IV Fluids

Clinical Skills
School of Medicine
2015/16
LEARNING OBJECTIVES

- Learn about body water distribution
- Types of IV fluids and when they are used
- Fluid and electrolyte balance
- Describe important information located on the label of the IV fluid
Distribution of body water

- The human body is composed of approx. 2/3 water
- Women and the elderly have a greater proportion of body fat and therefore a smaller proportion of total body water
- If we assume 60% of body weight is water in a 70kg male:
  - Total body water (TBW) = 42L
  - Intracellular fluid (ICF) = 28L (2/3 of TBW)
  - Extracellular fluid (ECF) = 14L (1/3 of TBW)
    - ECF = 3L Plasma, 10L interstitial fluid, 1L transcellular fluids
Key Terms

Osmotic pressure – the pressure needed to reverse osmosis (through a semipermeable membrane, i.e. a cell wall)

- It is the ability of a solute to attract water
- It is the primary determinant of water distribution between the 3 major compartments (plasma, ICF, ECF) as each compartment contains a different solute composition (ICF mainly K+, ECF mainly Na+)

Oncotic pressure – the pressure exerted by proteins to draw fluids back in
Types of Fluid

1. Crystalloids – electrolytes (Na+, K+, Ca2+, Cl-) in water
   - These do not contain large molecules so do not exert oncotic pressure
   - They are distributed to extracellular spaces and therefore used as maintenance fluids

   Examples of crystalloids:
   - Normal saline – 0.9% NaCl, isotonic
   - 5% dextrose – contains glucose which is rapidly consumed by the cells, hypotonic
   - Hartmans – contains lactate, K+, Ca2+, NaCl (‘physiological’)

Types of Fluid

2. Colloids – colloids contain larger molecules which stay in the circulation for longer

- These increase oncotic pressure and draw fluid back into the circulation
- They are good for maintaining blood pressure although do not have oxygen-carrying capacity
- They are expensive, have specific storage requirements and have a short shelf life

**Examples of colloids:**
- Haemaccel – contains gelatin
- Dextran – solution of high molecular weight dextrose
Types of Fluid

3. Blood and blood products

- Platelets, packed red blood cells and plasma are the most desirable fluids for replacement
- Haemoglobin in red blood cells carries oxygen to cells

Examples of blood products:

- Packed cells
- Plasma
- Albumin
- Cryoprecipitates
- Platelets
- Synthetics – gelafusion, gelafundin
# IV Fluids Tonicity

<table>
<thead>
<tr>
<th>Crystalloid</th>
<th>Action/Use</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hypotonic:</strong> &lt;250 mOsm/L</td>
<td>Shifts fluids out of vessels into cells.</td>
<td>May worsen hypotension as moves fluid out of vessels.</td>
</tr>
<tr>
<td>0.25% Normal Saline</td>
<td>Hydrates the cells</td>
<td>Can increase oedema.</td>
</tr>
<tr>
<td>0.45% NS</td>
<td></td>
<td>May cause hyponatraemia.</td>
</tr>
<tr>
<td>5% dextrose in water (D5W)</td>
<td></td>
<td>D5W may irritate veins.</td>
</tr>
<tr>
<td><strong>Isotonic:</strong> &gt;250 mOsm/L</td>
<td>No shift of fluid.</td>
<td>May cause fluid overload</td>
</tr>
<tr>
<td>0.9% NS</td>
<td>Vascular expansion.</td>
<td>Generalized oedema.</td>
</tr>
<tr>
<td>Lactated Ringer’s (LR)</td>
<td>Electrolyte replacement</td>
<td>Dilutes haemoglobin.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electrolyte imbalance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Proinflammatory in large doses (LR)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>May cause hyperchloremia</td>
</tr>
<tr>
<td><strong>Hypertonic:</strong> &gt;350 mOsm/L</td>
<td>Shifts fluids back into circulation.</td>
<td>May cause fluid overload.</td>
</tr>
<tr>
<td>D5 0.45% NS</td>
<td>Vascular expansion.</td>
<td>May cause hypernatraemia.</td>
</tr>
<tr>
<td>D5 0.9% NS</td>
<td>Electrolyte replacement.</td>
<td>May cause hyperchloremia.</td>
</tr>
<tr>
<td>Hypertonic Solution (HS)</td>
<td></td>
<td>HS slows inflammation and capillary permeability.</td>
</tr>
<tr>
<td>3% or 5%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fluid and Electrolyte Balance

- Fluid input must equal output
- Waste products are mainly excreted via the kidneys
- Minimal obligatory volume of urine (MOVU) is 1L/day or 0.5-1ml/kg/hr
- Insensible water losses = 500ml from lungs and faeces, 500ml from skin as sweat
- Minimal daily fluid replacement is therefore 1.5-2L
- A healthy adult requires approx. 3L fluid replacement per day
Fluid and Electrolyte Balance

- We lose approx 60mM of K+ and 100mM of Na+ per day which also need replacement

- **Enteric recycling** – 8L/day of fluids (bile, gastric juices, intestinal secretions) are recycled through the GI tract

- **Other fluid losses** – NG, drains, ileostomy

- Fluid and electrolyte losses must be replaced by oral fluids, food and IV fluids
Fluid and Electrolyte Balance

**Input:****
- Oral fluids
- Food
- IV fluids (A)
- oxidation = 300mls

**Output:**
- Urine (U)
- Insensibles (B) eg. Sweat, lungs & faeces
- Other losses (D) eg. NG, drains, ileostomy

**In a Healthy Adult**

<table>
<thead>
<tr>
<th>Input</th>
<th>Oral fluids (1200mls)</th>
<th>Food (1000mls)</th>
<th>Metabolism (300mls)</th>
<th>Total 2500</th>
</tr>
</thead>
</table>

**In a Hospital Patient**

\[ A \pm \text{oral intake} = U + B + D - C \]

Surgical Talk 2nd Edn.

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin
Fluid and Electrolyte Replacement

- Typical daily fluid and electrolyte regimens for a patient who is ‘nil by mouth’
  - If a patient is on fluids for several days the 2nd regimen is more appropriate to ensure patient does not become hyponatraemic
  - Each bag should run over 8 hrs

Surgical Talk 2nd Edn.
Fluid Replacement in Special Circumstances

Post-op patient

- A rise in ADH post-op leads to renal conservation of water and Na+ and some loss of K+ and H+
- Despite K+ loss via the kidneys blood K+ levels are normally maintained due to release of K+ from damaged cells
- There is usually therefore no need to replace K+
- 2L of fluid should be replaced in the first post-op day rather than 3L due to water and Na+ conservation
- Transient ileus may prevent enteric recycling (8L/day) so patients affected may need extra fluids based on urine output
Fluid Replacement in Special Circumstances

- **NG tube, drain, fistula** – losses need to be calculated daily and replaced in addition to other fluid replacement. Normal saline is usually used to replace these losses.

- **Ileostomy** – can result in huge fluid losses, especially post-op, so these losses should be calculated twice daily to prevent dehydration.

- **Pyrexia** – replace an extra 10% of fluid for each degree of fever.

- **Vomiting** – H+ replacement.

- **Diarrhoea** – K+ replacement.
Fluid Replacement in Special Circumstances

Heart or liver failure

- Avoid fluids containing sodium
- Give 5% dextrose
- Consider reducing fluids and giving diuretics if in fluid overload

Acute renal failure

- Replace fluid if fluid depleted and cause is pre- or post-renal
- If fluid depletion is due to a renal cause avoid K+ loads and drugs affecting renal function (e.g. NSAIDS, ACE-Is)
- Involve the renal team
Intravenous Fluid Packaging

Every IV fluid container must contain a label. The label provides important information that you must examine before administering the fluid to a patient.

This information includes:

- Type of IV fluid (by name and by type of solutes contained within)
- Amount of IV fluid (expressed in millilitres or “ml”)
- Expiration date
- The fluid should be clear and not used if it appears to be ‘cloudy’
Different volumes of Fluids
References


Thank You