

Supplement – How to Measure Fluid Volumes in an Organism*

I. Measurement of fluid compartment by the dilution method.*

In this application, the basic definition of concentration is used. In order to estimate indirectly an otherwise unmeasurable volume in the body, a known amount (M) of an indicator substance is injected. After it has been allowed to mix thoroughly, an aliquot of the compartment is analyzed and the concentration (C) of the tracer is determined. The volume (V) in which the tracer has been distributed can be calculated as

$$V = \frac{M}{C}$$

where **V = the unknown volume**

M = the amount of tracer injected

C = the concentration of tracer after mixing

II. The calculation of cell volume changes.

Most of the cells of the body are freely permeable to H₂O but much less permeable to solutes. Thus the total amount of solute within a cell will remain relatively constant even though the cell changes its volume. For example, a red cell in isotonic saline will have an internal solute concentration (C) equal to that in the surrounding medium, and a corresponding volume (V). The total amount (M) of solute in the cell is given by the product VC=M. If it is now placed in a hypotonic medium, water will enter the cell, and the solute concentration in the cell will decrease to equal that in the medium. At the same time the cell volume (V) will increase in such a way that:

$$V_1C_1 = V_2C_2 = M = \text{constant}$$

where

V₁ = initial volume of cell

C₁ = initial solute concentration of cell

V₂ = new volume of cell

C₂ = new solute concentration within cell

Thus, from a knowledge of V₁, C₁ and C₂, the new cell volume may be calculated:

$$V_2 = \frac{C_1V_1}{C_2}$$

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