Analysis Of Total Serum Calcium In A Nigerian Hospital Population.

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Abstract.
Background: Knowledge of prevalence of hypercalcaemia is very important especially in the north Eastern region of Nigeria with high prevalence of urinary tract calculi compared to other parts of the country.
Objective:
This study aim to determine the prevalence of hypercalcaemia among patients seen in University of Maiduguri Teaching Hospital, Maiduguri.
Method:
The data was essentially derived from output of request results from Department of Chemical Pathology, University of Maiduguri Teaching Hospital for a period of one year (January to December 2004).
Results:
The prevalence of hypercalcaemia was 10.5% while that of hypocalcaemia was 35.2%. However, hypercalcaemia was found only in 18(5.9%) before adjustment on serum albumin. Hypercalcaemia occurred more in patients with hypertension and only 6.3% was due to multiple myeloma. adjustment on serum albumin is necessary when the serum albumin is equal to or less than 36g/L or greater than or equal to 43g/L.
Conclusion:
Hypercalcaemia is common in this environment and deteminations of serum calcium should be an integral part of investigations of hypertension, urinary tract calculi, and malignant diseases.
Key wods:
Prevalence, Hypercalcaemia, Hypocalcaemia, Hospital, Nigeria.

Introduction.

Maintenance of normal serum calcium concentration in the extracellular fluid (ECF) depends on integrated regulation of calcium fluxes, a balance between input and output, with respect to the intestinal tract, kidneys, and bone. [1, 2] Calcium circulate in the ECF in three distinct fractions: about 50% biologically important ionized fraction, 40% is protein-bound, and 10% is complexes to anions such as bicarbonate, citrate, sulphate, phosphate, and lactate.[3] Most of the protein-bound calcium is bound to albumin, the remainder being complexes to globulin. Consequently, disorders of albumin have effect on the total serum calcium,[4, 5] usually measured in the study laboratory and many other laboratories in Nigeria.

Certain derived formula are applied to correct for the effect of these serum albumin disorders, and these formulae form an integral part of interpreting serum total calcium levels in clinical practice.[4-6]

This aspect of calcium homeostasis and metabolism has hardly been investigated in the North Eastern part of Nigeria. Thus, the status of the man in this part of Nigeria in terms of his calcium disposition is largely unknown. In the same token, there is a paucity of information about the prevalence of hypercalcaemia either at the community level or from hospital derived statistics despite the high prevalence of urinary tract stone disease in this region[7] compared to other parts of the Country.[8,9] and the significant relationship between hypercalcaemla an urinary tract stone diseases. [10,11],

This apparent lack of data prompted this retrospective study. The data was derived from the output of request results in the Department of Chemical Pathology, University of Maiduguri Teaching Hospital, Maiduguri.

We examined these results with the following objectives in mind:

(a) To determine the prevalence of hypercalcaemia and hypocalcaemia in this region.

(b) To determine the effect of adjustment of serum total calcium values on serum albumin in this region.

(c) To highlight the values of disorders of serum albumin those that really require the necessity for adjustment of serum total calcium on serum albumin.

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Materials and Methods.

Results of all serum calcium analysis in the Department of Chemical Pathology, University of Maiduguri Teaching Hospital, Maiduguri, for a period of one-year (January to December, 2004) were obtained from the Departmental day-sheets.

A total of 374 requests for serum total calcium analysis were recorded in the study period. However, results with request sent in from outside the hospital were excluded.

Also excluded were results with no record of serum albumin, those with no hospital registration number, and those of children less than one year.

Out of the 374, only 304 results were considered for the study. A formula, Corrected Calcium=Measured calcium +O.02 (40-measured albumin) was used for each result to determined the real (corrected) calcium value. Results with values below and above the study laboratory's reference value (2.5 to 2.70mmolIlL) were considered hypocalcaemia and hypercalcaemia respectively.

Age, sex and diagnosis for results considered hypercalcaemia were obtained from the patient's hospital record folders.

Serum total calcium was determined by O-cresulphthalein method[12] while serum albumin was determined by Bromocresol green (BCG) method[13].

Prevalence of hypercalcaemia was determined in percentage. The difference between the means of measured and adjusted serum total calcium values was sought using Student's test. P-value < 0.05 is considered statistically significant.

Results.

The prevalence of hypercalcaemia in this study is 10.5% and that of hypocalcaemia is 35.2% after adjusting measured total serum calcium on serum albumin. Only 18(5.92%) of the results were hypercalcaemic before adjustment on serum albumin.

There is male preponderance of both hypercalcaemia [18(56.3 %)] and hypocalcaemia [56(52.3%)].

Table 2 shows the mean±SD of total serum calcium values before and after adjustment on serum albumin. Although there was increased in mean±SD after adjustment this was not statistically significant, p>0.05

Table 3 shows working diagnosis of patients with hypercalcaemia. Hypercalcaemia occurred more in patients with hypertension and only 2(6.25%) cases of multiple myeloma.

Tables 4 and 5 showed some results with positive and negative effect of adjusting serum total calcium values on albumin respectively. Results in the tables indicated that adjustment is necessary when serum albumin is equal to or less than 36g/L or greater than or equal to 43g/L.

Table 1.

Sex distributions of serum total calcium after adjustment on serum albumin.

Variables	Males	Females	Total.
Hypercalcaemia	18(56.26%)	14(43.75%)	32(10.53%).
Hypocalcaemia	56(52.34%)	51(47.66%)	107(35.20%).
Normocalcaemia	88(53.33%)	77(46.67%)	165(54.28%).
Total	162(53.4%)	142(46.7%)	304(100%)

Table 2.

Comparisons of Mean±SD of serum calcium values before and after adjustment on serum albumin.

Variables	before adjustment	after adjustment.	P-values
Hypercalcaemia	3.02±0.92mmol/L	3.10±0.87mmol/L	>0.05
Hypocalcaemia	1.72±0.38mmol/L	1.80±0.16mmol/L	>0.05
Normocalcaemia	2.34±0.21mmol/L	2.44±0.16mmol/L	>0.05

Discussion.

The reference value of serum total calcium in the study laboratory is 2.5-2.7mmol/L. The prevalence of hypercalcaemia in this study is 10.5%. This is higher than previous reports in the other parts of the country.[6, 14] This underscores the importance for a greater concern in screening patients for hypercalcaemia as greater than 80% of patients with hypercalcaemia are asymptomatic at diagnosis [15,16]. The most Important causes of hypercalcaemia are hyperparathyroidism and

Table 3.

Working Diagnoses measured and adjusted serum calcium values of the 32-hypercalcaemic patients.

Serial no.	Working Diagnosis	serum albumin (g/L)	measured calcium values mmol/L)	adjusted calcium values (mmol/L)
1	Hypertension	44	7.50	7.42
2	Hypertension	42	3.10	3.06
3	Hypertension	40	2.73	2.73
4	Hypertension	36	2.80	2.88
5	Hypertension	33	2.70	2.84
6	Hypertension	42	2.90	2.86
7	Hypertension	38	3.00	3.04
8	Hypertension	21	2.90	3.28
10	ARF	33	2.60	2.74
11	ARF	26	2.50	2.78
12	Renal stone	42	2.80	2.76
13	Dysuria/Cal. Pos. crystals.	39	2.70	2.72
14	Renal stone	45	2.90	2.80
15	Renal stone	42	3.10	3.06
16	Renal stone	22	2.70	3.06
17	Renal stone	43	2.80	2.74
18	Nephrotic syndrome	26	2.50	2.78
19	Rickets	42	3.90	3.56
20	CRF	21	2.60	2.98
21	CRF	27	2.50	2.76
22	UTI	43	3.00	2.94
23	Diabetes Mellitus	44	2.90	2.82
24	Diabetes Mellitus	39	2.90	2.92
25	Sepsis	35	2.90	3.00
26	Sepsis	27	2.60	2.86
27	Sepsis	39	2.80	2.82
28	Post-op (appendicitis)	33	4.60	4.76
29	Post-op (hernia)	39	2.70	2.72
30	Multiple myeloma	38	3.10	3.40
31	Multiple myeloma	37	2.90	2.96
32	? hypocalcaemia	35	2.80	2.90

Table 4.

Some serum total calcium values with positive effect on adjustment on serum albumin.

Serial No.	Working diagnosis	serum albumin (g/L)	measured serum total calcium (mmol/L)	Adjusted serum total calcium (mmol/L)
	Chronic renal failure	29	2.40	2.60
	Sepsis	29	1.90	2.10
3	Pulmonary tuberculosis	15	1.50	2.00
	Pulmonary tuberculosis	24	1.80	2.10
	Retroviral disease	28	1.90	2.20
	Diarrhea/vomiting	23	1.40	1.80
	Retroviral disease	31	1.90	2.10
	Hypertension	21	2.40	2.80
	Intrauterine growth retardation	15	0.70	1.20
0	Retroviral disease	31	1.90	2.10
1	Acute renal failure	26	2.50	2.80
2	Retroviral disease	17	2.00	2.50
3	Chronic renal failure	21	2. 60	3.00
4	Nephrotic syndrome	26	2.50	2.60
5	Hypertension	34	2.70	2.80.

hypervitaminosis D3" Hyperparathyroidism, a leading cause of hypercalcaemia accounting for more than 50%, 3 has been reported in Ibadan[6] and Sokoto.[17] About 6% of patients with calcium containing urinary tract stone disease have hyperparathyroidism[3]. However, none of the hypercalcaemic patients in this study were screened for hyperparathyroidism because the test for parathyroid hormone is not available despite high incidence of urinary tract stone disease in this part of the country. One of the major sources of vitamin D is synthesis from the skin using ultraviolet light, and the temperature in the northeastern Nigeria may be as high as 43°C. Hence, there may be increased synthesis of vitamin D3 in this part of the country.

The best dietary source of calcium is dairy products especially mille. This is also available in this region. These three factors may explain the higher prevalence of hypercalcaemia and may not be unconnected to the higher incidence of urinary tract stone disease in this region where 76.9% of stones analyzed are calcium-containing stones [18].

The need for correction for protein binding is clearly demonstrated in this study, as only 18(5.92%) were hypercalcaemic before adjustment on serum albumin as against 32(10.53%) after adjustment. Thus, many of the patients would have been left without proper diagnosis and action, living the patients at a risk of developing chronic debilitating complications of hypercalcaemia especially renal stone and nephrocalcinosis both result into chronic renal failure.

Multiple myeloma, contributed only 6.25% of hypercalcaemic cases in this study while malignancies generally contributed 70%6 and 76%14 as reported in other parts of the country. Apart from metastasic effect of tumor on bones, tumor cells produce local factors capable of stimulating osteablastic bone resorption. These factors include PE2, PTHrP, TGF, IL-1, TNF, and 1, 25(OH)2 D3. The effect of these local factors produces what is called humoral hypercalcaemia of malignancy (HHM). This signifies incomplete investigations of malignancies in this hospital, and the importance of thorough investigations of diseases cannot be overemphasized.

This study also demonstrated the level of serum albumin where adjustment for serum total calcium is necessary. There may be no need for adjustment if the serum albumin is between 37g/L and 42g/L.

The traditional causes of hypercalcaemia e.g. malignancies, sarcoidosis, thyroid diseases, immobilization etc., were not observe among the

Table 5.

Some serum total calcium values with negative effect on adjustment on serum albumin

Serial no.	Working diagnosis	serum albumin (g/L)	measured serum total calcium(mmol/L)	adjusted serum tota calcium(mmol/L)
1	Diabetes mellitus	43	2.70	2.60
2	Hypertension	44	7.50	7.40
3	Medical checkup	46	1.90	1.80
4	Hypertension	52	1.90	1.70
5	Goitre (simple)	47	2.80	2.70
6	UTI/Cal. Oxa. Cryst in urine	45	2.70	2.60
7	Hypertensive Heart disease	44	2.60	2.52
8	Diabetes mellitus	46	2.10	1.90
9	Diabetes mellitus	56	2.10	1.80
10	Hypertension	46	1.90	1.80
11	Sepsis	45	1.80	1.70
12	Appendicitis	46	2.00	1.90
13	pyelonephritis	47	2.70	2.56
14	Medical checkup	46	2.40	2.28.
15	Diabetes mellitus	45	2.00	1.90

series of causes of hypercalcaemia in this study. Yet the prevalence of hypercalcaemia is higher than reports from other part of the country. While decreased exposure to sunlight causes rickets in children and osteomalaisia in adults due to decreased synthesis of vitamin D3, over expose could lead to increase synthesis resulting to hyprecalcaemia. It could therefore be deduce from this hospital based study that populations in this part of the country are over exposed to the higher sunlight and temperature in most part of year explaining the higher prevalence of hypercalcaemia in the study compared to reports from other parts of the country.

Similarly, this could also explain the higher prevalence of urinary tract calculi in this region. This hospital-based study therefore recommends a mandatory clnicopathological study involving analysis of parathyroid hormone and vitamin D3 in all urinary tract calculi patients attending University of Maiduguri Teaching Hospital.

Acknowledgement.
We wish to acknowledge the contribution of laboratory scientists in the department of Chemical Pathology, University of Maiduguri Teaching Hospital for analyzing the samples.

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