

# Renal Stones in Children of Hilly Population: Role of Vitamin D and Serum Calcium Levels

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## Abstract

**Background:** Renal stones in pediatric population are important disease which causes morbidity in children. Presentation of renal stones in pediatric population is quite different as compared to adults. The causes of renal stones have been postulated to be hypercalciuria, hyperoxaluria, hyperuricosuria, cystinuria, or infection. Elevated Vitamin D has been implicated as cause of hypercalciuria. However, levels of Vitamin D can be actually low in some patients of renal stones.

**Objective:** This study was planned to find any correlation between high Vitamin D levels and serum calcium levels in children presenting with renal stones.

**Study Design:** One hundred pediatric patients coming to surgery OPD with renal stones. Serum calcium, Vitamin D levels, and urinary calcium creatinine ratio were noted in all these patients.

**Participants:** One hundred pediatric patients coming to surgery OPD with renal stones/nephrolithiasis.

**Intervention:** All patients undergo USG to confirm the diagnosis. Serum Vitamin D and serum calcium levels were checked in all the patients. Data analyzed to find any correlation between serum Vitamin D and serum calcium levels and renal stones.

**Outcomes and Results:** We could not find any correlation between high Vitamin D levels, serum calcium, and renal stones. Rather, 87% of patients have low serum Vitamin D levels.

**Conclusion:** Children presenting with renal stones can have low levels of Vitamin D and calcium. In these children, supplementation should be given with regular follow-up to look for hypercalcemia and hypercalciuria.

**Key words:** Hypercalcemia, Renal stones, Vitamin D

## INTRODUCTION

Renal stones in pediatric population are important disease which causes morbidity in children. Presentation of renal stones in pediatric population is quite different as compared to adults. Children present with abdominal pain, hematuria, or features of urinary tract obstruction. Imaging of choice in pediatric population should have less 177 ionizing radiation. Chances of recurrence are also common so

metabolic profile should be done in all patients of renal stones in pediatric age group.<sup>[1,2]</sup>

The causes of renal stones have been postulated to be hypercalciuria, hyperoxaluria, hyperuricosuria, cystinuria, or infection. Out of these most common cause is hypercalciuria.<sup>[1,2]</sup> The cause of hypercalciuria can be high serum levels of calcium. Elevated Vitamin D has been implicated as cause of hypercalciuria.<sup>[3]</sup> A meta-analysis conducted by Hu *et al.* showed that increased Vitamin D levels are associated with urinary stones.<sup>[4]</sup> Other causes of hypercalciuria are renal tubular acidosis, spongy kidney, and certain drugs like corticosteroids.

However, in several studies, it has been observed that Vitamin D level is actually low in some patients of renal stones. In these patients, supplement of Vitamin D is

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known to cause increase in calcium excretion in urine.<sup>[5]</sup> There is also correlation with high serum calcium levels and hypercalciuria. Some studies from the UK have shown normal level of serum calcium levels in patients with renal stones.<sup>[6,7]</sup> This study was planned to find any correlation between Vitamin D levels and serum calcium levels in children presenting with renal stones.

### Aim

The aim of the study was as follows:

1. To study the levels of Vitamin D and calcium in patients of renal stones
2. To find correlation between Vitamin D, serum calcium levels, and water intake in children with renal stones.

## MATERIALS AND METHODS

This study was planned in pediatric patients coming to surgery outpatient department (OPD) with renal stones. Demographic data were collected from the patients. It was prospective study from October 2017 to October 2018. Ethical clearance for the study was taken before the study.

### Inclusion Criteria

The following criteria were included in the study:

1. Age <18 years
2. Unilateral or bilateral stones.

### Exclusion Criteria

The following criteria were excluded from the study:

1. Anatomical abnormalities such as horseshoe kidney and S-shaped kidney
2. Metabolic abnormalities which cause hyperoxaluria and hypercalciuria.

The patients were interviewed for their presenting signs and symptoms. Each child was asked about amount of water intake per day. Examination was done. Imaging of choice was ultrasound. In all patients, serum calcium levels and Vitamin D levels, urinary calcium, and renal functions were done. The value of these noted to find if renal stones are associated with high Vitamin D levels or serum calcium levels. Spot urinary calcium and creatine ratio were recorded.

Statistical analyses were performed with SAS version 9.2 (SAS Institute Inc., Cary, NC). Within-group differences were assessed by a paired *t*-test.  $P < 0.05$  was considered statistically significant.

### Observations

One hundred patients coming to surgery OPD with renal stones/nephrolithiasis were analyzed and following observations were made. Figure 1 shows age distribution

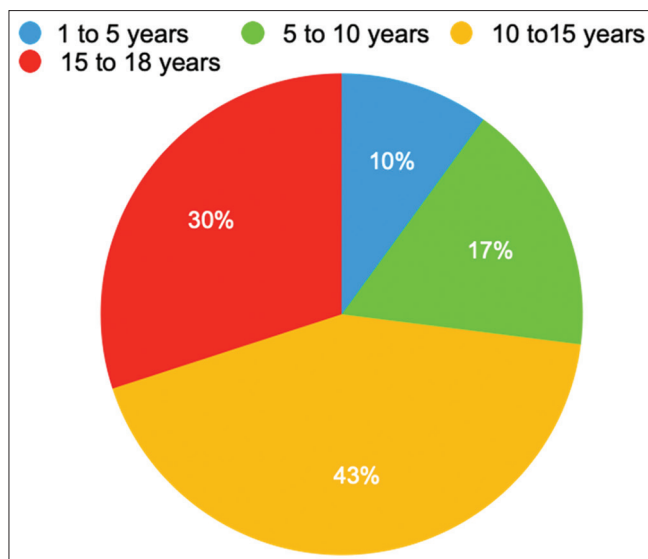


Figure 1: Age distribution of patients

in our patients. Table 1 shows demographic data and presenting complaints in our patients.

Daily intake of water was noted in all the patients. Presenting complaints in most of the patients were vague abdominal pain (90%). Severe abdominal pain was found only in eight patients. Features of urinary tract infection (UTI) were found in 87% of patients. Hematuria as presenting was seen only in 37% of cases. Only one patient had gross hematuria. Value of serum calcium, renal functions, urinary calcium, and serum Vitamin D obtained in all patients is shown in Table 1. Mean serum calcium level was 9.05 mg/dl and mean serum Vitamin D level was 14.9 ng/dl. Spot urinary calcium and creatine ratio were recorded. Mean value was 0.18 (0.16–0.25).

## RESULTS

In our study, we could not find any correlation between high vitamin D levels and renal stones,  $p$  value  $> 0.05$ . Even high serum calcium was also not found in children with renal stones.

## DISCUSSION

Renal stones are common cause of morbidity in adults and children. Although this is less frequent in developed nations, this is endemic in Indian subcontinent. Incidence of renal stones increases with age.<sup>[8]</sup> They are found more frequent in teenagers as compared to children <10 years. Male-to-female ratio found in our study was 3:2. Similar observations were made by study conducted by Agnieszka.<sup>[9]</sup>

**Table 1: Showing demographic data and laboratory values in patients**

Parameter (n= 100)	Value
Age in years (mean ± SD)	13±4
Male (%)	64
Male: Female	3:2
Presenting complaint	
Vague abdominal pain	90%
Urinary tract infection	87%
Haematuria	37%
Renal function (mean ± SD)	
Serum creatinine (mg/dl)	0.9±0.2
25-hydroxyvitamin D (ng/ml) n (%)	
0–9	19 (19)
10–19	68(68)
20–29	13(13)
Serum calcium	
≤8	12
8- 9	45
9- 10	37
>10	6
Urine calcium: creatine (range)	0.18(0.16–0.25)

Presentation of renal stones is quite different in children as compared to adults. We found that severe pain was less common presentation as compared to UTI. Our finding was also confirmed by Robert *et al.*<sup>[10]</sup> Another common presentation reported is hematuria by Copelovitch which was not found in our study.<sup>[8]</sup> Presenting complaints in most of the patients were vague abdominal pain (90%). Severe abdominal pain was found only in eight patients. Features of UTI were found in 87% of patients. There are more chances of UTI in patients of renal stones as compared to non-stone formers.<sup>[1]</sup> Hematuria as presenting was seen only in 37% of cases. Only one patient had gross hematuria. Similar findings were obtained by Kokorswhi *et al.*<sup>[11]</sup>

High serum calcium levels were not observed,  $P > 0.05$ . Similar observations were made by Abbaszadeh<sup>[11]</sup> who did not find any correlation between serum calcium and renal stones in children. Though levels of serum calcium and Vitamin D are interrelated, high serum vitamin D can lead to increased level of serum calcium which in turn can cause renal stones, but in our study, we could not find any correlation between high vitamin D levels and renal stones,  $p$  value  $> 0.05$ .

In our study, we could not find any correlation between high Vitamin D levels and renal stones,  $P > 0.05$ . This is in correlation with findings of Johri *et al.*<sup>[12]</sup> who also observed deficiency of Vitamin D in patients of renal stones. Some studies have shown a positive association between urinary calcium excretion and 25-hydroxyvitamin D serum levels in adult stone formers.<sup>[3]</sup> We did not find a relationship between 25-hydroxyvitamin D and urine calcium excretion or

prevalent kidney stone disease. Spot urinary calcium and creatine ratio were recorded. Mean value was 0.18 (0.16–0.25).

Despite the importance of Vitamin D in bone health, many clinicians are reluctant to give Vitamin D therapy in patients of renal stones even if there is hypovitaminosis as hypervitaminosis is considered a risk factor in renal stone formation. Vitamin D is essential for calcium absorption and maintaining bone health in pediatric population. Deficiency of Vitamin D can lead to rickets, hypocalcemia which can be symptomatic leading to tetany and seizures. In Vitamin D deficient patients, intestinal absorption of calcium and phosphorus is decreased.<sup>[10]</sup>

Cutaneous synthesis of Vitamin D due to ultraviolet radiation is significant source of Vitamin D supplementation.<sup>[13]</sup> However, children require less exposure to sunlight due to greater surface area and volume ratio. Other factors which affect synthesis of Vitamin D are pollution, dark skin, and indoor confinement. There are more reports of Vitamin D deficiency in children belonging to high altitude in spite of abundant sunlight and less pollution.<sup>[14]</sup> Whether these Vitamin D deficient patients with renal stones need Vitamin D supplementation or not are still not clear. Hypervitaminosis can lead to formation of renal stones due to increased excretion of calcium.<sup>[6]</sup> High levels of Vitamin D are reported to increase the incidence of urolithiasis, particularly in children.<sup>[15]</sup> Wang *et al.* also found that serum Vitamin D level in renal stone patient was high as compared to non-stone formers.<sup>[16]</sup> Tang<sup>[6]</sup> conducted a study which showed no correlation between high serum Vitamin D and prevalent renal stone. Leaf *et al.* also advocated Vitamin D repletion in stone formers who have Vitamin D deficiency.<sup>[17]</sup> Among stone formers with Vitamin D deficiency, a limited course of Vitamin D repletion does not seem to increase mean urinary calcium excretion, although a subset of individuals may have an increase. Leaf *et al.* suggested that Vitamin D therapy, if indicated, should not be withheld solely on the basis of stone disease, but 24 h urinary calcium excretion should be monitored after repletion.

Since there are more cases of Vitamin D deficiency in children who are residents of Himalayan range, and deficiency of Vitamin D can cause growth problems in these children, the authors recommend Vitamin D supplementation in these patient.

However, this supplementation should be done with caution with regular follow-up to look for hypercalcemia and hypercalciuria.

## CONCLUSIONS

Children presenting with renal stones can have low levels of Vitamin D and calcium. Message delivered: In these children with low levels of Vitamin D, supplementation should be given with regular follow-up with serum calcium and 24 h urinary calcium to look for hypercalcemia and hypercalciuria.

What is already known – Children with renal stones usually have high levels of Vitamin D.

What this study adds – Children with renal stones can have low levels of Vitamin D and these patients should be given supplementation of Vitamin D.

Limitations of study – We did not measure 24 h urinary calcium levels in these patients. Hypercalciuria can occur in patients given Vitamin D supplementation.

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