Vascular Access

OBJECTIVES

- Discuss the difference in fluid allocations within the body
- Discussion the types of fluid utilized in the emergent vs non-emergent settings
- Understand the differences in vascular access options in emergent vs. non-emergent settings
- Explore controversy in fluid resuscitation

Fluids in the human body

- Approximately 60% of the human body weight is water (slightly less in females)
- Plasma: 93% water (& 7% 'plasma solids')
- Fat: 10-15% water
- Bone: 20% water

Fluid Compartments

Intracellular Fluid

Extracellular Fluid

Comparison of Fluid Compartments

INTRACELLULAR

The ICF compartment is really a ***"virtual compartment"*** considered as the sum of this huge number of discontinuous small collections.

- **Location**: The distinction between ICF and ECF is clear and is easy to understand: they are separated by the cell membranes
- **Composition**: Intracellular fluids are high in potassium and magnesium and low in sodium and chloride ions
- **Behavior:** Intracellular fluids behave similarly to tonicity changes in the ECF

EXTRACELLULAR

The ECF is divided into several smaller compartments (e.g. plasma, Interstitial fluid, fluid of bone and dense connective tissue and transcellular fluid)

The water in bone and dense connective tissue and the transcellular fluids is significant in amount but is mobilized much more slowly then the other components of the ECF. The remaining parts of the ECF are called the functional ECF.

The ratio of ICF to ECF is 55:45.

Types of Fluids

Hypotonic

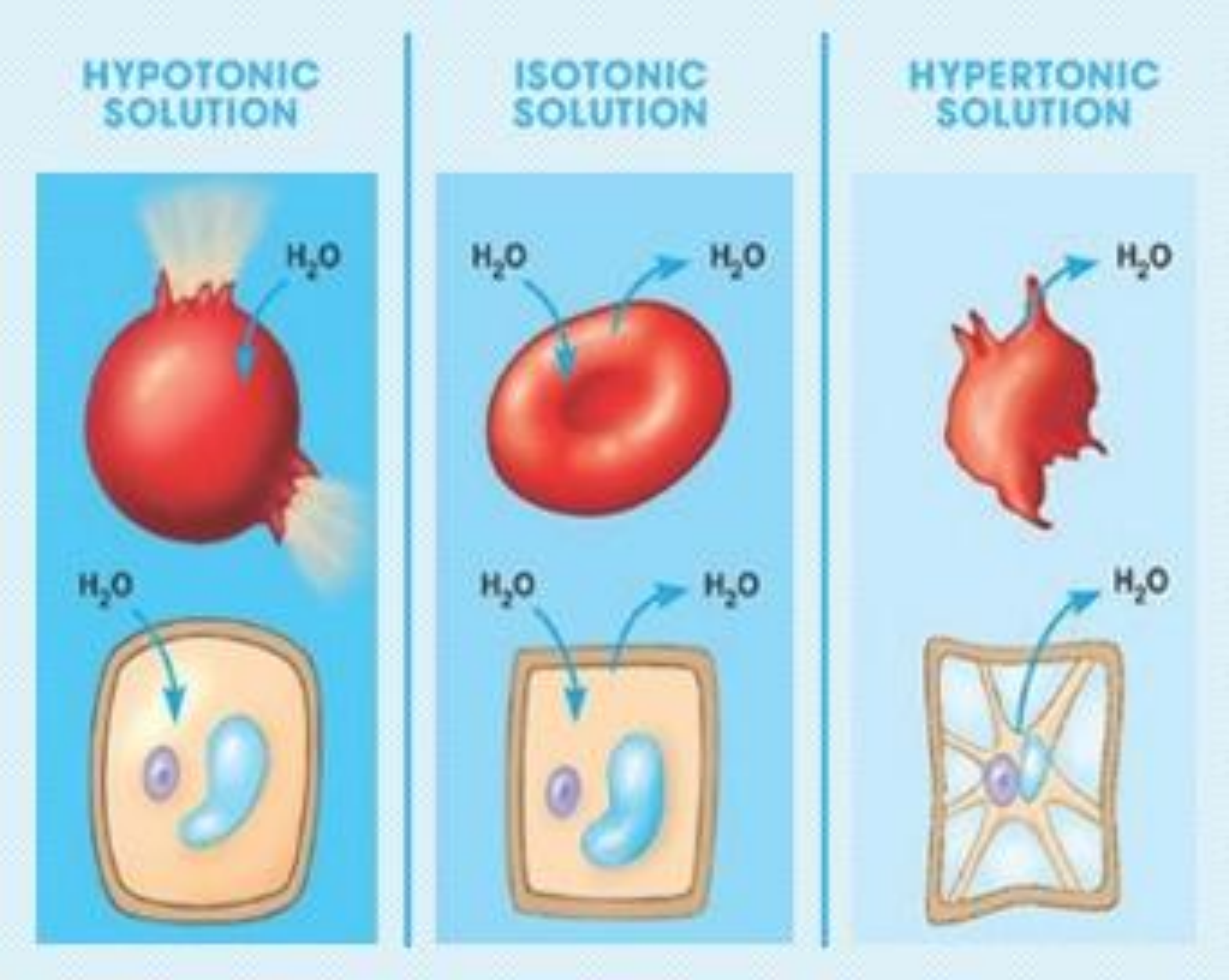
Hypotonic - solution has less sodium than that of the patient's currently circulating plasma. Would be used to push fluid from the vascular spaces into the cells. Too much and the cells will explode. Will decrease circulating volume, so you'd use it when you don't want increased pressure like cerebral edema, or in a dehydrated patient with very high electrolytes, etc…

Isotonic

Isotonic - has same sodium concentration of plasma. Use to replace volume in cases of blood loss, or to maintain hydration. No fluid shift between vascular spaces and cells - they're equalized

Hypertonic

Hypertonic - has a greater concentration of sodium than circulating plasma. Pulls fluid from the cells into the vascular spaces. Too much and the cells will crenate or shrivel up like prunes. Will rapidly expand circulating volume and might be used to treat bad burns, septic shock, etc.


HYPOTONIC SOLUTION
ISOTONIC SOLUTION
HYPERTONIC SOLUTION
H_2O
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Hypotonic

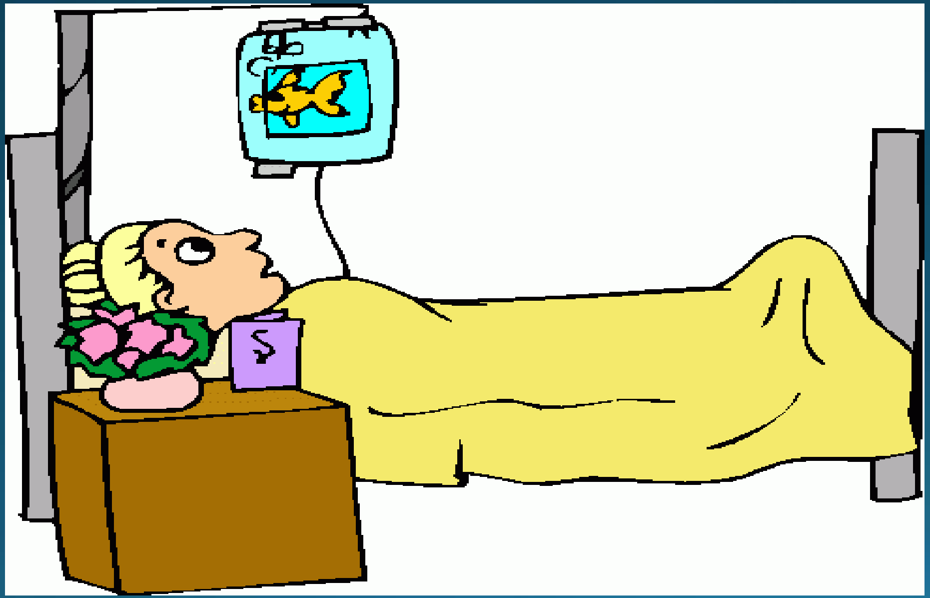
0.45% Saline

*5% Dextrose in Water

(this is technically *isotonic*, but once the dextrose is absorbed then it acts on the body as if it were hypotonic)

Isotonic

The most obvious one is 0.9% Saline Solution, better known as Normal Saline.



Hypertonic

10% Dextrose in Water

3% Saline

5% Dextrose in 0.45% Saline

5% Dextrose in 0.9% Saline

Vascular Access

Central Line

Most common

IV or IO used in emergent or resuscitative efforts

Surgical Procedure

Must have specialized training for insertion. May have several complications. Sterile technique

Types of Peripheral IV/IOs

The most common is the over-the-needle catheter. This is inserted into a vein via a needle that has a plastic catheter around it; the needle is withdrawn, leaving the plastic catheter in the vein.

The second type of peripheral IV catheter is a steel needle variation, often called a "butterfly" due to the wing-like plastic tubes at the base of the needle.

Types of Peripheral IO’s

Sternal Intraosseous

Hand Driven

Spring Loaded

Drill Inserted

Fluid Resuscitation

Fluid resuscitation is one of the most important aspects of the acute medical management of critically ill patients. Fluid volume deficits may be the result of excessive fluid loss, insufficient fluid intake or a combination of the two. Common situations leading to such deficits include blood loss, vomiting, diarrhea and dehydration.

Colloids vs. Crystalloids

Colloids are mainly used as plasma volume expanders in the treatment of circulatory shock.

Common examples include the plasma substitutes Gelofusine and Haemaccel.

Crystalloids are balanced salt solutions that freely cross capillary walls. They are made up of water and electrolytes and stay in the intravascular compartment for a shorter time than colloids.

Common examples include normal saline and sodium lactate preparations such as Hartmann's and Ringer-Lactate solutions.

Crystalloid vs. Colloid

	Crystalloids	**Colloids**
Advantage	• Cheap • Accessible	• Longer half life • Smaller volume required to expand intravascular volume
Disadvantage	• Short half life • Larger volume required for resuscitation	•Expensive • Risk of allergic reaction

How Much Fluid?

The debate over fluid resuscitation has been ongoing for some time.
An emergent patient in "shock" usually receives 20cc/kg of volume infusion of a crystalloid fluid.

A prospective trial comparing immediate with delayed fluid resuscitation *(Bickell, 1994)* included 598 adults with penetrating torso injuries who presented with a prehospital systolic blood pressure greater than 90mmHg. Patients assigned to the immediate resuscitation group received standard fluid resuscitation both before they reached the hospital and in A&E the delayed resuscitation group received intravenous cannulation but no fluid until they had reached the operating room. Among the 289 patients who received delayed fluid resuscitation, 203 (70%) survived to discharge from hospital, compared with 193 of the 309 (62%) who received immediate fluid resuscitation.

This study was one of many suggesting that it may be beneficial to delay fluid resuscitation in some situations, to ensure that the patient receives vital hospital treatment sooner *(Deakin and Hicks, 1994).*

Fluid Resuscitation

The debate of fluid resuscitation will continue but can differ depending on patient

Patients suffering from a traumatic injury can receive fluids, however those fluids do not have oxygen carrying capacity (crystalloids).

Patients in Septic Shock may not have the cardiovascular function to perfuse the incoming fluid resulting in edema which can complicate the original problem.

Conclusion

The fact remains in Pre-hospital and hospital care, vascular access is a necessity.

The debate over volume resuscitation will continue as more patients are studied.

A provider must understand the process of inserting a peripheral IV and/or IO.

In addition, all providers must understand the differences of fluid available for resuscitation and how these fluids move throughout the body