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COVER LETTER

Dear Editor-in-Chief,

We are pleased to submit our manuscript entitled
"Assessment of Calcium Carbonate Use as a Phosphate Binder among Hemodialysis Patients at a Tertiary Care Hospital in Sudan"
for consideration for publication in the global scientific journal

This manuscript presents original data from a descriptive cross-sectional study evaluating the effectiveness and adherence to calcium carbonate therapy among hemodialysis patients. The findings highlight the importance of regular use and monitoring of calcium-based phosphate binders, particularly in resource-limited settings.

The manuscript has not been published previously and is not under consideration elsewhere. All authors have approved the final version and declare no conflict of interest.

We believe that the findings will be of interest to nephrologists and healthcare professionals involved in dialysis care and CKD–MBD management.

Thank you for your consideration.

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MANUSCRIPT

Title

Assessment of Calcium Carbonate Use as a Phosphate Binder among Hemodialysis Patients at a Tertiary Care Hospital in Sudan

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Abstract

Background:
Chronic kidney disease–mineral and bone disorder (CKD–MBD) is a frequent complication in patients on hemodialysis and is associated with disturbances in calcium and phosphorus metabolism. Calcium carbonate is commonly used as a phosphate binder, yet inappropriate use and poor adherence may reduce its effectiveness.

Objectives:
To evaluate the use, effectiveness, and adherence to calcium carbonate as a phosphate binder among hemodialysis patients in sudan.

Methods:
A descriptive cross-sectional study was conducted at Saheron Hospital, Khartoum, Sudan, between February and April 2017. Seventy-eight patients on maintenance hemodialysis were enrolled. Data were collected using a structured questionnaire and laboratory records, including serum calcium and phosphorus levels and musculoskeletal symptoms. Statistical analysis was performed using SPSS, and associations were assessed using chi-square tests.

Results:
Calcium carbonate was used by 94.9% of patients. Normal serum phosphorus levels were observed in 87.2% of patients receiving calcium carbonate, while 43.6% achieved normal serum calcium levels. Regular intake and appropriate dosing were significantly associated with normal calcium and phosphorus levels ($p < 0.05$). After discontinuation of calcium carbonate, 41% of patients reported joint pain and backache, whereas 61% of patients who continued regular use reported no CKD–MBD symptoms.

Conclusion:
Calcium carbonate is an effective phosphate binder in hemodialysis patients when used regularly and appropriately. Patient education and continuous biochemical monitoring are essential to optimize outcomes and reduce CKD–MBD-related symptoms.

Keywords:
Calcium carbonate; Phosphate binders; Hemodialysis; CKD–MBD; Hyperphosphatemia

Introduction

Chronic kidney disease–mineral and bone disorder (CKD–MBD) is a systemic disorder characterized by abnormalities in calcium, phosphorus, parathyroid hormone, and vitamin D metabolism. These disturbances contribute to bone pain, fractures, vascular calcification, and increased mortality among patients with advanced chronic kidney disease, particularly those receiving dialysis.

Hyperphosphatemia plays a central role in the development of CKD–MBD. Phosphate binders are therefore a cornerstone of management. Calcium-based binders, particularly calcium carbonate, remain widely used due to their affordability and availability, especially in low-resource settings. However, excessive calcium intake may lead to hypercalcemia, and poor adherence can compromise treatment effectiveness.

This study aimed to assess the use of calcium carbonate as a phosphate binder among hemodialysis patients at Saheron Hospital and to evaluate its association with biochemical control and musculoskeletal symptoms.

Chronic kidney disease (CKD) is frequently complicated by chronic kidney disease–mineral and bone disorder (CKD-MBD), a systemic condition that develops early in the course of renal function decline and progresses with disease severity. CKD-MBD is defined by one or more of the following interrelated abnormalities: disturbances in calcium, phosphate, parathyroid hormone (PTH), and vitamin D metabolism; renal osteodystrophy (ROD); and vascular or other soft-tissue calcifications. Impaired renal phosphate excretion, reduced synthesis of active vitamin D (calcitriol), and consequent hypocalcemia lead to secondary hyperparathyroidism, which plays a central role in the pathophysiology of the disorder. These metabolic derangements contribute not only to skeletal complications but also to increased cardiovascular morbidity and mortality, making CKD-MBD a major clinical and public health concern worldwide.

Renal osteodystrophy represents the skeletal manifestation of CKD-MBD and encompasses a spectrum of bone turnover abnormalities, including high-turnover disease due to secondary hyperparathyroidism and low-turnover or adynamic bone disease. Progressive phosphate retention and elevated PTH levels result in increased bone resorption, reduced bone mineralization, and structural bone weakness. Although symptoms such as bone and joint pain, fractures, and deformities may eventually occur, the disease often remains clinically silent for prolonged periods, leading to delayed recognition. Biochemical assessment, including measurements of serum calcium, phosphate, PTH, and vitamin D levels, remains the cornerstone of diagnosis, as histological bone changes may precede overt clinical manifestations.

Management of CKD-MBD focuses on correcting mineral imbalances, preventing progression of renal osteodystrophy, and reducing cardiovascular complications. Current KDIGO and KDOQI guidelines recommend a multifaceted approach that includes dietary phosphate restriction, use of phosphate binders, calcium and native or active vitamin D supplementation, calcimimetic therapy, and optimization of dialysis adequacy to enhance phosphate removal. In selected cases, intensified dialysis regimens, renal transplantation, or para thyroidectomy for refractory secondary hyperparathyroidism may be required. Early detection and individualized, guideline-directed therapy are essential to improve skeletal outcomes, minimize cardiovascular risk, and enhance overall quality of life in patients with CKD.

Materials and Methods

Study Design and Setting

This was a descriptive cross-sectional hospital-based study conducted at Saheron Hospital, Khartoum, Sudan, from February to April 2017.

Study Population

Patients receiving maintenance hemodialysis at the study center were eligible. Of 99 patients, 78 consented and were included.

Data Collection

Data were collected using a structured questionnaire and medical records. Variables included demographic characteristics, dose and frequency of calcium carbonate, method of administration, serum calcium and phosphorus levels, frequency of investigations, and symptoms related to CKD–MBD.

Statistical Analysis

Data were analyzed using SPSS. Descriptive statistics were expressed as frequencies and percentages. Associations between calcium carbonate use and biochemical or clinical outcomes were assessed using chi-square tests. A p-value <0.05 was considered statistically significant.

Ethical Considerations

Participation was voluntary, confidentiality was maintained, and informed consent was obtained from all participants.

Results

A total of 78 patients were included; 56.4% were male and 43.6% were female. Calcium carbonate was used by 74 patients (94.9%).

Regular intake was reported by 43.6% of patients, while 39.7% reported irregular intake. Most patients took calcium carbonate twice daily, and crushing the tablets was the most common method of administration.

Normal serum phosphorus levels were observed in 87.2% of patients receiving calcium carbonate. Normal serum calcium levels were achieved in 43.6%, while 20.5% developed hypercalcemia. Discontinuation of calcium carbonate occurred in 55.5% of patients, mainly due to poor compliance (57.8%) and hypercalcemia (28.9%).

Following discontinuation, 41% of patients reported joint pain and backache. In contrast, 61% of patients who continued calcium carbonate regularly reported no musculoskeletal complaints. Calcium carbonate intake, regularity, and dose were significantly associated with calcium and phosphorus levels and CKD–MBD symptoms ($p < 0.05$).

Discussion

This study demonstrates that calcium carbonate is the most commonly used phosphate binder among hemodialysis patients at Saheron Hospital. Its use was associated with effective control of serum phosphorus and improvement in calcium levels, consistent with international findings.

Poor adherence and hypercalcemia were the primary reasons for discontinuation. Patients who discontinued therapy experienced a higher prevalence of musculoskeletal symptoms, highlighting the importance of adherence and close biochemical monitoring.

These findings support the continued use of calcium carbonate as a cost-effective phosphate binder, provided that patients are appropriately educated and regularly monitored.

Limitations

This was a single-center study with a relatively small sample size. The cross-sectional design and reliance on patient self-reporting may limit causal interpretation.

Conclusion

Calcium carbonate is an effective phosphate binder for hemodialysis patients when used correctly and consistently. Regular intake is associated with improved biochemical control and fewer CKD–MBD symptoms. Patient education and routine monitoring are essential to optimize outcomes and quality of life.

Recommendations

- Regular patient education on correct calcium carbonate use
- Continuous monitoring of serum calcium and phosphorus
- Active involvement of nurses and pharmacists in adherence support

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Conflict of Interest

None declared.

Funding

No external funding was received.

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Tables:

Table (1): socio demographic data of patients on dialysis in saheron hospital (n=78).

Characteristic	Frequency (n %))
Gender	
Male	44(56.4)%
Female	34(43.6) %

Table (2): causes of end stage renal disease in patients on dialysis in saheron hospital n=78

Cause of ESRD	
Use of analgesic	1(1.3)%
Autoimmune disease	1(1.3)%
Hypertension	19(24.4)%
Hypertension ,use of analgesic	3(3.8)%
Hypertension ,kidney stone	1(1.3)%
Hypertention,drinking salt water	3(3.8)%
Hypertension .kidney stone	4(5.1)%
Oligo hydrous	6(7.7)%
Drinking salt water	20(25.6)%
Drinking salt water ,kidney stone	1(1.3)%
Septrin uses	1(1.3)%
Stone kidney	9(11.3)%
Urinary tract infection	7(9)%
Urinary tract infection ,drink salt water ,hypertension	2(2.6)%

Table (3) number of patients who are take of ca(co)3 in saheron hospital

Patients take ca(co)3	
Yes	74(94.9)%
No	4(5.1)%

Table (4) distribution of patients according to frequency of ca(co)3 in take in patients on dialysis in saheron hospital

frequency of ca(co)3	
BD	74 (69.2)%
TDS	20(25.6)%

Table (5) distribution of respondent according to phosphorus level after ca(co)3 intake in patients on dialysis in saheron hospital

Phosphorus level	Percent
High	2.6%
Normal	87.2%
Low	10.3%

Table (6) distribution of respondent according to symptoms of mineral and bone disorder after stop ca(co)3 intake

Mineral and bone disorder complain	Percent
Bach ach	2.6%
Bach ach fracture	2.6%
Joint pain	14.1 %
Joint pain bach ach	41%
Joint pain fracture	1.3%
Joint pain fracture Bach ach	5.1%
No complain	23%

Table (7): the association of socio demographic factors with calcium and phosphorus level, February- April 2017 (n = 78)

Variable	Calcium level p-value	Phosphorus level p-value
Gender	.145	.255
Caco3 intake	0.00*	0.00*
Regularity of. ca(co)3 intake	0.00*	.07*
Way of use ca(co)3	0.00*	.99
Dose of ca(co)3	0.00*	0.00*
Frequency of ca(co)3 intake	.01*	.402

Table (8): the association of socio demographic factors with mineral and bone disorder symptoms, February -April 2017 (n = 78)

Variable	mineral and bone disorder symptoms p-value
Gender	.0407
Ca(co)3 intake	.02*
Regularity of ca(co)3 intake	.034*
Way of use ca(co)3	.657
Dose of ca(co)3	0.00*
Frequency of ca(co)3 intake	.451

Multimedia manuscript

Figures:

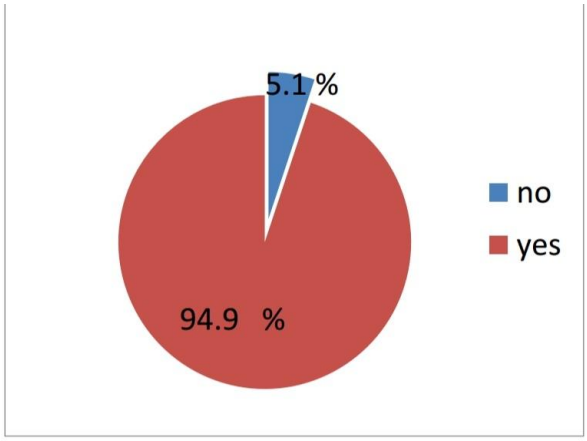


Figure (1) distribution of patients on dialysis in saheron hospital according to ca(co)3 intake

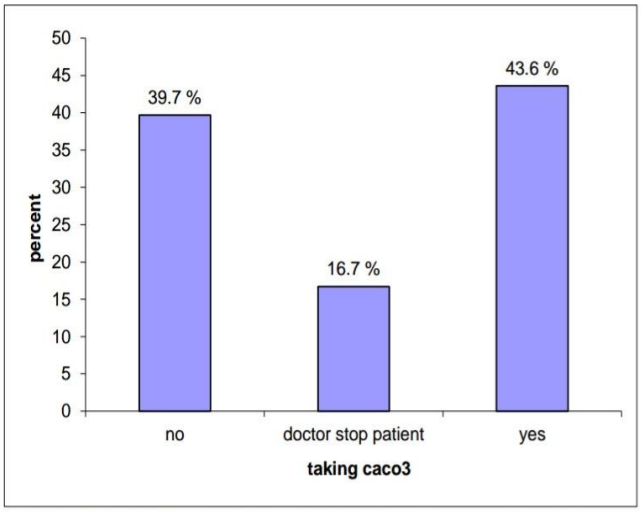
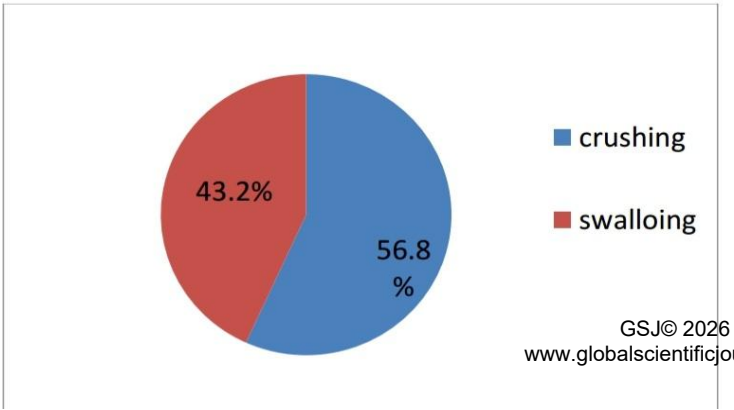


Figure (2) distribution of patients on dialysis according to regularity of ca(co)3 intake in saheron hospital

Figure (3) distribution of patients patients on dialysis according to how to take ca(co)3 in saheron hospital



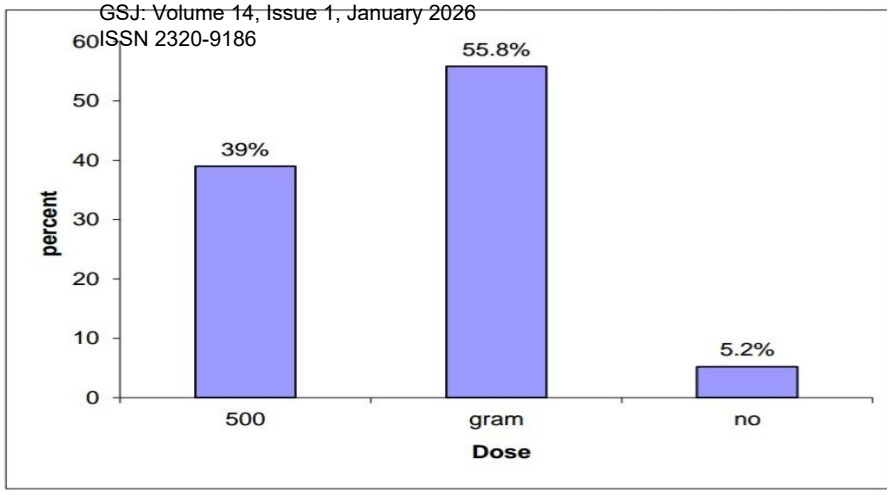
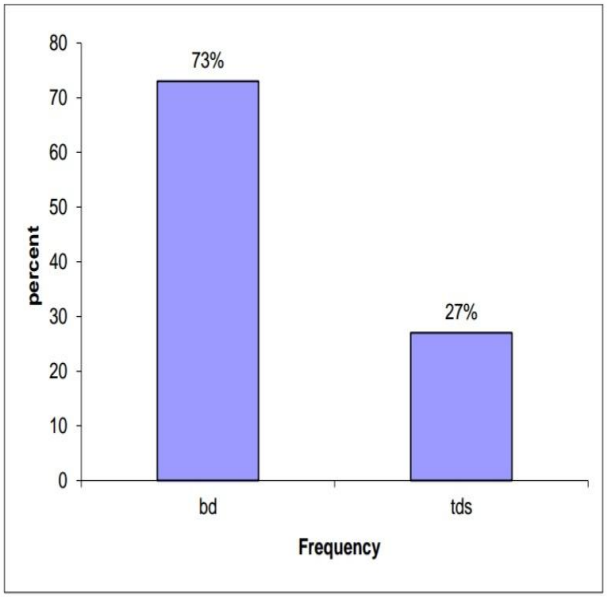


figure (4) the dose of ca(co)3 in patients on dialysis in saheron hospital

Table (4) figure (5) distribution of patients according to frequency of ca(co)3 in take in patients on dialysis in saheron hospital



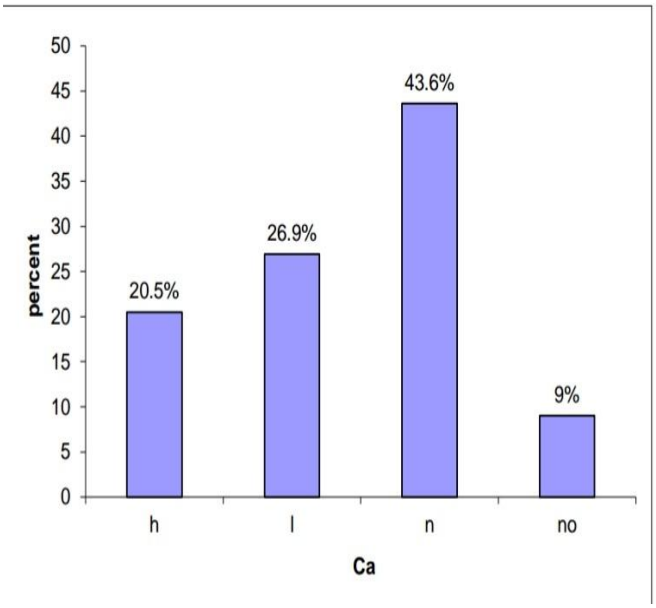
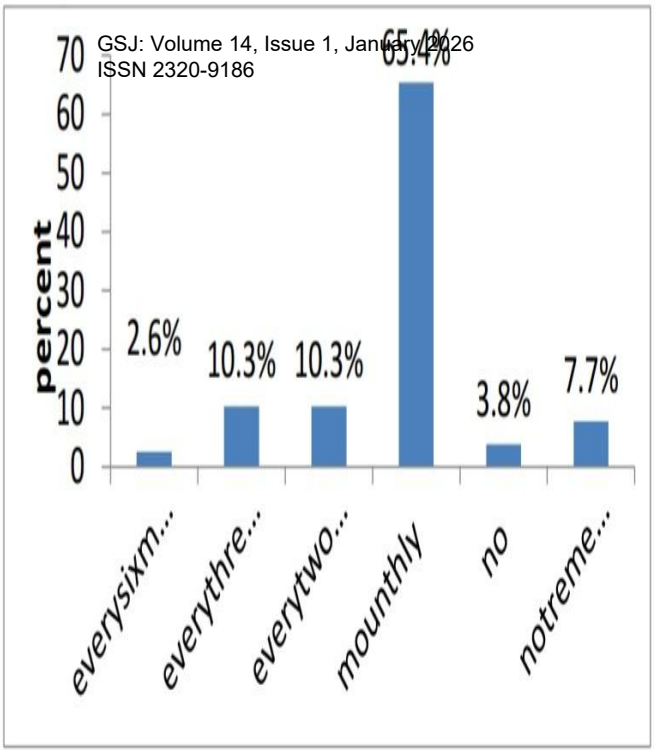
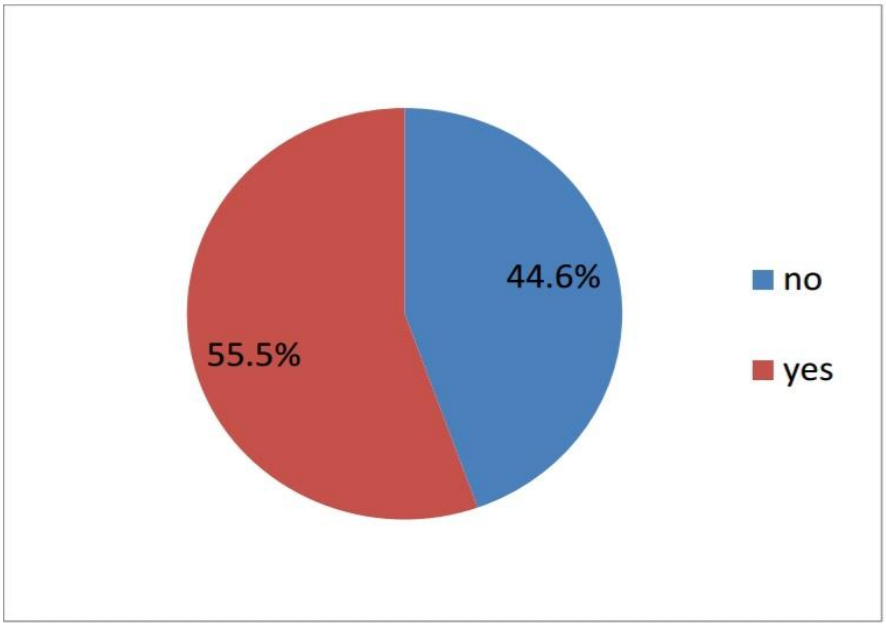


Figure (6) distribution of patients according to calcium level after ca(co)3 intake in patients on dialysis in saheron hospital



Figure(7) distribution of patients on dialysis according to frequency of investigate in saheron hospital



Figure(8) stop the intake of ca(co)3 in patients on dialysis in saheron hospital

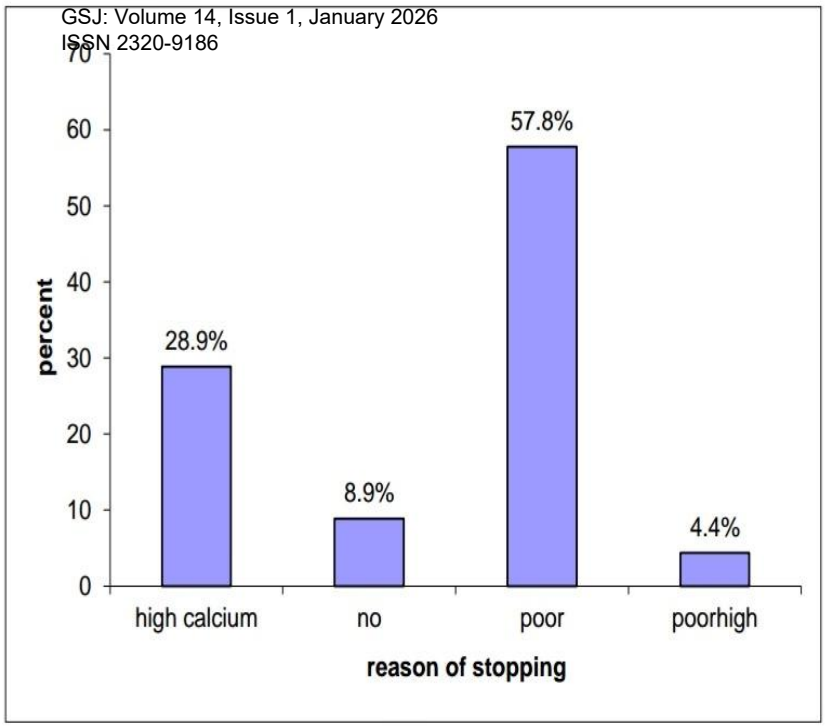


Figure (9) distribution of patients according to reason of stop the intake ca(co)3

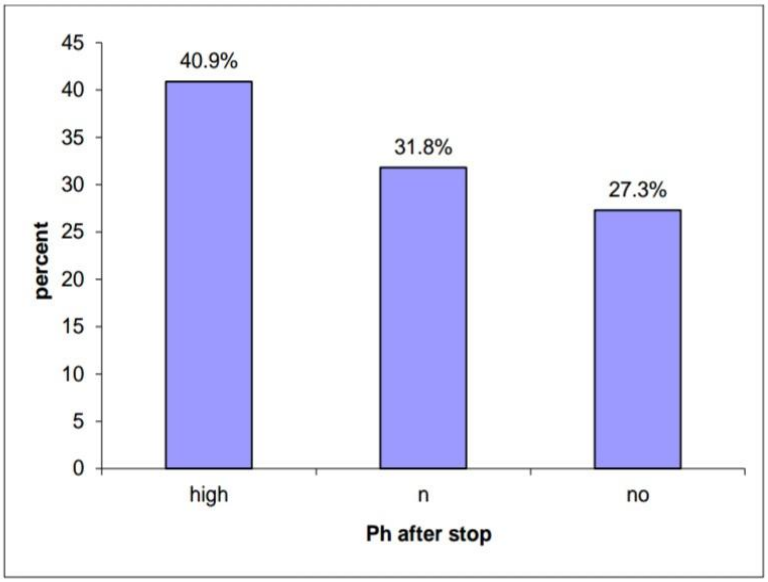


Figure (10) distribution of patients according to calcium and phosphorus level after stop ca(co)3 intake in patients on dialysis in saheron hospital

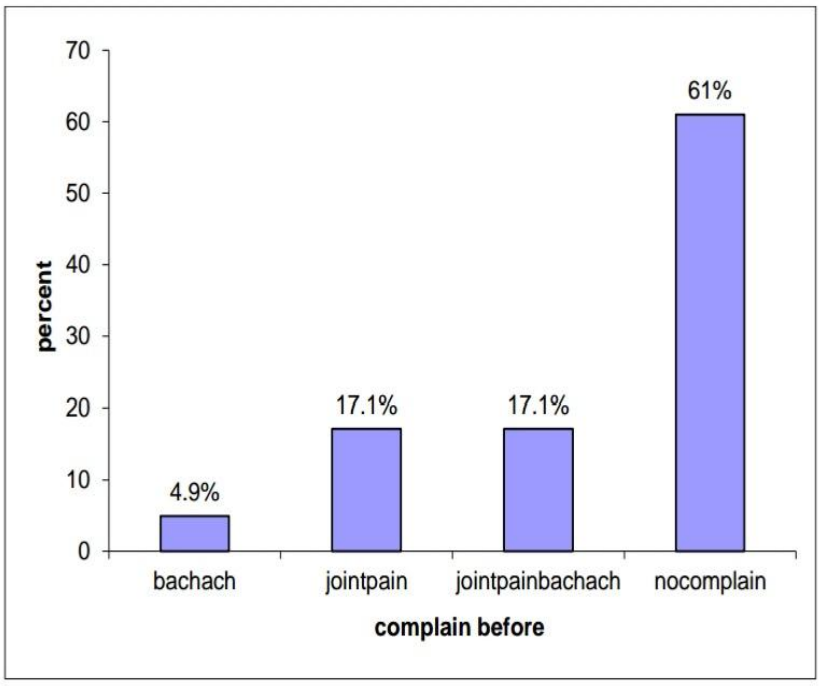


Figure (11) distribution of patients according to complain related to mineral and bone disorder before stop ca (co)3 intake in saheron hospital