Getting to know rehydration therapies

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Wildlife rehabilitators across the country are given bags of IV solutions by vets or medical professionals as a donation. These professionals do this out of kindness and support; carers gratefully accept usually anything they can get for free.

The veteran carer may think to ask"how do I use this and can I use it on wildlife safely"? However, most don't. Those who do, may ask" in what situation do I use this"?

Most wildlife rehabilitators and fostercarers don't know the application for the various IV solutions available or offered. Osmosis & Osmotic pressure is greatly influenced by what is administered. Which solution suits which application? Which solution to use safely in most situations? Which should be avoided in many situations, and why they should be avoided?

As a wildlife rehabilitator I have been put in this situation and did not really think of it as an issue until the black Saturday fires when all manner of fluids were donated from every possible medical institution.

Upon learning of the dire consequences that could occur from the wrong administration of these fluids I thought it would be good for most carers to at least be able to appreciate the difference of the fluids and their role.

Firstly we need to understand what we are putting into animals in an emergency situation, understanding electrolytes should be the basis of our education as we all have the requirement to utilize these as most animals that come into our care are in shock and need fluid replacement and electrolytes.

Electrolytes work with fluids to sustain health and wellbeing, they can be found in many concentrations depending on where they are (inside or outside the cells). Electrolytes are necessary for almost all cells reactions and the general cell performance

Electrolytes assist the body to regulate water distribution, control acid balance & conduct nerve impulses. They also play a part in energy generation and blood clotting. The six major electrolytes have specific abilities and can give us insight into why certain things can go wrong when the electrolyte balance is out of balance.

*Potassium (*K)

The dominant cation in intracellar fluid (ICF)

Regulates cell excitability

Permeates cells membranes, thereby affecting the cells electrical status

Helps to control ICF osmolality and consequently, ICF osmotic pressure

Has an important role in muscle contraction and myocardial membrane responsiveness. Cardiac functions (heart) So without the correct balance of potassium the heart cannot function properly

Magnesium(Mg)

A leading ICF Cation

Contributes to many enzymatic and metabolic processes, particularly protein synthesis

Regulates and changes nerve impulse transmission and skeleton muscle reactions. (Unbalanced Mg concentration dramatically affects neuromuscular processes) This can give the feeling of being uncoordinated.

Helps the cardiovascular system function normally

Helps sodium and potassium cross the cell membranes

Phosphorus (P)

The major ICF anion

Promotes energy storage & carbohydrate, protein, and fat metaboloism

Acts as a Hydrogen Buffer

Promotes energy transference to cells through the formation of energy storing substances.

Along with calcium is an essential component of bones and teeth

Phosphorus is readily absorbed through the GIT

Is required for food to be metabolized and converted to energy

Sodium (Na)

The main extracellular fluid (ECF) cation

Helps govern normal ECF osmolality (A shift in Na concentrations triggers a fluid volume change to restore normal solute and water ratios)

Helps maintain acid base balance

Activates nerves and muscle cells

Influences water distribution (with Chloride)

Chloride (CI)

The main ECF anion helps maintain normal ECF osmolality

Affects Body pH

Plays a vital role in maintaining acid base balance; combines with hydrogen ions to produce hydrochloric acid (aids in a healthy GIT) Hydrochloric acid is what breaks food down, this is one of the reasons of appetite loss if electrolyte balances during dehydration occurs

Calcium (Ca)

A Major cation in teeth & bones found in fairly equal concentrations in intracellular fluids and extra cellular fluids and is found in cell membranes, where it helps cells adhere to one another and maintain their shape

Acts as an enzyme activator within cells (muscles must have Ca to contract)

Aids coagulation, so we need it to enable blood clotting

Affects Cell Membrane permeability and firing level

Regulates thyroid and parathyroid, maintaining hormone such as antidiuretic hormone ADH

Osmosis

Osmosis is the passage or movement of water/fluid molecules across a membrane surface, this happens when fluids have more or less solutes, so they may move from an area with less solutes and more fluid to another area with more solutes and less fluid. Remembering that with osmosis the fluid moves not the solutes. This happens by passing through the semi permeable membrane from an area of Lower concentration to an area of higher concentration attempting to keep the balance just right or attempting to reach equilibrium.

Fluid Tonicity

We all are told about isotonic fluids but what does it mean

Isotonic fluids such as normal saline 0.9% saline have a concentration of dissolved particles equal to the intracellular fluid. Osmotic pressure therefore is the same inside and outside the cells. So the cells neither shrink nor swell with subcut fluids or interperitoneal infusions. Isotonic fluids can pass between the cells easily without asking the body to do much work at all.

Hypertonic fluid has a tonicity greater than intracellular fluid, so osmotic pressure is unequal inside and outside the cells. Dehydration or rapidly infused fluids such as 3% saline or 50% dextrose draw water out of the cells into the more highly concentrated extracellular fluid

Hypotonic fluids such as half normal saline 0.45% have a tonicity less than that of intracellular fluid so osmotic pressure draws water into the cells from the extracellular fluids. Severe electrolyte losses or inappropriate use of IV fluids can make body fluids hypotonic.

Some examples of IV solutions *that are considered isotonic*

Dextrose 5% in water is used for fluid loss and dehydration and hypernatremia (too much sodium)

However the special considerations that come with using this are many-Firstly the solution is isotonic but becomes hypotonic when the dextrose is metabolized, you should never use it in the cases of resuscitation as it can cause hyperglycemia. It should be used cautiously in anything that may have any issues with renal failure or cardiac issues as it can cause a fluid overload. It does not provide enough daily calories for prolonged used; it may eventually cause protein breakdown.

0.9% sodium chloride (normal saline)

Used for Shock, Hyponatremia , blood transfusions, resuscitation, fluid challenges, metabiolic alkalosis, hypocalcaemia, fluid replacement in diabetic ketoacidosis.
This replaces extracellular fluid so should not be used with patients with congestive heart failure, edema or hypernatremia as it can lead to an over load

Lactated Ringer's solution

Can be confusing as it is referred to in so many ways, however it is a solution that is isotonic with blood and intended for intravenous administration. Veterinary administration may also be subcutaneous.

Lactated Ringer's solution is abbreviated as "LR", "RL" or "LRS". It is also known as **Ringer's lactate solution** (although Ringer's solution technically refers only to the saline component, without lactate). It is very similar - though not identical to - Hartmann's Solution, the ionic concentrations of which differ.

It can be used in burns patients but should not be used for first few days, Is good for Lower GI tract fluid loss, Acute Blood loss and can treat hypovolemia due to third Spacing.

Things you needs to know about lactated ringers

The electrolyte content is similar to serum but does not contain magnesium, Contains potassium; DON'T USE WITH renal failure or anything you expect may be leading to such as severely dehydrated patients it can cause hypokalemia. Don't use in anything with liver issues as the patient can't metabolise lactate, a functional liver converts it to bicarbonate.

Hartmann's solution or compound sodium lactate is a solution that is isotonic with blood and intended for intravenous administration. Hartmann's IV Infusion is used to replace body fluid and mineral salts that may be lost for a variety of medical reasons. Hartmann's IV Infusion is especially suitable when the losses result in too much acid being present in the blood. Hartmann's solution is abbreviated as "CSL". It is very similar—though not identical to—lactated Ringer's solution, the ionic concentrations of which differ.

Some examples of IV fluids *that are considered Hypotonic*

0.45 % sodium chloride (half normal saline)

Can be used for water replacement, hypertonic dehydration, Sodium and chloride depletion, Gastric fluid loss from vomiting. You should use caution with this fluid if the following issues are present it may cause cardiovascular collapse or increased intracranial pressure, DO NOT USE with liver issues, trauma or burns.

Some examples of IV fluids *that are considered Hypertonic*

Dextrose 5 % in half normal saline Solution (0.45%)

Uses are quite specific mainly for diabetic ketoacidosis after initial treatment with normal saline and half normal saline solution- this can prevent hypoglycemia and cerebral edema (occurs if serum osmolality is reduced too rapidly) this is really a product that would need close supervision of a vet for specific conditions such as if glucose falls below the safe serum levels, refer to "selected serum and plasma biochemistry values" in Medicine of Australian Mammals for the specific species you are dealing with

Dextrose 5% in normal saline solution

Used for Hypotonic dehydration, Temporary treatment of circulatory insufficiency, when syndromes present of inappropriate antidiuretic hormone.

Conclusion

Obviously there is a lot more for us all to learn about rehydration therapy as wildlife carers.

We need to build a good relationship with a vet that understands the differences associated with wildlife as opposed to the treatment of domestic animals. There are a lot of differences between fluids that we as carers are only just beginning to understand. In almost all cases the safest rehydration therapy is 0.9% saline solution and for those of us needing to intervene with sub cut fluids this should be our only choice. Veterinarians can run serum and plasma biochemistry values tests, access blood serum values for each species & give appropriate advice upon results if and when we need to choose other fluids. Considering we are dealing with a vast array of species, that has usually experienced a huge amount of stress both physically and mentally and we ourselves are often under resourced and overtired. Possessing an understanding of electrolytes and their influence on the body, osmosis, fluid tonicity and how other forces can change the balancing act that occurs, gives us better insight into rehydration therapy and how we can be better at what we do.

Glossary of terms

Permeability ability of a solid substance to allow fluids to pass through it

Interperitoneal injection or IP injection is the injection of a substance into the peritoneum (body cavity).

Hypernatremia is an electrolyte disturbance that is defined by an elevated sodium level in the blood.Hypernatremia is generally not caused by an excess of sodium, but rather by a relative deficit of free water in the body. For this reason, hypernatremia is often synonymous with the less precise term, dehydration.

Hyponatremia is an electrolyte disturbance (a disturbance of the salts in the blood) in which the sodium (*Natrium* in Latin) concentration in the plasma is lower than normal (*hypo* in Greek), The large majority of cases of hyponatremia occurring in adults result from an excess amount or effect of the water retaining hormone known as Antidiuretic Hormone commonly abbreviated as ADH.

ICF Intra cellular fluid

ECF extra cellular fluid

Hypovolemia (also hypovolaemia) is a state of decreased blood volume; more specifically, decrease in volume of blood plasma, It is thus the intravascular component of volume contraction (or loss of blood volume due to things such as hemorrhaging or dehydration), but, as it also is the most essential one, *hypovolemia* and *volume contraction* are sometimes used synonymously. It differs from dehydration, which is defined as excessive loss of body water. Furthermore, hypovolemia defines water deficiency only in volume rather than specifically water.

Ketoacidosis is an extreme and uncontrolled form of ketosis, which is a normal response to prolonged fasting. In ketoacidosis, the body fails to adequately regulate ketone production causing such a severe accumulation of keto acids that the pH of the blood is substantially decreased. In extreme cases ketoacidosis can be fatal.

Hypocalcaemia is the presence of low serum calcium levels in the blood

Appendix References

Fluids & electrolytes made incredibly easy, Springhouse,1997

Suggested reading

Medicine of Australian Mammals