Water Balance in Intensive Care Unit Patients

Essay

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List of Abbreviations

% W/V	:	Percent of weight of solution in the total volume of solution
2D	:	Two Dimension
ABCDE	:	Airway, Breathing, Circulation, Disability, Exposure
ADH	:	Anti Diuretic Hormone
Ag	:	Antigen
Cm	:	Centimeter
Cm H_2O	:	Centimeter of water
Cm^2	:	SquareCentimeter
COPD	:	Chronic Obstructive Pulmonary Disease
CPM	:	Central PontineMyelinosis
CVP	:	Central Venous Pressure
D5	:	5% Dextrose
D5 1/2NS	:	Dextrose in half amount of normal saline
D5LR	:	Milliliter
D5NS	:	5% Dextrose in Normal Saline
D5W	:	5% Dextrose in Water
Da	:	Daltons
DDFPe	:	DoDecaFluroPentane emulsion
D_{max}	:	maximum Dimension
D_{min}	:	minimum Dimension
EABV	:	Effective Arterial Blood Volume
ECF	:	ExtraCellular Fluid
ECHO	:	sonogram of the Heart
GFR	:	Glomerular Filtration Rate
H_2PO_4	:	Phosphoric Acid
HBOC	:	Hemoglobin carrying Oxygen
HES/HAES	:	Hydroxyethyl starch
ICF	:	IntraCellular Fluid
ICU	:	Intensive Care Unit
IMHA	:	Immune Mediated Hemolytic Anemia

List of Abbreviations

IV	:	IntraVenous
IVC	:	Inferior Vena Cava
IVC $_{DI}$	:	Inferior Venacava Distensibility Index
IVC $_{VI}$	:	Inferior Venacava variability index
IVC$_{CI}$	:	Inferior Vena cava Collapsibility index
LA	:	Left Atrium
LR	:	Lactated Ringer
LV	:	Left Ventricle
mEq/L	:	Milliequivalent per liter
mg/ml	:	5% Dextrose in Lactated Ringer solution
mL	:	milligram per milliliter
ml/kg/hr	:	milliliter / kilogram / hour
mm	:	millimeter
mm Hg	:	Millimeter of mercury
M-mode	:	Motion mode
mmol/L	:	millimole per Liter
mOsm/L	:	milliosmole per Liter
MW	:	Molecular Weight
NaCl	:	sodium Chloride
NG tube	:	NasoGastric tube
NSAID	:	Non-Steroidal Anti-Inflammatory Drugs
NSS	:	Normal Saline Solution
O_2	:	Oxygen
PaO_2	:	Partial pressure of Oxygen dissolved in the blood
PCC	:	Prothrombin Complex Concentrate
PEEP	:	Positive End-Expiratory Pressure
PFC	:	PerFluroCarbons
PH	:	Potential of Hydrogen
PO_2	:	Partial pressure of Oxygen
PO_4	:	Phosphorus
PVR	:	Pulmonary Vascular Resistance

List of Abbreviations

RA	**:**	Right Atrium
RACE	**:**	Regional Approach to Cardiovascular Emergencies
RAP	**:**	Right Atrial Pressure
RV	**:**	Right Ventricle
SAM	**:**	Systolic Anterior Motion
T_4	**:**	Thyroxine hormone
TBW	**:**	Total Body Water
TCA	**:**	Tri-Carboxylic Acid cycle
U/S	**:**	UltraSonography

Introduction

The total body water in a 70-kilogram adult man, the total body water is about 60 percent of the body weight, or about 42 liters .Women normally have a greater percentage of body fat compared with men, their total body water averages about 50 percent of the body weight. In premature and newborn babies, the total body water ranges from 70 to 75 percent of body weight **(Bhave and Neilson, 2011).**

As cell membranes are relatively impermeable to most solutes but are highly permeable to water (i.e., they are selectively permeable), whenever there is a higher concentration of solute on one side of the cell membrane, water diffuses across the membrane toward the region of higher solute concentration. The rate of diffusion of water is called the rate of osmosis ***(*Kramer and Eric, 2012*)*.**

Fluid distributed between the plasma and interstitial spaces are determined mainly by the balance of hydrostatic and colloid osmotic forces across the capillary membranes. The maintenance of a relatively constant volume and a stable composition of the body fluids are essential for homeostasis. Some of the most common and important problems in clinical medicine arise because of abnormalities in the control systems that maintain this relative constancy of the body fluids **(Bhave and Neilson, 2011).**

Intravenous fluids are chemically prepared solutions that are administered to the patient. They are tailored to the body's needs and used to replace lost fluid and/or aid in the delivery of IV medications. IV fluids come in different forms and have different impacts on the body **(Perel et al., 2013)**.

Fluids come in four different forms: Colloids, Crystalloids, blood and blood products, Oxygen carrying solutions **(Lekkerkerker et al.,2011).**

Maintaining adequate circulation is a key task of critical care physicians, yet it is also one of the most challenging areas in the critical care setting. Traditionally, assessment and monitoring of fluid status (intravascular volume) has relied upon invasive modalities such as pulmonary artery and central venous catheters. And non-invasive such as urine output volume, consciousness, base deficit and lactate level. **(Bellomo et al., 2012).**

Hypovolemia is a reduction in the volume of the ECF compartment in relation to its capacitance **(Gulati , 2016).**

The major goal in treatment of hypovolemia is to restore hemodynamic integrity and tissue perfusion **(Kramer et al., 2008).**

Hypervolemia refers to expansion of ECF volume, which varies, even in normal individuals, with dietary sodium intake **(DiSomma et al., 2010).**

Therapeutic intervention to reduce ECF volume without addressing the underlying disease is often met by complications, especially when ECF volume expansion is associated with decreased intravascular volume or EABV. Nevertheless, three treatment modalities are available to reduce ECF volume directly by inducing negative sodium balance: dietary sodium restriction, diuretics, and extracorporeal fluid removal by ultrafiltration **(Titze et al., 2014)**.

AIM OF THE WORK

The aim of this work is to spot a light on water balance in intensive care unit patients by fluid administration focusing on the changes in fluid hemostasis & calculation of fluid requirements, their physical characteristics and whether to select crystalloid or colloid solutions.

Chapter (1):

Physiology of water balance

Water constitutes approximately 55% to 65% of body weight, varying with age, gender, and amount of body fat. Therefore, water constitutes the largest single constituent of the body. Total body water (TBW) is distributed between the IntraCellular Fluid (ICF) and ExtraCellular Fluid (ECF) compartments. About 55% to 65% of TBW resides in the ICF and 35% to 45% is in the ECF. Approximately 75% of the ECF compartment is interstitial fluid and only 25% is intravascular fluid (blood volume), as shown in Figure 1 **(Tanner, 2009).**

The maintenance of a relatively constant volume and a stable composition of the body fluids is essential for homeostasis. Some of the most common and important problems in clinical medicine arise because of abnormalities in the control systems that maintain this relative constancy of the body fluids **(Bhave and Neilson, 2011).**

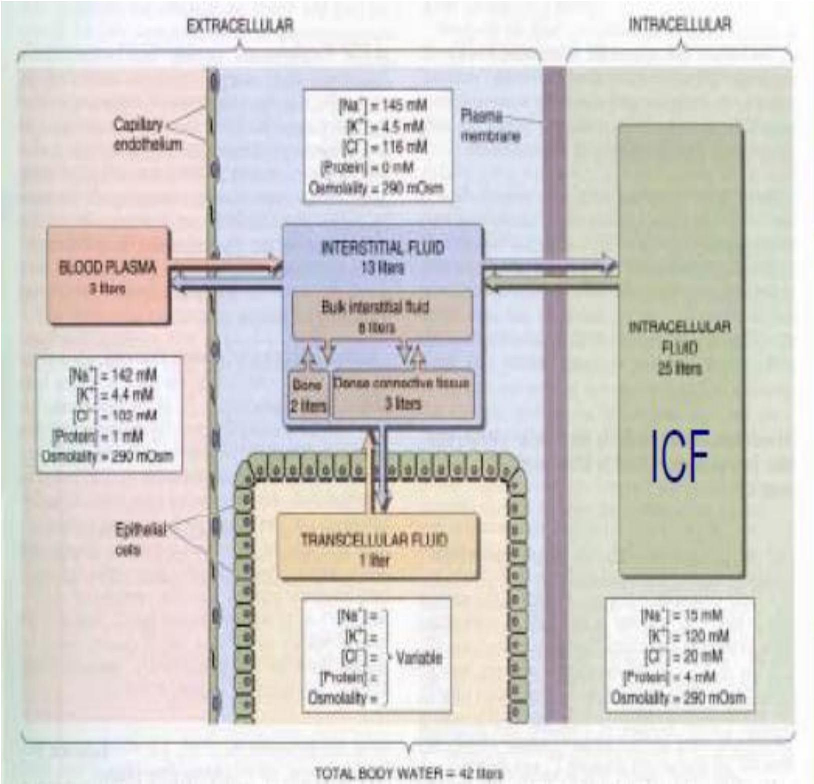

Fig. (1): Total body water **(Tanner, 2009).**

Fluid Intake and Output are Balanced during Steady-State Conditions:

The relative constancy of the body fluids is remarkable because there is continous exchange of fluid and solutes with the external environment, as well as within the different body compartments **(Tanner, 2009).**

Daily Intake of Water:

Water is added to the body by two major sources:

(1) It is ingested in the form of liquids or water in food, which together normally add about 2100ml/day to the body fluids.

(2) It is synthesized in the body by oxidation of carbohydrates, adding about 200ml/day.

Intake of water is highly variable among different people and even within the same person on different days, depending on climate, habits, and level of physical activity as shown in table1**(Jequier and Constant , 2010)**.

Table (1): **Daily Intake and Output of Water (ml/day) (Jequier and Constant, 2010).**

	Normal	**Prolonge, heavy excercise**
Intake		
Fluid ingested	**2100**	**?**
From metabolism	**200**	**200**
Total intake	**2300**	**?**
Output		
Insensible: skin	**350**	**350**
Insensible: lung	**350**	**650**
sweat	**100**	**5000**
feces	**100**	**100**
urine	**1400**	**500**
Total output	**2300**	**6600**