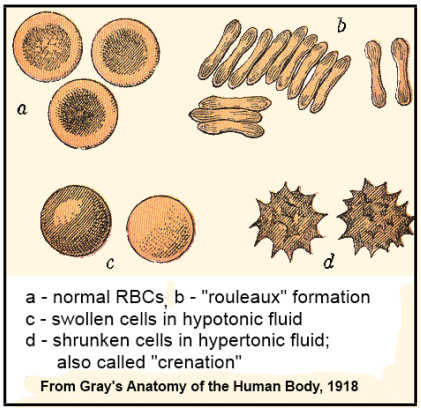
Zuku Review FlashNotes

Fluids Tune-up

FLUID THERAPY, (part 1)

A working knowledge of FLUID THERAPY is a must for every veterinarian

The first step is to know your fluids vocabulary:



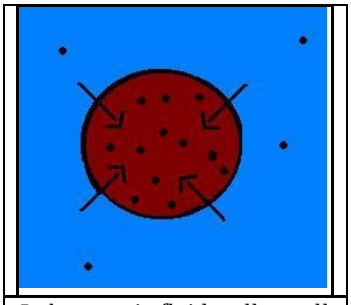
a - normal RBCs, b - "rouleaux" formation
c - swollen cells in hypotonic fluid
d - shrunken cells in hypertonic fluid;
also called "crenation"
From Gray's Anatomy of the Human Body, 1918

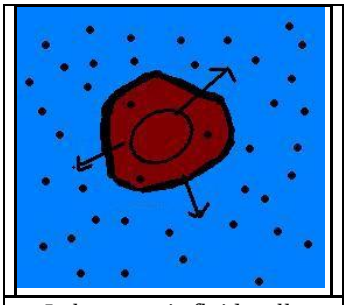
Osmolarity = the number of particles/liter of solution ≈ total concentration of a solution or fluid environment; measured in milliosmoles/liter;

Osmolality is the same but is measured as milliosmoles/kg.

Tonicity – the effect a solution or fluid environment has on cell volume; fluid moves in response to the concentration gradient created by the surrounding environment, limited by permeability of the cell membrane; "tonicity" is the *effect*ive osmolarity of the surrounding fluid/environment on cell volume:

isotonic = no change hypotonic = volume ↑s (swells) hypertonic = volume ↓s (shrinks)


In hypotonic fluid, cells swell as fluid moves into cells


In hypertonic fluid, cells shrink as fluid moves out of

Hypovolemia – inadequate effective circulating blood volume; absolute hypovolemia – actual loss of fluid out of the vascular space; relative hypovolemia – usually caused by vasodilation such that the circulating volume is inadequate; seen with systemic, severe, inflammatory conditions, anaphylaxis, sepsis

Replacement – fluids used to replace deficits; constituents similar to that of plasma; given as bolus or continuous infusions

Maintenance – fluids used for daily requirements; lower levels of sodium and chloride vs plasma; higher levels of calcium, potassium, and/or magnesium; provide water, some calories; patients are switched to these once the initial deficit is corrected. Continuous infusion ONLY, not as a bolus, risk of edema.

Resuscitation – correction of life-threatening hypovolemia, essentially, fluid replacement therapy for patients with extreme fluid deficits

Crystalloids – solutions with electrolytes and other substances that are able to cross into all fluid compartments of the body; mainstay of resuscitation and all types of fluid therapy; normal or 0.9%saline, dextrose solutions, lactated ringers (LRS), ringers, Normosol®, Plasmalyte®, etc are all crystalloids. Hypertonic crystalloids include all concentrations of saline greater than 0.9%. 7% hypertonic saline is the one most commonly used in veterinary medicine.

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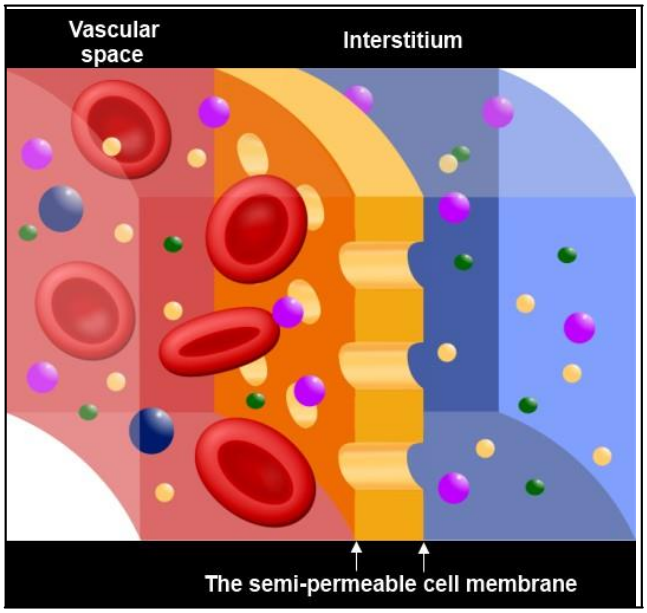
Balanced solutions – constituents and concentrations resemble content and osmolality of normal extracellular fluid; eg, LRS. Unbalanced solutions include 0.9% saline, 5% dextrose, etc.

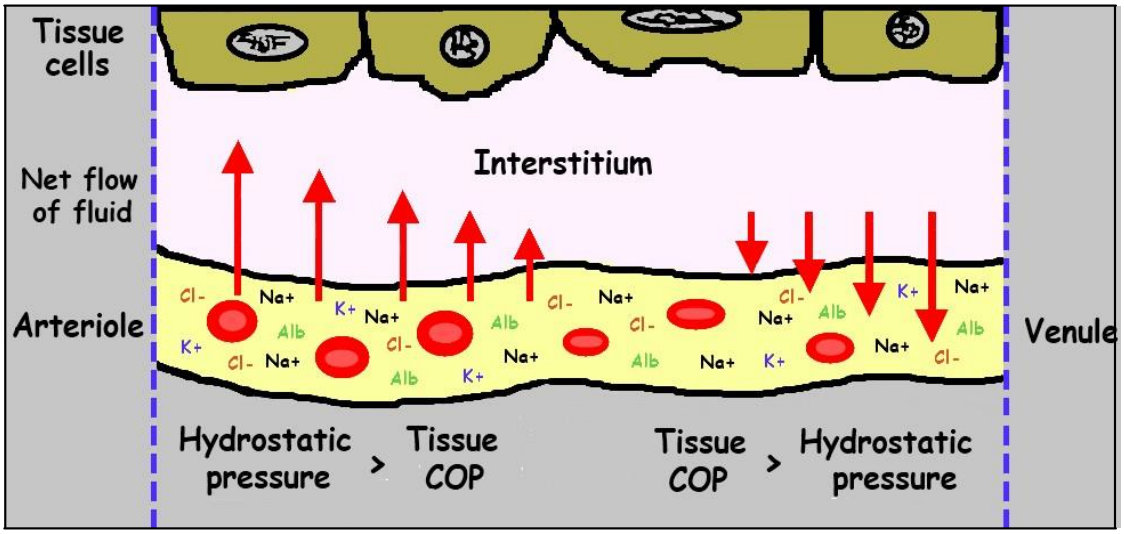
Colloids – molecules of high molecular weight (BIG), usually protein or carbohydrate, that are not able to readily cross cell membranes and therefore remain in the vascular space for long durations; hetastarch, dextrans, plasma, albumin; prepared in normal saline or lactated ringers solution.

COP – colloid osmotic pressure – the pressure created by the presence of colloids in a solution that prevents movement of fluid across a semi-permeable membrane;



Fluid transfer between vascular space and interstitium

2 most common colloids used in Vet Med:
6% Hetastarch – 69,000 Daltons , COP 34
6% Dextran 70 – 41,000 Daltons, COP 6



Direction of fluid flow across a capillary membrane in a normal patient; ↑ blood pressure, ↓ tissue COP, or ↑ permeability will increase net flow into the interstitium = edema.

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Total Body Water/Fluid compartments

- The body is composed of fluid and structural elements.
- The **fluid portion of the body** is approximately **60% of the total body weight**.
  - **2/3** of body fluid is **intracellular (ICF)**, *inside* cells.
  - **1/3** of body fluid is **extracellular (ECF)** *outside* cells
    - ECF is found *between/around* cells and within vascular spaces.
- Fluid moves passively between these areas according to:
  - Concentration gradients of large molecules (COP) and
  - Sodium, and
  - In response to hydrostatic pressure (capillary blood pressure or tissue pressure).

TOTAL BODY WEIGHT = 100%		
****20% EXTRACELLULAR** (ECF) = Interstitial **16%** & Plasma **4%**	**40% INTRACELLULAR** (ICF)	**40% EVERYTHING ELSE**
TOTAL BODY WATER (TBW) = **60%***		

***** *Total Body Water and **ECF compartments are larger in neonates, ~ 70% and 30% of body weight, respectively*

Solute/mEq/L	ECF	ICF
Na^+	145	12
K^+	4	140
Ca^{2+}	2.5	4
Mg^{2+}	1	34
Cl^-	110	4
HCO_3^-	24	12
Phosphate ions	2	40
Protein	15	50
COP Plasma	≈ 20 mmHg	
COP Interstitium	≈ 5 mmHg	

- Intravascular fluid loss is reflected by changes in the cardiovascular system – heart rate, pulse strength, capillary refill time, mucous membrane color, and temperature.
- Loss of fluid from tissues, ie, the interstitium and intracellular areas is apparent from the clinical signs of dehydration – loss of skin turgor, dryness of the mucous membranes, and sunken eyes.
- Most patients will have fluid loss from both areas, so the clinical signs are combined to determine the overall fluid deficits.

There are always two questions you need to ask yourself about identification and treatment of fluid loss:

1. **Is there a fluid deficit?** Identify hydration deficit, estimate volume lost
2. **What fluids do I use for replacement?** What type of deficit is present? How was fluid lost?