ORIGINAL ARTICLE

# STUDY OF CALCIUM LEVELS IN PATIENTS WITH RENAL FAILURE

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## ABSTRACT

**Background**: Renal failure and its consequences like renal osteodystrophy is a challenge for developing countries like Pakistan. The current study was aimed to evaluate the levels of serum calcium in patients with renal failure so that renal osteodystrophies could be avoided in these patients. **Methods:** Total ninety subjects of both genders visiting Sheikh Zayed Hospital Lahore were selected randomly. Sixty subjects were clinically diagnosed patients of renal failure. Thirty subjects, clinically normal for kidney functions, were included in the study as control. These were classified in different age/gender based groups. Blood samples from the patients and control were analyzed in an auto-analyzer for serum calcium, serum creatinine and blood urea nitrogen. **Results:** Serum creatinine and blood urea nitrogen values were statistically significantly higher in the renal failure patients compare to normal subjects. Serum calcium levels were significantly lower in patients with renal failure as compared to normal subjects. **Conclusion:** It was concluded that positive correlation exists between serum creatinine and blood urea nitrogen. A negative correlation exist between serum creatinine, blood urea nitrogen and serum calcium levels in all group of patients with renal failure.

**KEY WORDS:** Renal failure, Renal osteodystrophy, Serum calcium, Serum creatinine.

## INTRODUCTION

The kidneys are paired extra peritoneal organ which perform several essential functions to maintain the homeostasis of health. The kidneys help filter the blood and remove waste products from the body. These regulate the amount of electrolytes in the body such as sodium, potassium, calcium, chloride, phosphate and magnesium. Formation of calcitriol, the active form of vitamin $D_3$ and regulation of acid base balance in the body are main functions which make kidney more important for human body.[1] The kidneys can lose to perform its function properly for a number of reasons such as diabetes, hypertension, dehydration, certain cancers, sepsis and side effects from some medications. Lose of renal function can lead to acute or chronic kidney failure. In chronic failure kidneys gradually lose the ability to properly filter out waste therefore harmful toxic waste products accumulate in body, while in acute renal failure, renal functions are diminished suddenly for short period of time.[2] Among the numerous causes of this diabetes mellitus is on the top of list and second most common is long standing, uncontrolled hypertension. Nephrotic syndrome is third most common cause of chronic renal failure worldwide.[3]

Calcium plays several important roles in human body like it is the structural unit of bones and teeth, contraction and relaxation of muscles, stabilizes nervous tissue by transmitting impulses throughout the nervous system, required for blood clotting as it activates various enzymes, blood vessel expansion and contraction and intracellular transduction mechanisms. The body struggles to maintain constant concentrations of calcium in blood, muscle, and intercellular fluids, though less than 1% of total body calcium is required to sustain these functions. The remaining 99% of the body's calcium supply is stock up in the bones and teeth where it supports their structure. Calcium homeostasis is also regulated by vitamin D. Very small dose of vitamin D is required to affect the absorption of calcium from the intestine. Vitamin D hormone has no direct effect on the calcium homeostasis. Concentrations of ionized calcium in blood are extremely constant in healthy persons because of the homeostatic system con-

cerning the actions of the three calciotropic hormones on the target organs of bone, gut, and kidney, and possibly also on fluxes between the bone canalicular fluid and the extracellular fluid.[4] Normal calcium homeostasis is mainly reliant on the interactions of Parathyroid hormone, 1, 25(OH) 2D3, and calcitonin on these organs to retain the ionized calcium concentration. Abnormal mineral metabolism has the potential to significantly increase mortality in patients with chronic kidney disease, especially by the time renal replacement therapy is required. Osteodystrophy is approximately universally present in chronic renal failure. Osteodystrophy present in chronic renal failure patients and caused by abnormal parathyroid hormone secretion in which the glomerular filtration rate is greater than 30 cc/minute. Osteodystrophy may be ameliorated after considered for parathyroidectomy and 1, 25 dihydroxychole-calciferol improve the management of patients with renal osteodystrophy.[5,6]

Creatinine is a commonly used as measure of kidney function as it is a breakdown product of creatine phosphate in muscle, and is usually produced at a fairly constant rate by the body depending on muscle mass. The diagnosis of renal failure is usually suspected when serum creatinine is greater than the upper limit of the "normal" interval. Urea is major nitrogenous end product of protein and amino acid catabolism, produced by liver and distributed throughout the intracellular and extracellular fluid. In kidneys, urea is filtered out of blood by glomerulli and is partially being reabsorbed with water. The most frequently determined clinical indices for estimating renal function depends upon concentration of urea in the serum. It is useful in differential diagnosis of acute renal failure and pre renal condition where blood urea nitrogen–creatinine ratio is increased. Increased serum creatinine and blood urea nitrogen (BUN) are associated with kidney disease or failure, blockage of the urinary tract by a kidney stone, congestive heart failure, dehydration, fever, and shock and bleeding in the digestive tract.[7,8]

The present study was planned to evaluate serum calcium, serum creatinine and blood urea nitrogen values in patients suffering from renal failure to assess the status of kidney functions and to correlate these values in these patients so that the risk of developing renal osteodystrophies could be prevented.

## MATERIAL AND METHODS

Total of 90 subjects (45 male and 45 female) were selected for this study. Out of these, 60 individuals (30 male and 30 female) were known cases of renal failure, they were selected randomly from Sheikh Zayed Hospital Lahore. A group of 30 subjects (15 male and 15 female) not suffering from renal failure as their serum creatinine and blood urea nitrogen values were within normal ranges were taken as control group. Controls were healthy individuals and they were selected from common peoples who were spending normal life and were not suffering from any type of renal disease, confirmed by serum creatinine and blood urea nitrogen levels. Serum creatine value >1.3 mg/dl and blood urea nitrogen value >18 mg/dl were kept cut off values between normal and diseased groups.

A written research participant consent form was filled by each study participant to undergo tests. History, demographic information and biochemical results of the patients were recorded. A 6-8 ml blood sample was collected in disposable syringes from peripheral vein which was allowed to clot for 25 to 30 mints at room temperature (37°C), then centrifuged at 3000 RPM for 3 minutes and clear serum obtained was poured in tubes and kept frozen at -20°C for estimation of serum creatinine, blood urea nitrogen and serum calcium levels.. Creatinine, blood urea nitrogen and serum calcium were determined on chemistry auto analyzer. All data were entered and analyzed through SPSS version 15. Results of serum creatinine, blood urea nitrogen and serum calcium were expressed as Mean±SEM for each group. Two groups were compared for significance by Students'' test. ANOVA technique was used for the comparison of serum creatinine, blood urea nitrogen and serum calcium of all the groups. Pearson correlation coefficient was utilized to see the correlation between different markers. A 'p' value of less than 0.05 was considered statistically significant.

## RESULTS

Results of this study are given below in tables.

**Table 1: The Mean±SEM values of the studied parameters in total study subjects (n=90).**

| Parameter | Normal Subject (n=30) Mean±SEM | Renal Failure Subjects (n=60) Mean±SEM |
|---|---|---|
| Calcium mg/dl | 8.91±0.10 | 7.41±0.09 |
| Creatinine mg/dl | 0.92±0.05 | 7.25±0.60 |
| BUN mg/dl | 12.86±1.09 | 62.45±4.49 |

**Table 2: The Mean±SEM values of the studied parameters in total male subjects (n=45)**

| Parameter | Normal Subject (n=15) Mean±SEM | Renal Failure Subjects (n=30) Mean±SEM |
|---|---|---|
| Calcium mg/dl | 9.073±0.11 | 7.387±0.15 |
| Creatinine mg/dl | 0.880±0.07 | 7.563±0.92 |
| BUN mg/dl | 11.133±0.90 | 60.800±6.95 |

**Table 3: The Mean±SEM values of the studied parameters in the chronic renal failure and the normal males subjects below 40 years of age (n=23)**

| Parameter | Normal Subject (n=8) Mean±SEM | Renal Failure Subjects (n=15) Mean±SEM |
|---|---|---|
| Calcium mg/dl | 8.98±0.22 | 6.97±0.30 |
| Creatinine mg/dl | 0.66±0.10 | 7.81±1.49 |
| BUN mg/dl | 12.4±1.63 | 59.16±11.03 |

**Table 4: The Mean±SEM values of the studied parameters in the chronic renal failure and the normal males subjects older than 40 years of age (n=23)**

| Parameter | Normal Subject (n=8) Mean±SEM | Renal Failure Subjects (n=15) Mean±SEM |
|---|---|---|
| Calcium mg/dl | 12±0.129 | 7.661±0.124 |
| Creatinine mg/dl | 0.99±0.0781 | 7.394±1.166 |
| BUN mg/dl | 10.50±1.022 | 63±8.627 |

**Table 5: The Mean±SEM of the studied parameters in the chronic renal failure and the normal female subjects (n=45)**

| Parameter | Normal Subject (n=15) Mean±SEM | Renal Failure Subjects (n=30) Mean±SEM |
|---|---|---|
| Calcium mg/dl | 747±0.153 | 7.44±0.099 |
| Creatinine mg/dl | 0.967±0.071 | 6.937±0.765 |
| BUN mg/dl | 14.600±1.854 | 63.433±5.733 |

**Table 6: The Mean±SEM of the studied parameters in the chronic renal failure and the normal males subjects below 40 years of age (n=22)**

| Parameter | Normal Subject (n=7) Mean±SEM | Renal Failure Subjects (n=15) Mean±SEM |
|---|---|---|
| Calcium mg/dl | 8.671±0.173 | 7.41±0.354 |
| Creatinine mg/dl | 0.986±0.119 | 6.81±1.378 |
| BUN mg/dl | 16.714±3.451 | 57.09±5.909 |

**Table 7: The Mean±SEM of the studied parameters in the chronic renal failure and the normal females subjects above 40 years of age (n=22)**

| Parameter | Normal Subject (n=7) Mean±SEM | Renal Failure Subjects (n=15) Mean±SEM |
|---|---|---|
| Calcium mg/dl | 8.812±0.248 | 7.41±0.141 |
| Creatinine mg/dl | 0.95±0.083 | 7.01±0.906 |
| BUN mg/dl | 12.75±1.433 | 67.10±8.266 |

## DISCUSSION

The current study illustrated that serum calcium values were statistically significantly low as compared to control group. The mean serum calcium level was found to be 8.91 mg/dl in controls while in patients with renal failure, it was 7.41 mg/dl. In early renal failure a shortfall of Calcitriol synthesis is an important factor; as renal failure progresses, the lack of Calcitriol become more pronounced as suggested by Lorenzo, who reported that because of classic sequence of events in renal failure that begins with a deficit of Calcitriol synthesis and retention of phosphorus results in serum calcium decreases and compensatory hyperplasia of the parathyroid gland result in increase parathyroid hormone, causing high turnover bone disease known as osteitis fibrosa.[1]

Serum creatinine was found to be statistically significantly high in all groups of patients with renal failure as compared to control group. The serum Creatinine level was 0.92 mg/dl in normal subjects and 7.25 mg/dl in renal failure subjects. Peter J has also studied the abnormal behavior of serum creatinine in 1510 patients and concluded that a serum creatinine level of greater than 1.7 mg/dl had a sensitivity of 12.6% and a specificity of 99.9% for the detection of renal failure.[9] When serum creatinine was correlated with serum calcium levels, it showed consistent negative correlation in all groups of the patients with renal failure. This negative correlation was highly significant in most of groups with renal failure. The reason for this is that kidney play vital role in excreting toxic nitrogenous compounds like creatinine and blood urea nitrogen from the body. When renal functions are compromised by any mean, these substances accumulates in the blood, and at the same time Calcitriol synthesis in the kidney is compromised, with further cause decrease in the serum calcium by excreting calcium in the urine combined with decrease calcium absorption from the gastrointestinal tract. Blood urea nitrogen values also showed same behavior and it was elevated in all patients with renal failure as compared to normal subjects who were taken as control group. The correlation between serum creatinine and blood urea nitrogen was significantly positive while correlation between blood urea nitrogen and serum calcium was significantly and consistently negative in all patients of renal failure.[10]

## CONCLUSION

It was also concluded that positive correlation exists between serum creatinine and blood urea nitrogen. A negative correlation exist between serum creatinine, blood urea nitrogen and serum calcium levels in all group of patients with renal failure.

It is therefore suggested here to start combine calcium and vitamin D therapy early when renal functions become deteriorate, to reduce the risk of developing osteodystrophy.

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