

Review of Literature

How Much Calcium; Our Women Need!!

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Calcium is one of the major elements of the body which is needed for several vital functions; so appropriately named 'miracle mineral'. Many millions of people have health problems directly or indirectly resulting from calcium deficiency. Taking 500-1000mg of calcium can be an insurance-policy; especially for older people and pregnant women. Getting enough of this "Miracle" mineral every day may require a small effort. If you consider the payoff good health - its worth it.

Key words: Calcium, need

Many mothers tell their children "Drink your milk, you need calcium (Ca) for the healthy teeth and bones". They are right, calcium does help keep bones and teeth strong and it also plays a key role in other vital body functions.

Recent studies have declared calcium as a possible player against many diseases. Bad news about it is that millions of people throughout the world do not get enough of this "Miracle Mineral".

Calcium is one of life essential element, its importance can be assessed by the fact that its deficiency "hypocalcaemia" as well as its abundance "hypercalcaemia" can cause "life threatening" crises.

- An adult contain about 1100gm=275mol of Ca^{++}
- 99% of this calcium is in skeleton.
- Normal plasma Ca level is 10mg/dl
{10mg/dl=5meq/L=2.5mmol/L}

Part of it is bound to plasma proteins which is non-deffusable portion.

It is the free (ionized) calcium in body fluid i.e., a vital second messenger necessary for

- Blood coagulation
- Muscle contraction
- Nerve function

The decrease plasma concentration of calcium causes inhibition of neuromuscular transmission so there should be hypotonia in muscles especially in skeletal muscles. But there is spasm of skeletal muscle especially skeletal muscles of extremities; laryngospasm can be severe enough to occlude "endotrachial tube" leading to asphyxia. This is called "Hypocalcaemic Tetany". The initial action of low Ca is overbalanced by direct excitatory effect of hypocalcaemia on nerve and muscle cells.

Hypocalcaemia can also cause clotting defect; however, the level of plasma Ca at which lethal tetany occurs still above the level at which clotting defect occurs..

Calcium Metabolism

Many hormones are actively involved in Ca metabolism.

1,25 Dihydroxy Cholecalciferol: (most active Vit D₃ metabolite)
When U.V. rays shirkes (mammalian) epidermis, the 7-dehydrocholesterol is rapidly converted to pre-vit D₃ which slowly forms vit. D₃ (cholecalciferol). This is removed from skin into plasma by a carrier protein and

transported to liver where hydroxylation occurs {25(OH) Vit D₃} and further hydroxylation takes place in the proximal tubules of kidney to form the most active form of vit. D₃ called 1,25 dihydroxy cholecalciferol or "Calcitrol". It acts via cell membrane receptors leading to formation of various protein through m-RNA which actively transports Ca across epithelium of gastrointestinal tract.

It also activates "osteoclasts" in bone (increases number of mature osteoclasts and increase Ca mobilization from bone into circulation).

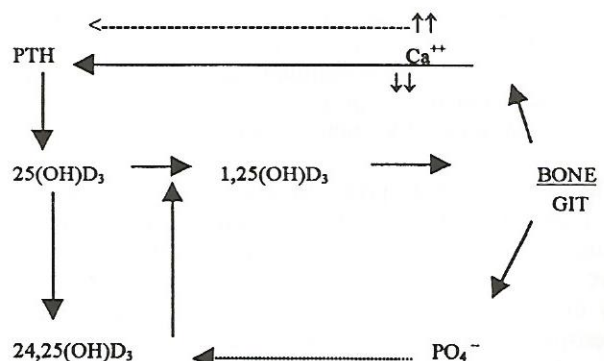
Osteoblast stimulation is also done by it but overall effect is Ca-mobilization.

In vitamin D deficiency there is poor intestinal absorption of calcium; which may result in hypocalcaemia and new protein of bone will fail to mineralize resulting "Rickets" in children and "Osteomalasia" in adults. Other main causes of such pathological sequelae are:

- Inadequate Sun light exposure
- Inadequate Ca intake specially dairy products
- Inadequate pro previt. D₃ intake
- Increased Ca loss; (renal disease; Lactation, repeated pregnancies without supplementation etc.).

Parathormone (PTH):

PTH is a linear polypeptide hormone produced by four parathyroid glands located within thyroid gland.



Formation of 1,25(OH)₂D₃ is regulated by plasma Ca⁺⁺ which affects through PTH. PTH is essential for life as its absence (may be due to parathyroidectomy) leads to

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imbalance in Ca^{++} metabolism (constant hypocalcaemia) and hypocalcaemic tetany; clinically evident by "Chostek Sign" and "Trousseau's Sign".

Calcitonin

It is a Ca lowering hormone, derived from "ultimo-Branchial" bodies; a pair glands embryologically derived from the 5th branchial arch which in mammals becomes incorporated into thyroid tissue. It also function through specific receptors and lowers plasma calcium and phosphates concentration. It inhibits bone resorption (by directly inhibiting osteoclastic activity) and increases calcium excretion by renal tubules so the net effect is low plasma Ca^{++} concentration.

Prolactin

Increases activity of 1-alpha hydroxylase in renal tubules and increases plasma Ca^{++} concentration by stimulating the production of 1,25, dihydroxycholecalciferol.

Estrogen

It increases the total concentration of 1,25 dihydroxycholecalciferol due to more production of binding protein without any steady change in free hormone concentration.

Physiological Role of Ca^{++} During Pregnancy

Pregnancy has greater impact on Ca^{++} physiology. Approximately 30gm of Ca^{++} are accumulated during pregnancy and most of it is in fetus. Maximum accumulation occurs during last three months of pregnancy coincidental with mineralization of fetal skeleton.

RDA (Recommended Daily Allowance) of Ca^{++} is following according to FDA (Food and Drug Administration of USA.).

- RDA in nonpregnant woman =800mg
- RDA in pregnant woman =1200mg
- RDA in lactating woman =1200mg

Daily increase 250-300mg (average) during last trimester as a compensatory mechanism. Ca^{++} absorption increases and Ca^{++} excretion decreases during pregnancy. It is also seen that level of plasma Ca^{++} fall in parallel with the fall of plasma proteins.

So in all pregnant women who have low plasma protein levels due to decrease intake, increase utilization and impaired absorption as a result of number of factors like, anaemia, malnutrition, repeated pregnancies with less than 2 years of interconceptional intervals, lactation, haemorrhagic accidents of pregnancy, bleeding disorders, prevalence of diseases like tuberculosis, worm infestation etc.

They become more prone to develop hypocalcaemia (acute, insidious) and fetus tries to fulfil Ca^{++} need by extracting mothers stores (which are almost always in negative Ca^{++} balance) so putting immense burden on already depleted maternal stores and causing diminished bone density, and finally osteomalasia.

In obstetrics this depicts dangerous picture as decreasing pelvic capacity especially after 4th and 5th pregnancy; increasing the chances of cephalopelvic disproportion (the relative fetal weight increases in

successive pregnancies). This leads to more chances of obstructed labours and as a consequent more need of operative deliveries. This is directly proportional to poor fetal and maternal outcome and major cause of high rates of fetal and maternal morbidity and mortality in addition to crippling results for mothers (like vesicovaginal fistulae) due to poor obstetrical services.

Studies indicate a direct correlation between bone density in the new born and maternal Ca^{++} intake during pregnancy so providing further evidence that maternal nutrition is important to neonatal wellbeing in addition to "safe motherhood"^{1,6,7}.

Different clinical trials of Ca^{++} supplementation have shown promising results in

- Prevention of preeclampsia²
- Prevention of haemorrhagic accidents in pregnancy (like APH and PPH)³.
- Hampering the progression of some autoimmune diseases
- Prevention of serious allergies
- Prevention of earlier and late osteoporosis and with it the incidence of hip fracture decreases.
- A possible association between maternal calcium and Vit. D status and early neonatal hypoglycemia is suggested by many observation. Seasonal incidence of this complication has been noted with peak incidence occurring during last trimester which coincides with increasing demand of Ca^{++} and time of least sun exposure.

Calcium RDA during pregnancy is 1200mg which is 400mg above non-pregnant woman's RDA. It is virtually impossible to obtain this level with natural foods other than dairy products. Women have to take 900-1000ml pure milk to extract 1200mg of Ca which is an unlikely possibility for the women of 3rd world countries (including Pakistan)⁵.

So women who consumes no or less milk or dairy products should be supplemented with Ca^{++} (but the essential role of vit. D in Ca-metabolism must be kept in mind for the women living in dark and crowded houses). RDA of Vit. D in pregnancy is 200iu/5mg⁶. This should be started as early as 2nd half of pregnancy. Placenta transports an intermediate product i.e., 25, hydroxy Vit. D₃, and its 1-alpha hydroxylation takes place in fetal kidney and probably in placenta itself.

Certain drugs like Phenytoin and Heparin inhibit 1-alpha-hydroxylation of vit. D in renal tubules, so when long term treatment with these drugs is necessary in pregnancy, additional supplementation with Ca and vit D is mandatory.

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