

DETERMINATION OF TOTAL SERUM CALCIUM

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Abstract

The Calcium is the major mineral component of the bones. 99% of the quantity of Calcium from the body is found in the bones and teeth, that constitute a huge reservoir for the maintaining of the serum Calcium level, and the rest is distributed in the biologic liquids and soft tissues. The ions of Calcium play an important role in the transmission of nervous impulses, the muscular contraction, the cardiac function and in the processes of coagulation.

The hormonal regulation of the metabolism of Calcium and that of Phosphorus is complex. The mutual relations between the thin bowel, the skeleton, kidneys and endocrine system, in particular the parathyroides, maintain the hemostasis of Calcium and Phosphorus. Also, the calcitonin, vitamin D, estrogens, androgens are factors that influence the level of Calcium. The abnormal concentrations of serum Calcium can indicate parathyroidian dysfunctions, diseases of the bones, carcinomas, syndrome of malnutrition and malabsorption, deficiency of Vitamin D and renal diseases. 90% of the cases of hyperkalemia appear in the context of hyper parathyroidism, as a paraneoplastic manifestation or in granulomatous affections. Hyperglycemia from the sarcoidosis, supra renal deficiency and hyperthyroidism is detected usually in a clinical background suggestive for the diagnosis.

Key words: serum Calcium, mineral component, malabsorption, malnutrition

INTRODUCTION

The ions of Calcium mediate the intracellular effects of many hormones or of some nervous signals. They regulate the concentration of the striated and smooth muscles, control the exocrine, endocrine secretions, have a special role in the cellular divisions, are modulators of some fundamental metabolic processes.

The cytosolic concentration of Calcium in repose is very small. This small concentration contrasts with the extracellular Calcium level which creates a gradient of concentration very pronounced between the two compartments. The small concentration of Calcium in cytoplasm is maintained by the functioning of some mechanisms that take the Calcium off the cell by the very small natural permeability of the membranes for cationic, by the functioning of some mechanisms that store Calcium in mitochondria and endoplasmic reticule.

The decreased level of Calcium in cytoplasm prevents the forming of phosphates of Calcium hardly soluble.

Also starting from a very low level it is easily to accomplish a fast and substantial increase of the concentration of cytosolic concentration of Calcium.

The increase of the Calcium concentration in cytoplasm takes place by the introduction of the cation from the extracellular fluid or by its discharge from the endoplasmic reticle. The storing of Calcium from mitochondria intervenes only in the collision of the variations of the cytosolic Calcium on long term.

The answers mediated of Calcium are some very fast and of short duration, while the others are installed slowly and last longer. The fast answers are mediated by the influx of Calcium from the outside after electric stimulations.

The slower and prolonged modifications of concentration of Calcium take place by opening the channels that are controlled by some ligands.

MATERIAL AND METHODS

The method of determination of serum Calcium is spectrophotometric and implies the following process:

1. Preparing the patient – à jeun (before eating).

Note: are not administered supplements of Calcium 8-12 hours before; it can't be made the determination of the calcemia in patients treated with EDTA or who received substances of radiologic contrast.

2. Specimen harvested – venous blood.

Mentions: the harvest is made in the morning (there are diurnal variations), in clinostatism (there are variations of posture, because half of the Calcium is connected by proteins; in clinostatism the calcemia as the proteinemia are smaller than in orthostatism). On harvesting will be avoided the venous stasis with the tourniquet (produces values falsely increased). If the using of the tourniquet is indispensable, the sample will be taken more than 1 minute after the recovery of the circulation. On harvesting and afterwards during the manipulation of the samples, are not used gloves powdered with Calcium carbonate (wash the gloves in running water, without soap or detergents, even if they are labeled “powder free”).

3. Harvesting recipient – vacutainer without anticoagulant with/without separating gel.
4. Processing necessary after harvesting – is separated the serum by centrifuge.
5. Volume of the sample – minimum 0.5 mL serum.
6. Causes of rejection of sample – hemolysate specimen.

7. Stability of the sample – the separated serum is stable 7 days at the temperature of the room; 3 weeks at 2-8 °C; 8 months at -20°C .

RESULTS AND DISCUSSIONS

Table 1.

Values of reference	
Age	Values mg/dL
Children (0-10 days)	7.6 -10.4
Children (10 days-2 years)	9.0 – 11.0
Children (2-12 years)	8.8 – 10.8
Children (12-18 years)	8.4 – 10.2
Adults (18-60 years)	8.6 – 10.0
Adults (60-90 years)	8.8 – 10.2
Adults (>90 years)	8.2 – 9.6

Hyperkalemia is accompanied most often by hypopotassemia and leads to dehydration because the Calcium in excess determines nephrogenic diabetes insipidus.

In order for the values of the Serum Calcium to be interpreted correctly, it always has to be determined simultaneously the total serum proteins and albumin, because in the serum 0.8 mg of Calcium is connected to 1.0 g of albumin; for correction, at the value obtained for Calcium is added 0.8 mg/dL for each 1.0 g/dL with which the serum albumin decreases under 4.0 g/dL; the connection to globulins affects the value of the total Calcium only if the globulins are in concentration of over 6 g/dL.

Increased values are met in the serum proteins totally increased, syndrome of dehydration, the venous stasis secondary to applying the tourniquet for a long time, the dosing using tubes closed with cap, hyponatremia (<120mEq/L), which increases the fraction of Calcium connected by proteins and thus increases easily the value of the total Calcium.

The low values in hypomagnesaemia (for example the secondary to chemotherapy with cisplatin), hypophosphatemia (secondary to administration of laxative, enema with phosphates, to chemotherapy in leukemia or lymphomas, rhabdomyolysis), hypernatremia, hypoalbuminemia, hemodilution.

Modifications of the reference values appear also after the administration of some medicine.

Increases appear following some antacid medicine (alkaline), androgen, salts of Calcium, danazol, diethylstilbestrol (fast increase in 24 hours in patients with breast cancer), dihydrotachysterol, chronic administration of diuretics (cloralidona, ethacrynic acid, furosemide, thiazide), ergocalciferol, isotretinoin, lithium, progesterone, PTH, tamoxifen, Vitamin D, Vitamin A.

Regarding the decreases of Calcium they appear after the administration of albuterol, alprostadil, aminoglycoside (ex.: gentamicin), asparaginase, barbituric acid (for elder persons), calcitonin, carbamazepine, carbenoxolone, carboplatin, corticosteroids; diuretics (initial effect): acetazolamide, etacrynic acid, furosemide; ergocalciferol, estrogen (in post-menopause), fluorines, gastrin, glucagon, glucose, indapamid, insulin, isoniazid, laxatives (excess), salts of Magnesium, methicillin, phenytoin, phosphates, plicamicin, saline solutions (the effect appears in case of hypercalcemia), tetracycline (for pregnant women), tacrolimus, tobramycin.

CONCLUSIONS

The concentration of Calcium in the extracellular fluid and the calcemia are maintained with constant values in spite of the fluctuations in share, excretion and storing of Calcium in the bones.

Homeostasis of the extracellular Calcium is assured by the hormonal parathormone and 1,25 dihydroxy – cholecalciferol that acts on the bone, kidney and intestine.

The dose of the ionic Calcium is preferred to that of total Calcium because the ionized fraction is physiologically active and can be measured fast, an essential thing in some situations (hepatic transplant, fast or massive transfusions of blood on citrate that make practically impossible the interpretation of the total Calcium values);

- The complications with lethal potential are frequent in values of the ionic calcium $< 2 \text{ mg/dl}$ ($< 0,50 \text{ mmol/l}$);
- In case of multiple sanguine transfusions and value of the ionic Calcium $< 3 \text{ mg/dl}$ ($< 0,95 \text{ mmol/l}$) is indicated the administration of Calcium.

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