بسم الله الرحمن الرحيم

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Calcium And Anesthesia

Essay
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Master Degree in Anesthesia

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Contents

ABBREVIATIONS

ATP	Adenosine Triphosphate
Ca^{++}	Calcium Ion
CAMP	Cyclic Adenosine Monophosphate
CCBs	Calcium Channel Blockers
CHF	Congestive Heart Failure.
CICR	Calcium Induce Calcium Release.
CT	Calcitonine
CVP	Central venous pressure.
DHP	Dihydropyridines.
dp/dt	diastolic pressure/diastolic time.
EDTA	Ethyline Diamine Tetra Acetic Acid
$ETCO_2$	End Tidal CO_2
GABA	Gamma Amino Butyric Acid.
GMP	Guanidine Monophosphate.
HLA	Human Leucocytic Antigen
LVEDP	Left Ventricular End Diastolic Pressure.
MAC	Mean Alveolar Concentration.
MH	Malignant Hyperthermia
MMR	Masseter Muscle Rigidity
NMS	Neuroleptic Malignant Syndrome.
$PaCO_2$	Arterial CO_2 Tension.
PK	Phospho Kinase
PSVT	Paroxysmal Supraventricular Tachycardia.
PTH	Parathyroid hormone
$PvCO_2$	Venous CO_2 Tension.
ROC	Receptor Operated Channel.
RYR	Ryanodine Receptor.
SR	Sarcoplasmic Reticulum
VOC	Voltage Operated Channel.

INTRODUCTION

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Calcium is a divalent cation found primarily in the extracellular fluid . Circulating calcium includes protein bound (40%), chelated (10%) and ionized fractions (50%), only the ionized fraction is physiological active .

Because mathematical formulae that correct total calcium measurements for albumin concentration are inaccurate in critically ill patients , ionized calcium should be directly measured (Zaloga and Chernow B , 1985) .

Calcium is essential for excitation contraction coupling , muscle function , ciliary movement , mitosis , neurotransmitter release , enzyme secretion ,hormonal secretion and cellular metabolism in addition , it forms structural component of bone and cell membranes (Lucchesi , 1989) .

Calcium is also important for the cardiac pacemaker activity and for generation of cardiac action potential .(Zaloga GP, 1990) .

Calcium is regulated by parathyroid hormone (PTH) and vitamin D , both of which mobilize calcium from bone , increase reabsorption of calcium from the renal tubule and enhance intestinal absorption of calcium .

PTH and vitamin D can maintain normal level of circulating calcium even in the absence of dietary calcium intake .

Also calcium metabolism is regulated by Calcitonin hormone as well as by adrenal glucocorticoids , growth hormone and thyroid hormone (Arnaud CD , 1978) .

Acute acidemia increases ionized calcium level on the other hand acute alkalemia decreases ionized calcium level (Bleyer A and Goldfarb S , 1993) .

CHAPTER I

PHYSIOLOGY OF CALCIUM

Calcium is one of the important ions in the body. This cation plays a direct or indirect role in wide variety of physiologic processes including muscle contraction, cellular secretion, enzyme function, blood coagulation, membrane structure and function and perhaps even in anesthetic action (*Carafoli et al, 1985*).

Distribution:-

Calcium is chiefly an extra cellular cation, it constitutes about 20% of body weight. Normal serum concentrtration of calcium is 8.5-10.5 mg/dl (*Zaloga, 1990*).

Calcium circulates in the plasma in three forms, an ionized form (50%), Protein bound form (40%) and chelated form (10%). It is the ionized fraction that is physiologically active(*Zaloga & Chernow, 1988*).

Calcium is present mostly in the skeleton, only about 1% of the total body calcium is in solution in body Fluids.

Bone contain over 99% of body calcium, it serves as the major reservoir in maintenance of calcium homeostasis.

A highly integrated and complex endocrine system maintains calcium, phosphate and magnesium homeostasis in all vertebrates (*Araund, 1978*).

Factors affecting calcium level:-

Variety of factors influence calcium level.

Since calcium is bound to protein (mostly albumin) decreases in albumin concentration will lower the total blood calcium concentration, despite the maintenance of normal ionized calcium levels as in case of nephrosis or liver cirrhosis who have low protein concentration.

Such decreases in albumin are common following fluid resuscitation and major surgery. Most patients with low total serum calcium level and low albumin level have normal ionized calcium concentration (*Zaloga et al,1985*).

Citrate which is used as preservative and anticoagulant in blood products induces decrease in ionized calcium which is usually small and transient in patients with normal kidney and liver function as well as normothermia and normal parathyroid-vitamin D axis.(*Howland et al 1976*).

Acid-base alteration also affect the level of ionized calcium. Acidosis decreases calcium binding to albumin (increases ionized calcium) while alkalosis increases calcium binding to albumin (decreases