



Clinical Significance Of Albumin – Corrected Calcium To Assess Hypercalcemia In Inpatients Of A Tertiary Care Hospital

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Abstract

Background: Hypercalcemia is a rather prevalent ailment in hospitalised patients. The interpretation of total calcium should consider serum albumin as the changes in albumin concentration alone can cause alteration in the total calcium.

Materials and Methods: This descriptive study was conducted among 50 inpatients with an intention to determine the clinical significance of albumin-corrected calcium to assess hypercalcemia in inpatients in a tertiary care hospital. The study was conducted in the department of General Medicine at Believers church medical college hospital, Kerala, India.

Results: Among 50 subjects enrolled in the study, 82% were having normal calcium levels and only 18% were mildly hypercalcemic before the calcium correction. But after the correction of calcium, 50% of subjects were found to be hypercalcemic and none were having normal values.

Conclusion: Hence we evinced that the interpretation of patients serum total calcium values can often be misleading unless some allowance is made for albumin concentration. Therefore adjustment of serum total calcium concentration for albumin is essential to detect abnormal values and it is clinically significant to check albumin- corrected calcium.

Keywords: Corrected calcium, Hypercalcemia, Malignancy, Primary hyperparathyroidism

Introduction

Calcium is required for a variety of cell processes, including muscular contraction, nerve impulses, and the release of vital molecules from various cells. Calcium levels in the blood might be high or low due to disturbances in calcium metabolism.^[1] Calcium in plasma is divided into three types: ionised (45%), complexed (bound to phosphate, bicarbonate, sulphate, citrate, and lactate), and protein bound (50%) primarily to albumin.^[2] Albumin concentration changes can impact total calcium without changing the physiologically and therapeutically significant ionised calcium fraction.^[3] Albumin levels should therefore be considered when

assessing hypercalcaemia. Vitamin D and parathyroid hormone (PTH) both play a role in calcium homeostasis, either directly or indirectly.^[4] Hypercalcemia is defined as serum calcium value of greater than the upper limit of the normal (ULN) reference range of 10.5 mg/dL or 2.5 mmol/L.^[5] Malignancies, symptomatic or asymptomatic primary hyperparathyroidism, granulomatous illnesses, drug-related causes, and other unusual causes are the most common causes of hypercalcemia in any hospital setting.^[6]

Wide changes in the amounts of calcium-binding molecules in the blood can affect the total calcium concentration measurement without affecting the free

fraction of calcium. To "correct" the recorded calcium content, we apply many types of calculations. The purpose is to obtain a corrected result that would have been obtained if all calcium-

binding compounds' concentrations were within their respective reference intervals. The following two equations are used for results expressed as mg/dl and mmol/L, respectively.^[7]

$$CC \text{ mg/dl} = TC \text{ mg/dl} + 0.8 [4 - \text{measured albumin g/dl}]$$

$$CC \text{ mmol/L} = TC \text{ mmol/L} + 0.02 [40 - \text{measured albumin g/L}]$$

Hypercalcemia can be classified into:

Mild hypercalcemia: 10.5 to 11.9 mg/dL

Moderate hypercalcemia: 12.0 to 13.9 mg/dL

Hypercalcemic crisis: 14.0 to 16.0 mg/dL

Cell membranes become hyperpolarized as a result of hypercalcemia. Patients with levels of calcium between 10.5 and 12 mg per dL can be asymptomatic. When the serum calcium level rises above this stage, multisystem manifestations become apparent.^[8] But the profile of hypercalcemia is changing in tertiary care settings.

Materials And Methods

This descriptive study was conducted among 50 inpatients admitted under the general medicine department at Believers Church Medical College Hospital, Thiruvalla, a tertiary care hospital.. The study was approved by the Institutional Ethics Committee of Believers Church Medical College Hospital, Kerala, India. The patients who underwent evaluation of calcium and albumin levels were randomly collected and the data was retrieved using electronic health records of the hospital. The collected data was during a period from February 1st to July 31st, 2018. Serum total calcium and albumin were measured by standard methods. A computer-based list of patients with normal serum calcium levels was included in the study. The serum total calcium concentrations were then adjusted for albumin using the corrected calcium equation. We excluded patients with comorbidities, those under the age of 50 and female subjects who were pregnant. The data collected were entered in Microsoft excel - 2010 version and results were presented in tabular form and presented as frequency and percentages.

Results

Table 1 shows the distribution of hypercalcemic patients based on age group. Among 50 population enrolled in this study, majority of subjects belong to the age group of 71-80 years [30%] followed by 61-70 years [26%], 81-90 years [24%] and 51-60 years [20%]. Figure 1 shows the distribution of patients based on gender. Female predominance was observed where 68% were female [34 subjects] and 32% were male [16 subjects]. Considering the etiologies leading to hypercalcemia, we had found that 15 subjects were known to have hypercalcemia due to Multiple Myeloma (30%) followed by Primary hyperparathyroidism (20%), breast cancer in 6 subjects (12%), fractures (8%) and shown in Table 2. Table 3 shows the grading of calcium level in a population of 50. The majority of subjects (41 subjects) had normal calcium levels of about 82% and 9 subjects had mild level of calcium (18%). The distribution of albumin levels in the population was shown in Figure 2. The majority of subjects were with low levels of albumin (45%) followed by 5% of subjects with normal levels of albumin. The grading of corrected calcium was shown in Table 4. Among 50 study population enrolled in the study, the majority of subjects were in grade 1 which were about 94% (47 subjects), followed by 3 subjects had grade 2 (6%) hypercalcemia after correction of calcium. Figure 3 shows the variation in calcium concentration before and after the correction of calcium. Before calcium correction 82% were having normal calcium levels and 18% were mildly hypercalcemic. After the calcium correction 50% were found to be hypercalcemic.

Discussion

In this study conducted in 50 patients, our intention was to assess the significance of albumin corrected calcium in a hospital setting to get the measure of hypercalcemia. According to the study conducted by

Payne *et.al.* out of 189 patients 75 patients who had normal calcium level became abnormal on adjustment.^[3] In this study, 71-80 age group was more affected and based on the gender, females were more hypercalcemic. As reported by Catalano A *et.al.* the incidence of hypercalcemia in the age range 19-65 was 16.92% and in patients over 65 years was 18.11 %.^[9] The reasons for hypercalcemia can vary. Among 50 subjects enlisted in this study, 30% of hypercalcemia were due to multiple myeloma, 20% due to primary hyperparathyroidism, 12% due to breast cancer and 8% of fractures. Gastanaga VM *et.al.* in the study Prevalence of hypercalcemia among cancer patients in the United States stated that, myeloma patients had highest prevalence.^[5] The serum calcium levels were normal in 41 subjects (82%) and mildly elevated in 9 subjects (18%). While assessing the albumin levels in these subjects, 90% had low albumin levels, 10% with normal albumin levels and none had high levels of albumin. In accordance with the study conducted by Carroll MF *et.al.* low serum albumin level affect the total serum calcium level.^[8] While determining the variation in calcium concentration before and after the correction, 82% were having normal serum calcium levels and 18% were only with mild hypercalcemia before the calcium correction but after the albumin corrected calcium 50% were hypercalcemic and none were in the normal range. Thus from our study, we figured out that there is a logical significance of albumin – corrected calcium to be done in a tertiary care hospital. So that the physicians can order for a corrected calcium rather than total serum calcium in patients for whom calcium test was ordered.

Conclusion

This descriptive study reveals that the albumin – corrected calcium has a clinical significance in interpreting hypercalcemia. Since hypercalcemia has a changing pattern in hospital settings, the interpretation of patients serum total calcium readings can be misleading unless albumin content is taken into account so that patient's results are more reproducible when the correction is done.

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Tables And Figures

Table 1: Distribution of age group

SL.No.	Age Group	Frequency	Percentage
1	51 – 60	10	20
2	61 – 70	13	26
3	71 – 80	15	30
4	81 – 90	12	24
Total		50	100

Figure. 1: Distribution of the patient based on gender

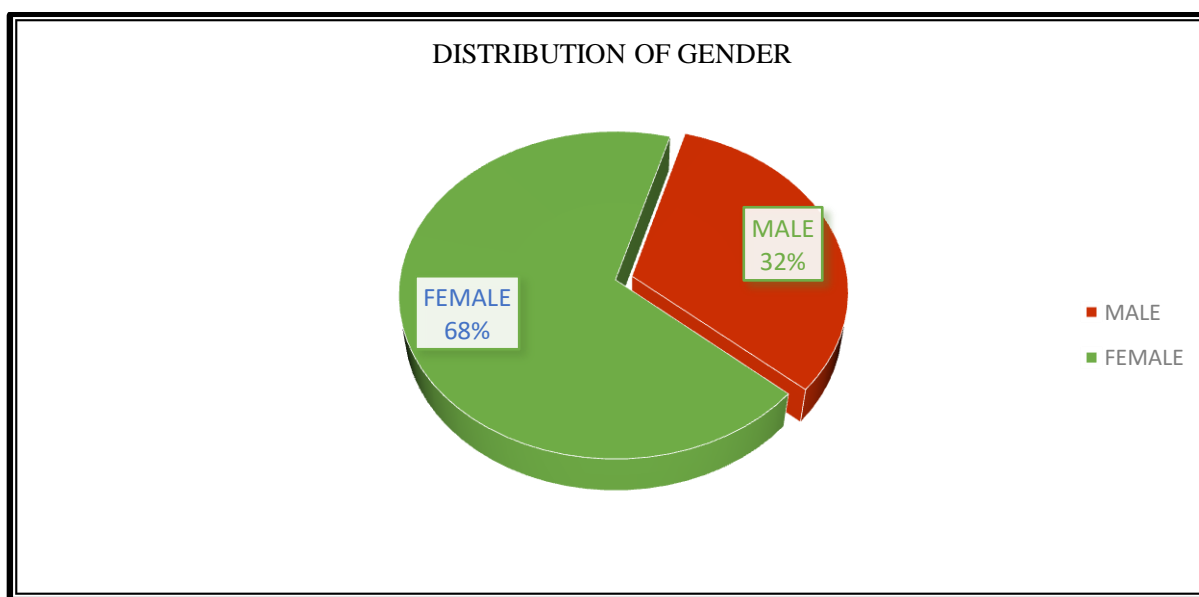


Table. 2: Distribution of etiologies

SL.No.	Diagnosis	Number of subjects (%)
1	Multiple Myeloma	15(30%)
2	PHPT	10(20%)
3	Fracture	4(8%)
4	Vitamin D Intoxication	3(6%)
5	Breast Cancer	6(12%)
6	Tb	2(4%)

7	Cholelithiasis	3(6%)
8	Autoimmune thyroid disease	3(6%)
9	Renal Calculi	2(4%)
10	Sarcodiosis	2(4%)

Table. 3: Distribution of calcium level

SL.No.	Stages	Calcium Range	Number of subjects (%)
1	Normal	8.5 – 10.4	41(82)
2	Mild	10.5 – 11.9	9(18)
3	Moderate	12- 13.9	0(0)
4	Severe	> 14	0(0)

Figure. 2: Distribution of albumin level

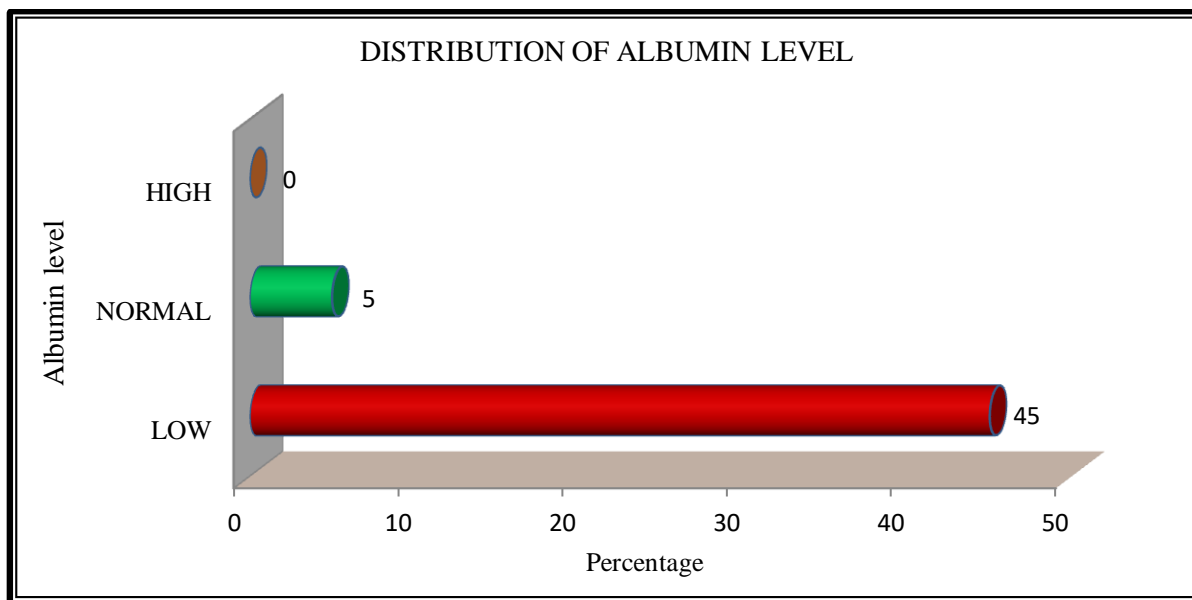


Table. 4: Distribution of corrected calcium level

SL.No.	Grade	Corrected calcium level	Number of subjects (%)
1	Grade 1	<11.5	94(47)
2	Grade 2	11.6 – 12.5	6 (3)
3	Grade 3	12.6 – 13.5	0(0)
4	Grade 4	>13.6	0(0)

Figure. 3: Variation in calcium concentration before and after correction of calcium

