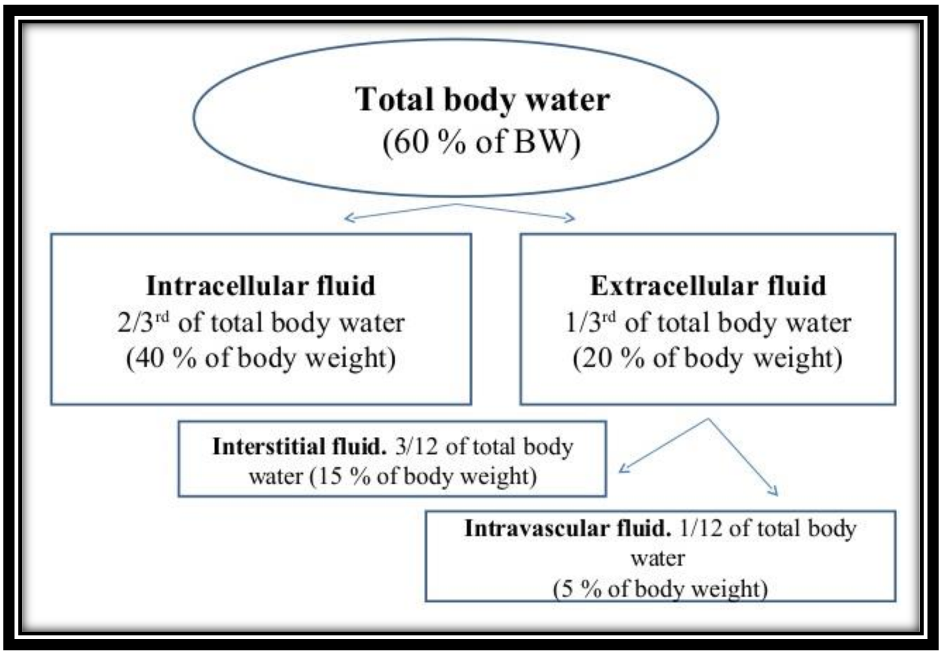
Small-animal surgical patients commonly require fluid, electrolyte, and/or acid-base therapy to maintain adequate perfusion to the tissues and to ensure acid-base and electrolyte homeostasis. Perioperative patients often are not drinking or eating, yet the animal continues to make urine, saliva, and gastrointestinal secretions and to lose fluid via respiratory evaporation.



The cell membrane separates the intracellular fluid from the extracellular fluid and is very permeable to water, but not solutes. The cell membrane contains different types of proteins, some of which are channels that allow certain solutes to pass through, whereas others actively transport solutes across the membrane. The most important transporting protein is Na^+- K^+/ATPase; it extrudes Na^+ from the cell and transports K^+ into the cell, consuming adenosine triphosphate (ATP) as it moves the solutes against their concentration gradients. This movement of Na^+ and K^+ contributes to the large disparity in Na^+ and K^+ concentrations between intracellular fluid and extracellular fluid: Na^+ concentration is very high in the extracellular fluid and very low in the intracellular fluid and K^+ is very high in the intracellular fluid and very low in the extracellular fluid. The major cation in the intracellular fluid is K^+, with much smaller contributions made by Mg^{++} and Na^+. Major anions in the intracellular fluid include PO_4^{-2} and the polyanionic charges of the intracellular proteins.

Movement of fluid from the intravascular to extravascular (interstitial and intracellular) space occurs at the level of the capillary. The capillary membrane is composed of endothelial cells and a subendothelial matrix that separates the intravascular space from the interstitial space.

Volume deficiencies in each of the body fluid compartments exhibit different clinical signs or laboratory abnormalities. Loss of abnormal amounts of hypotonic fluids from the body (extracellular fluid) leads to an increase in extracellular fluid tonicity and subsequent fluid shifts from intracellular fluid to extracellular fluid to establish iso-osmolarity between compartments. Loss of intracellular fluid may lead to intracellular fluid deficits, as evidenced by cerebral obtundation and hypernatremia/ hyperosmolarity (hypertonic dehydration).

The rate of fluid administration in the preoperative surgical patient with volume depletion depends primarily on the clinical status of the animal, based on the physical examination and laboratory parameters.

Estimating % dehydration based on P/E

% Dehydration	Physical Examination Findings
< 5	History of **fluid loss** but no findings on physical examination
5	**Dry oral mucous membranes** but no panting or pathological tachycardia
7	Mild to moderate **decreased skin turgor, dry oral mucous membranes, slight tachycardia,** and normal pulse pressure
10	Moderate to **marked degree of decreased skin turgor, dry oral mucous membranes, tachycardia, and decreased pulse pressure**
12	Marked loss of skin turgor, dry oral mucous membranes, and significant signs of **shock**

Fluid deficit calculation

Body weight (kg) x % dehydration = volume (L) to correct

Fluids during anesthesia

The decision about whether to provide fluids during anesthesia, and the type and volume used, depends on the patient's signalment, physical condition, and the length and type of procedure.Current recommendations are for less than 10 mL/kg/hr to avoid adverse effects of hypervolemia. Consider starting the anesthetic procedure at 3 mL/kg/hr in cats and 5 mL/kg/hr in dogs.

Maintenance fluid rates

Cat: Formula = 80 x body weight (kg)$^{0.75}$ per 24 hr Rule of thumb 2–3 mL/kg/hr

Dog: Formula = 132 x body weight (kg)$^{0.75}$ per 24 hr Rule of thumb 2–6 mL/kg/hr

Fluids for the sick patient

Assess for three types of fluid disturbances.

1. Changes in volume (e.g., dehydration, blood loss, heart disease)

a. Fluid deficit calculation for dehydration:

body weight (kg) x % dehydration = volume in liters to correct.

See section on dehydration for more details on determining timeframe for replacement of deficit.

b. Treatment for hypervolemia includes correcting underlying disease (e.g., chronic renal disease, heart disease) decreasing or stopping fluid administration, and possibly use of diuretics.

2. Changes in content (e.g., hyperkalemia, diabetes or renal disease)

a. In general, the choice of fluid is less important than the fact that it is isotonic. Volume benefits the patient much more than exact fluid composition. Isotonic fluids will begin to bring the body's fluid composition closer to normal, pending laboratory results that will guide more specific fluid therapy.

3. Changes in distribution (e.g., pleural effusion, edema)

a. For pulmonary edema or pleural/abdominal effusions, stop fluid administration.

Fluid Types

Various types of fluids are available and are commonly categorized on the basis of their tonicity, electrolyte composition relative to extracellular fluid, molecular weight, and pH. Fluids that have the same osmolarity as the extracellular space are isotonic, those with a lower osmolarity are hypotonic, and those with a higher osmolarity are hypertonic. Fluids that contain electrolytes similar to those of the extracellular space are referred to as balanced, and those that do not are unbalanced.