Tonicity and osmotic pressure

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Objectives

1. Tonicity
2. Osmosis and osmotic pressure

Tonicity of solution

Table 25–2

Osmolar Substances in Extracellular and Intracellular Fluids

	Plasma (mOsm/L H_2O)	Interstitial (mOsm/L H_2O)	Intracellular (mOsm/L H_2O)
Na^+	142	139	14
K^+	4.2	4.0	140
Ca^{++}	1.3	1.2	0
Mg^+	0.8	0.7	20
Cl^-	108	108	4
HCO_3^-	24	28.3	10
HPO_4^-, $H_2PO_4^-$	2	2	11
SO_4^-	0.5	0.5	1
Phosphocreatine			45
Carnosine			14
Amino acids	2	2	8
Creatine	0.2	0.2	9
Lactate	1.2	1.2	1.5
Adenosine triphosphate			5
Hexose monophosphate			3.7
Glucose	5.6	5.6	
Protein	1.2	0.2	4
Urea	4	4	4
Others	4.8	3.9	10
Total mOsm/L	301.8	300.8	301.2
Corrected osmolar activity (mOsm/L)	282.0	281.0	281.0
Total osmotic pressure at 37°C (mm Hg)	5443	5423	5423

Osmosis and osmotic pressure

For each milli osmo of solute particle difference between inside and outside will create an osmotic pressure of 19.3 millimetres of mercury.

300mosmol/L times 19.3/mosmol/L it will create 5790mmHg osmotic pressure which is very high

blood plasma likes to any other extracellular fluid except protein. The total amount of solute particles is small higher than intra and extra which make it hypertonic. The difference will be around 25 millimetre of mercury. Which means that the blood plasma is about 25 mmHg higher than it anywhere else and this is called osmotic pressure or colloid pressure

If you add 4millimole of KCL to 1 L of water you will end up with 8 mosm/L

If we add 2 millimole cacl2 into 1 L of water, you will end up with 6mosm/L

If you add 5 millimole of glucose into water, it will stay as one particle so it will end up with 5 mosm/L

How to quantify numerically the tonicity of solution?

How to compute the total osmolarity of 150 mM Nacl solution?

150 mM solution is equal to 0.15 M solution .

First of all, what we mean by this question is the total of solute particle in a Liter of solution.

If you take 150 mmole of Nacl molecule in each salt particle you will multiply times two since it will break up into 150moml Na and 150mmol cl for the total of 300 mosmol/L

mole/L of solution or M: Molarity - it is the # molecules of EACH solute found in a solution per unit of volume of solution. It is expressed in mole/ liter of solution

mole/kg of solvent or m: Molality - it is the # molecules of EACH solute found in a solution per unit of weight of solvent. It is expressed in mole / 1000g of solvent

Physiological saline is 0.9% NaCl. This means that 100 ml's of physiological saline contains 0.9 g of NaCl. One liter of physiological saline must contain 9 g of NaCl. We can determine the molarity of a physiological saline solution by dividing 9 g by 58 g... since we have 9 g of NaCl in a liter of physiological saline, but we have 58 grams of NaCl in a mole of NaCl. When we divide 9 g by 58 g, we find that physiological saline contains 0.154 moles of NaCl per liter. That means that physiological saline (0.9% NaCl) has a molarity of 0.154 molar. We might express this as 0.154 M... or 154 millimolar (154 mM).

A 0.9% NaCl and a 0.154 M NaCl solution are the same thing. They are physiologic isotonic solution

Assignment 2

Q2. Which of the following solutions when infused intravenously would result in an increase in extracellular fluid volume, a decrease in intracellular fluid volume, and an increase in total body water after osmotic equilibrium?

- A) 1 L of 0.9% sodium chloride solution
- B) 1 L of 0.45% sodium chloride solution
- C) 1 L of 3% sodium chloride solution
- D) 1 L of 5% dextrose solution
- E) 1 L of pure water

How to quantify numerically the tonicity of solution?

- A 3% sodium chloride (NaCl) solution is hypertonic and when infused intravenously would increase extracellular fluid volume and osmolarity, thereby causing water to flow out of the cell. This would decrease intracellular fluid volume and further increase extracellular fluid volume.

- The 0.9% NaCl solution and 5% dextrose solution are isotonic, and therefore would not reduce intracellular fluid volume.

- Pure water and the 0.45% NaCl solution are hypotonic, and when infused would increase both intracellular and extracellular fluid volumes

Tonicity of solution