-  The ICF is primarily a solution of potassium and organic anions, proteins etc. (Cellular Soup!).
-  The cell membranes and cellular metabolism control the constituents of this ICF.

**Extracellular Fluid (ECF)** is the remaining  $\frac{1}{3}$  of your body's water.

- ECF is about 20% of your weight.

- The ECF is primarily a NaCl and NaHCO<sub>3</sub> solution.

- The ECF is further subdivided into three sub-compartments:

- **Interstitial Fluid (ISF)** surrounds the cells, but does not circulate. It comprises about  $\frac{3}{4}$  of the ECF.

- **Plasma** circulates as the extracellular component of blood. It makes up about  $\frac{1}{4}$  of the ECF.

- **Transcellular fluid** is a set of fluids that are outside of the normal compartments. These 1-2 liters of fluid make up the CSF, Digestive Juices, Mucus, etc.

# Fluids

Fluid intake is derived from two sources:

- (1) Exogenous; and**
- (2) Endogenous.**

**60% of the body weight is water**

□ **Exogenous water** is either **drunk** or **ingested** in solid food. The quantities vary within wide limits, but **average 2—3 liters** per 24 hours, of which nearly half a liter is contained in solid food.

□ **Taking into consideration their **body weight** and **age**** , the water requirements of infants and children are relatively greater than those of adults because of: **(1)** the larger surface area per unit of body weight; **(2)** the greater metabolic activity due to growth; and **(3)** the comparatively poor concentrating ability of the immature kidney.

□ **Endogenous water** is released during the **oxidation of ingested food**; the amount is normally less than 500 ml/24 hours.

□ However, during starvation, this amount is supplemented by water released from the breakdown of body tissues.

## ***Special Notes:***

- ☞ All the body's fluid compartments are in osmotic equilibrium (except for transient changes).
- ☞ The ions and small solutes that constitute the ECF are in equilibrium with similar concentrations in each subcompartment.
- ☞ **The ECF volume is proportional to the total Na content.**



## Fluid output

*Water is lost from the body by four routes.*

✓ *Sensible as water lost in urine and feces*

✓ *Insensible as water lost from the lung and skin*

### *1. By the lungs*

□ About 400 ml of water is lost in expired air each 24 hours.

□ **In a dry atmosphere**, and when the **respiratory rate is increased** and patients who has their trachea intubated, the loss is correspondingly greater.

## **2. By the skin**

□ Throughout life, invisible perspiration is always occurring.

□ The cutaneous fluid loss **varies** within wide limits in accordance with:-

- 1. Atmospheric temperature and humidity** (In a temperate climate the average loss is between **600** and **1000** ml/24 hours)
- 2. Muscular activity** and
- 3. Body temperature** (each one degree Celsius increase in body temperature over 24 hours increase further 250 ml loss of water)

### **3. Faeces**

Between **60** and **150** ml of water are lost by this route daily. In **diarrhoea** this amount is greatly multiplied.

### **4. Urine**

The output of urine is under the control of multiple influences, such as **blood volume**, **hormonal** and **nervous influences**,

□ Among which the **antidiuretic hormone** plays a major role controlling tonicity of the body fluids, a function that it performs by stimulating the reabsorption of water from the renal tubules

□ The normal urinary output is approximately **1500 ml/24 hours**, and provided that the kidneys are healthy, the **specific gravity of the urine bears an inverse relationship to the volume.**

□ **A minimum urinary output** of approximately 400 ml/24 hours is required to excrete the end products of protein metabolism

## Water depletion

Pure water depletion is usually due to **diminished intake**.

**This may be due to;-**

1. Lack of availability,
2. Difficulty or inability to swallow because of:
  - A. painful conditions of the mouth and pharynx, or obstruction in the oesophagus.
  - B. Exhaustion and paresis of the pharyngeal muscles
3. Increased loss from the **lungs after tracheostomy**. This loss may be as much as 500 ml in excess of the normal insensible loss. After tracheostomy, humidification of the inspired air is an important preventive measure.

# Clinical features

**The main symptoms are:-**

1. Weakness
2. Intense thirst.
3. The urinary output is diminished and its specific gravity increased.
4. The increased serum osmotic pressure causes water to leave the cells (intracellular dehydration), and thus delays the onset of overt compensated hypovolaemia.

# Treatment

Provide water orally or parenterally

## Water intoxication

□ This can occur when excessive amounts of water, low sodium or hypotonic solutions are taken or given by any route.

### Causes

1. The commonest cause in the surgical ward is the overprescribing of intravenous 5% glucose solutions to postoperative patients.
2. Colorectal washouts with **plain water**, instead of saline, have caused water intoxication during total bowel wash-through prior to colonic surgery.
3. A major component of the TURP (transurethral resection of the prostate) during which, the water intoxication caused by excessive uptake of water (and glycine) from irrigation fluid.



4.If the body retains water in excess to plasma solutes. This can be seen in the syndrome of inappropriate antidiuretic hormone (SIADH) secretion which is most commonly associated with lung conditions such as **lobar pneumonia**, **empyema** and **oat-cell carcinoma of bronchus**, as well as **head injury**.

## Clinical features

These include:-

1. Drowsiness,
2. Weakness,
3. Sometimes convulsions and coma.
4. Nausea and vomiting of clear fluid,
5. Polyuria (except if the disease due to SIADH)
6. Laboratory investigations may show decrease haematocrit (PCV), serum sodium and other electrolyte concentrations.

## Treatment

- The best course is water restriction.
- If the patient fails to improve, transfer to an intensive care or high dependency unit will be necessary for more **invasive monitoring** and controlled manipulation of fluids and electrolytes.

### Important note:-

- *The administration of diuretics or hypertonic saline should be undertaken lightly as rapid changes in serum sodium concentration may result in neuronal demyelination and a fatal outcome.*

**Thank you**