Iv fluids

Types, indications, complications

By: Ishraq Arabiat
Types of fluid:

- **Crystalloid Solutions:**
  1. Normal saline
  2. Dextrose solution 5%
  3. Lactated Ringer’s solution
  4. Others (plasmalyte, 0.45NaCl)

- **Colloid solutions:**
  1. Natural (human albumin)
  2. Artificial (gelatins, dextrans and hydroxyethyl starches)
The three types of crystalloids are:

– **Hypotonic**: When the extracellular fluid has fewer solutes (osmolarity) than the fluid in the cells. Water will move from extracellular space into the cells.

– **Hypertonic**: When the extracellular fluid has more solutes (osmolarity) than within the cells, water flows out of the cells.

– **Isotonic**: Both the extracellular and intracellular fluids have the same osmolarity, so there is no movement of water between them.
**Crystalloid Solutions:**

<table>
<thead>
<tr>
<th>Solution</th>
<th>Glucose (g/L)</th>
<th>Na⁺</th>
<th>K⁺</th>
<th>Ca^{2+}</th>
<th>Cl⁻</th>
<th>Lactate</th>
<th>PO₄⁻³</th>
<th>Mg^{2+}</th>
</tr>
</thead>
<tbody>
<tr>
<td>5% Dextrose (D₅W)</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10% Dextrose (D₁₀W)</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Normal Saline (NS)</td>
<td>0</td>
<td>154</td>
<td>0</td>
<td>0</td>
<td>154</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>D₅NS</td>
<td>50</td>
<td>154</td>
<td>0</td>
<td>0</td>
<td>154</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>D₅½NS</td>
<td>50</td>
<td>77</td>
<td>0</td>
<td>0</td>
<td>77</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.2% NS</td>
<td>0</td>
<td>31</td>
<td>0</td>
<td>0</td>
<td>31</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3% NaCl</td>
<td>0</td>
<td>513</td>
<td>0</td>
<td>0</td>
<td>513</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ringer's Lactate (LR)</td>
<td>0</td>
<td>130</td>
<td>4</td>
<td>3</td>
<td>109</td>
<td>28</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>D₅LR</td>
<td>50</td>
<td>130</td>
<td>4</td>
<td>3</td>
<td>109</td>
<td>28</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
1. 0.9% Normal Saline (NS, 0.9NaCl)  
(154mEq of Cl /154mEq of Na)  

• a sterile, nonpyrogenic, isotonic crystalloid fluid.  

** Uses of NS:  

✓ extracellular fluid replacement (e.g., dehydration, hypovolemia, hemorrhage, sepsis),  

✓ treatment of metabolic alkalosis in the presence of fluid loss, and for mild sodium depletion  

✓ can also be used as a flush -- to clean out an intravenous (IV) catheter. This helps prevent blockage and removes any medicine left in the catheter area after the patient has received an IV infusion.  

• IMPORTANT:  

NS is also the only fluid used in conjunction with blood product administration.
Large volume resuscitation with 0.9% normal saline leads to an overload of chloride ions into the blood. It produces hyperchloremic metabolic acidosis because of its high chloride content and lack of bicarbonate.

Also, may contribute to preoperative acute kidney injury.

Side effects:
- Injection site infections.
- Thrombophlebitis

Contraindications: in any situations where salt retention is undesirable (edema, heart disease, cardiac decompensation, primary or secondary aldosteronism)
2. Dextrose 5% in Water (D5 or D5W, an intravenous sugar solution)

• A crystalloid that is both isotonic and hypotonic, Initially hypotonic once the cells have absorbed the dextrose, the remaining water and electrolytes become an isotonic solution.

• Indications:

1. It is used for replacement of pure water deficits
2. as a maintenance fluid for patients on sodium restriction (hypernatremia)
3. It prevents the catabolic state (hypoglycemia and ketosis) that follows prolonged fasting
Adverse effect of dextrose using:
– injection site infections .
– Excessive nutrition .
– Nausea .
– Hyperosmolar syndrom.

Contraindications:
- Allergy to corn or corn products.
3. lactated Ringer’s solution (Hartmann's solution)

<table>
<thead>
<tr>
<th>FLUID</th>
<th>NA (mmol/L)</th>
<th>CL (mmol/L)</th>
<th>K (mmol/L)</th>
<th>CA (mg/dL)</th>
<th>LACTATE (mmol/L)</th>
<th>PH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal saline solution</td>
<td>154</td>
<td>154</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>6.0</td>
</tr>
<tr>
<td>Lactated Ringer’s solution</td>
<td>130</td>
<td>109</td>
<td>4</td>
<td>3</td>
<td>28</td>
<td>6.5</td>
</tr>
</tbody>
</table>

- LR is an isotonic crystalloid containing sodium chloride, potassium chloride, calcium chloride, and sodium lactate in sterile water.
• Uses of lactated Ringer’s solution:

1. It is used for replacing fluids and electrolytes in those who have **low blood volume or low blood pressure**.
2. It may also be used to **treat metabolic acidosis** in cases other than those caused by lactic acidosis.
3. And to wash the **eye following a chemical burn**.

• It is **contraindicated in**:

1. Patients with a **pH > 7.5**.
2. Patients with **liver disease** who are unable to metabolize lactate,
3. Or for any patient with **lactic acidosis**.
   Use with extreme caution in cases of renal failure.
4. Plasmalyte

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>•</td>
<td>is a family of balanced crystalloid solutions</td>
</tr>
<tr>
<td>•</td>
<td>It closely mimics human plasma in content of electrolytes, osmolality and pH that’s why it is most popular isotonic solutions used in surgery.</td>
</tr>
<tr>
<td>•</td>
<td>It contains small amount of potassium.</td>
</tr>
</tbody>
</table>
5. **45% Normal Saline (Half Normal Saline, 0.45NaCl)**

- A hypotonic crystalloid solution of sodium chloride dissolved in sterile water, administered to treat hypernatremia or diabetic ketoacidosis.
- It is contraindicated in patients with burns, trauma, or liver disease due to depletion of intravascular fluid volumes.
0.9% NaCl

- Shock
- Resuscitation
- Fluid challenges
- Blood transfusions
- Metabolic alkalosis
- Hyponatremia
- DKA

- Use with caution in patients with heart failure, edema, or hypernatremia.
- Can lead to fluid overload.

Lactated Ringers’

- Dehydration
- Burns
- GI tract fluid loss
- Acute blood loss
- Hypovolemia

- Contains potassium, can cause hyperkalemia in renal patients.
- Patients with liver disease cannot metabolize lactate.
- Lactate is converted into bicarb by liver.

D5W

- Fluid loss and dehydration
- Hypernatremia

- Solution becomes hypotonic when dextrose is metabolized
- Do not use for resuscitation
- Use cautiously in renal and cardiac patients
Colloids Solutions:

- Colloids have large molecules that are unable to pass through semipermeable membranes. They remain in the blood vessels.
- They’re also called volume or plasma expanders, because they draw fluid from the interstitial space back into the blood vessels with oncotic pressure.
indications for colloids include:

1. fluid resuscitation in patients with severe intravascular fluid deficits (e.g., hemorrhagic shock) prior to the arrival of blood for transfusion

2. fluid resuscitation in the presence of severe hypoalbuminemia or conditions associated with large protein losses such as burns.

** (Replacing an intravascular volume deficit with crystalloids generally requires three to four times the volume needed when using colloids, this justifies their indication for the use where more than 3–4 liters of crystalloid solution has been injected)
Types of colloids:

1. **Albumin**
   - Half life = 1.6 hours in plasma
   - Expands volume 5x in 30 minutes and its effect lasts 1-2 days.

**Side effects:**
1. volume overload
2. Fever ?? Pyrogens in albumin
3. Defects in hemostasis
2. Dextran

- High molecular weight polysaccharide (40000 >coagulation effect than dextran 70000 )
- 10% solution in NS or D5W
- SE: anaphylaxis, coagulopathy, renal failure
- it is used by microsurgeons??

Because it is used as a volume expander but also reduces blood viscosity, von Willebrand factor antigen, platelet adhesion, and red blood cell aggregation so it improves microcirculatory flow and decrease risk of microthrombus formation.
3. hydroxyethyl starch (Hespan) (the best colloid)

- is highly effective as a plasma expander and is less expensive than albumin. Allergic reactions are rare, but anaphylactic reactions have been reported.
- Hetastarch can decrease von Willebrand factor antigen levels, may prolong the prothrombin time, and has been associated with hemorrhagic complications. It is potentially nephrotoxic.
Complications Associated with Intravenous Fluid Therapy:

- Excess of fluid can result in fluid load. Due to this, the patient may suffer from pulmonary edema or heart failure.
- Infections
- Electrolyte imbalances. For example, high potassium levels can affect the heart.
- Bleeding, pain and/or inflammation at the site of injection.
- Air embolism, if air goes through the tubing into the body.
- Allergic reaction to the fluid or drug administered.
• Differences between colloids and crystalloids
1. Colloids are more expensive than crystalloids
2. Colloids have higher molecular weight.
3. Half life of crystalloids is between 15 to 20 minutes while colloids last 2-3hrs.
4. Colloids act as plasma expanders.