Calcium, plasma, total

Calcium is the most abundant mineral element in the body with about 99 percent in the bones primarily as hydroxyapatite. The remaining calcium is distributed between the various tissues and the extracellular fluids where it performs a vital role for many life sustaining processes. Among the extra skeletal functions of calcium are involvement in blood coagulation, neuromuscular conduction, excitability of skeletal and cardiac muscle, enzyme activation, and the preservation of cell membrane integrity and permeability.

Calcium levels and hence the body content are controlled by parathyroid hormone (PTH), calcitonin, and vitamin D. To maintain calcium homeostasis, we require sufficient intake, normal metabolism and appropriate excretion. An imbalance in any of these modulators leads to alterations of the body and circulating calcium levels. Increases in serum PTH or vitamin D are usually associated with hypercalcemia. Increased calcium levels may also be observed in multiple myeloma and other neoplastic diseases. Hypocalcemia may be observed e.g. in hypoparathyroidism, nephrosis, and pancreatitis.

Total Calcium is reported as direct and after adjustment for plasma albumin level. Adjusted total calcium has the same reference interval as total calcium and is a surrogate for ionised calcium.

General information

Collection container:

Adults – serum (with gel separator, 4.9mL brown top Sarstedt tube)

Paediatrics – lithium heparin plasma (1.2mL orange top Sarstedt tube)

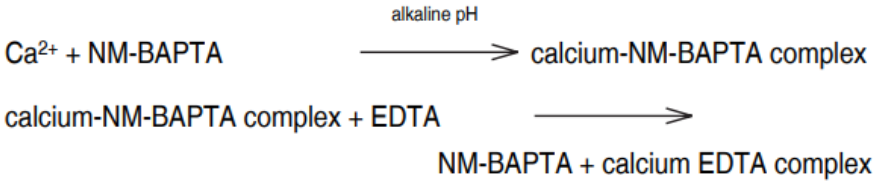
Type and volume of sample:

The tubes should be thoroughly mixed before transport to the lab. 1mL whole blood is required as a minimum volume.

Specimen transport/special precautions: N/A

Laboratory information

Method principle: Calcium ions react with 5-nitro-5'-methyl-BAPTA (NM-BAPTA) under alkaline conditions to form a complex. This complex reacts in the second step with EDTA.



The change in absorbance is directly proportional to the calcium concentration and is measured photometrically.

This method has been standardized against the SRM 956 c level 2 reference material.

Biological reference range:

0 to 14d: 2.0-2.7 mmol/L
All others: 2.2 – 2.6 mmol/L

Calcium can be measured in other fluids. These reference ranges will NOT apply.

Turnaround times: Same day as sample receipt

Clinical information

Factors known to significantly affect the results:

It is important to collect multiple samples in different tube types in the correct order. Contamination from EDTA (FBC) tubes or citrate (clotting) tubes will result in artefactually low calcium concentrations will result in artefactually high calcium concentrations

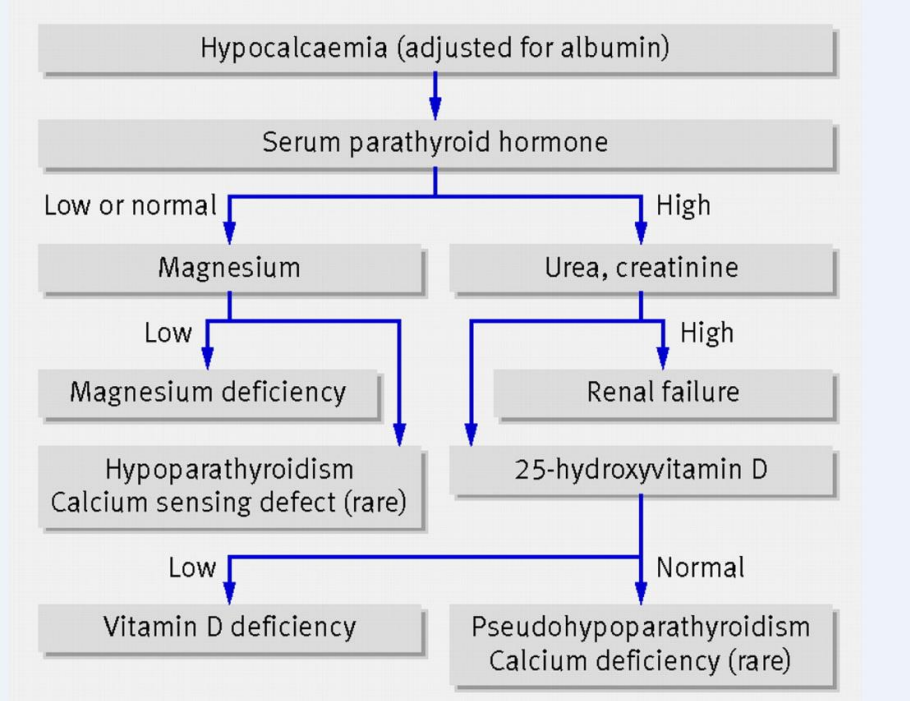
Avoid prolonged stasis during sample collection as the calcium concentration (and other analytes) may be artefactually increased.

Clinical decision points:

Adjusted calcium Concentrations below 1.80 mmol/L (1.50mmol/L in neonates) and above 3.10 mmol/L will be telephoned to the requesting clinicians or ward.

The total and adjusted concentrations are reported as approximately 45% of the circulating calcium is bound to albumin. Where patients may have physiological or pathological conditions resulting in chronically very low or raised albumin concentrations (click on link for more information on albumin [link]) then the accuracy of the adjusted calcium concentration will be affected.

Systematic investigation of low or high calcium is key to determining the most likely underlying cause, usually starting with a PTH (parathyroid hormone) measurement, 24h urine calcium and a 25OH vitamin D measurement. Interpretation must be in conjunction with clinical signs and symptoms and a thorough drug history as well as of length of time of onset of the symptoms.

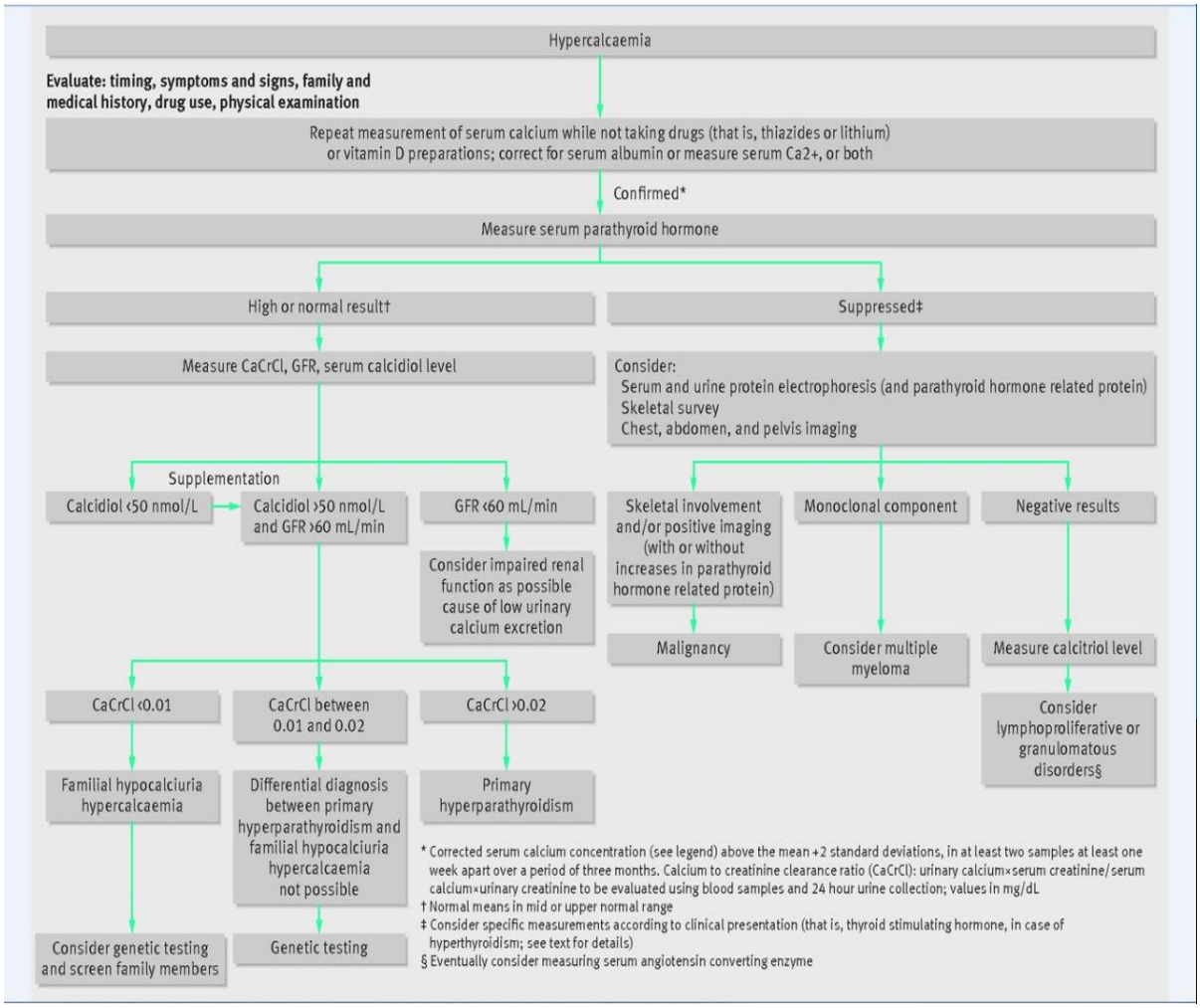


From BMJ (see link below)

Other causes of hypocalcaemia include:

- Massive transfusion (chelation from citrate in the preparation)
- Chronic liver disease and biliary obstructive diseases (from impaired absorption and conversion of vitamin D)
- Overexpression of fibroblast growth factor 23 (oncogenic osteomalacia)
- Severe pancreatitis (calcium saponification)
- Hungry bone syndrome

Investigation of Hypercalcaemia:



From BMJ (see below)

References:

- Diagnosis and Management of Hypocalcaemia, https://www.bmj.com/content/336/7656/1298
- The diagnosis and Management of Hypercalcaemia, https://www.bmj.com/content/350/bmj.h2723
- Assessment of Hypercalcaemia, https://bestpractice.bmj.com/topics/en-gb/159
- Assessment of hypocalcaemia, https://bestpractice.bmj.com/topics/en-gb/160?q=Hypocalcaemia%20(assessment%20of)&c=suggested

(Last updated September 2020)