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A CASE SERIES OF CKD WITH RENAL OSTEODYSTROPHY IN CHILDREN

Paediatric Medicine

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ABSTRACT

The presence of chronic kidney disease (CKD) has a variety of effects on mineral and bone metabolism, hence the term Mineral Bone Disease (CKD-MBD). It encompasses interrelated pathophysiology of bone turnover, mineralization and volume. This leads to alterations in calcium, phosphate, vitamin D, parathyroid hormone and a phenotype of increased fracture risk, cardiovascular disease, and mortality in the context of End Stage Renal Disease(ESRD). In our case series, the common presenting complaints were difficulty in walking with pain in bilateral lower limbs associated with limb deformities. Early diagnosis and treatment of underlying causes of CKD is essential to prevent the bony deformities in these children.

KEYWORDS

End Stage Renal Disease, Chronic Kidney Disease, Secondary Hyperparathyroidism.

INTRODUCTION

In patients with CKD, abnormalities in the metabolism of minerals and bones are frequent. There is a lot of evidence showing that these derangements are linked to higher mortality and morbidity rates[1]. If left untreated, changes to the systems that regulate calcium and phosphorus homeostasis start to emerge early in the course of kidney disease (CKD) and progress as kidney function declines.[2]

These patients experience discomfort in their bones, a higher risk of bone fractures and deformities, myopathy, muscular soreness, and tendon rupture. Moreover, hyperphosphatemia seems to be linked to a higher death rate. PTH blood levels that are too high have a negative impact on practically every organ's performance.[1]

In our case series, the common presenting feature was pain in bilateral lower limbs with difficulty in walking and deformity of both lower limbs. We present herewith the clinical features, diagnostic approach and the challenges we encountered in managing the Chronic Kidney Disease associated with Mineral and Bone Disease.

Prevention of disturbances in mineral and bone metabolism and management early in the course of chronic kidney disease is extremely important in improving the quality of life and longevity of CKD patients.

CASES

Case 1

A 12 year old female came with complaints of difficulty in walking with pain in bilateral lower limbs since 2-3 months.Pain would worsen on exertion and was associated with deformities of lower limbs which was gradually progressive over last few months.

On clinical examination child had short stature, anemia, gait abnormality and genu valgum. Rest systemic examination was normal. Investigations revealed hypocalcemia, hyperphosphatemia, secondary hyperparathyroidism, elevated creatinine, hypovitaminosis D, raised alkaline phosphate. Arterial Blood Gas showed metabolic acidosis with normal anion gap.

X- rays showed bony changes of rickets .

USG abdomen was suggestive of B/L small contracted kidneys.

Patient was diagnosed as CKD with Type 1 Distal RTA with osteodystrophy.

Case 2

A 12 year old female child came with complaints of deformity of both lower limbs with difficulty in walking since 1 month and increased bone and joint pains since last few days.

Clinical examination revealed, anemia with genu valgum and rachitic changes.

Serum calcium concentration was 6.9 mg/dl, serum phosphate concentration was 5.6mg/dl. Serum creatinine was 3.1mg/dl. Serum alkaline phosphatase was 892 IU. Vitamin D3 levels were 12.22 ng/ml. iPTH level was 436 pg/ml.

X- rays showed bony changes of rickets .

Blood investigations revealed hypocalcemia, hyperphosphatemia, secondary hyperparathyroidism, elevated creatinine, hypovitaminosis D, raised alkaline phosphate. Arterial Blood Gas showed metabolic acidosis with normal anion gap Child was diagnosed as CKD with Type 1 Distal RTA with osteodystrophy.

Case 3

An 8 year old boy presented with pain in bilateral lower limbs with difficulty in walking.

On clinical examination child had short stature, anemia, gait abnormality and genu valgum. Rest systemic examination was normal. Investigations revealed hypocalcemia, hyperphosphatemia, secondary hyperparathyroidism, elevated creatinine, hypovitaminosis D, raised alkaline phosphate.

X- rays showed bony changes of rickets .

USG abdomen was suggestive of thickened bladder wall with bilateral hydroureteronephrosis MCU depicted gross vesicoureteric reflux suggestive of bladder outlet obstruction.

Case 4

A 15 year old patient came with chief complaints of joint pains, difficulty in walking and climbing stairs. The present complaint started 2 weeks ago and weakness is progressively increased to the present condition.

Musculoskeletal examination showed bowing of the legs and arms.

Investigations revealed hypocalcemia, hyperphosphatemia, secondary hyperparathyroidism, elevated creatinine, hypovitaminosis D, raised alkaline phosphate.

CT scan showed chronic renal parenchymal disease with bilateral contracted kidneys.

Patient was diagnosed as end stage renal disease with osteodystrophy.

Case 5

15 year old boy presented with progressive knee bending since the age

of 9 years, when he started developing pain and progressive bending of both his knee joints.

On examination, he had short stature with genu valgum. There was widening of wrist joints.There was no other systemic findings.

Investigations revealed hypocalcemia, hyperphosphatemia, secondary hyperparathyroidism, elevated creatinine, hypovitaminosis D, raised alkaline phosphate.

CT scan showed left renal agenesis with right small kidney.

Case 6

A 7 year old boy presented with short stature and intermittent episodes of bone pains more in lower limbs since last 3 months.Also parents complained that the child is not gaining adequate height.

On examination, he had profound short stature with genu valgum.He also had hypertension (>95th centile)

Investigations revealed, hypocalcemia, hyperphophatemia, secondary hyperparathyroidism,raised serum creatinine, hypervitaminosis D with raised alkaline phosphatase.

He also had reduced GFR.

He was diagnosed as ESRD with osteodystrophy.

Case	Age (yrs)	Sr.Creat (mg/dl)	Sr.Ca (mg/dl)	Sr.P (mg/dl)	ALP (IU)	Vit D3 (ng/ml)	iPTH (pg/ml)
1	12	2.7	6.8	6.4	960	9.37	595
2	12	3.1	6.9	5.6	892	12.22	436
3	8	5.2	7.1	5.8	936	8.75	849
4	15	5.8	6.9	5.7	838	11.2	398
5	15	4.7	6.6	5.4	860	9.55	1320
6	7	7.2	7.0	6.8	1150	10.0	1800

RESULTS

In our study, we enrolled 6 children, who presented with complaints of pain in lower limbs with difficulty in walking with deformity of lower limbs.

All children had various causes of CKD varying from Type 1 distal RTA, Vesicoureteric reflux, renal agenesis to End Stage Renal Disease leading to development of renal osteodystrohpy or renal rickets. They were treated with Calcium and Vitamin D3 supplementation in therapeutic doses along with Phosphate binders (Sevelamer) and Calcimimetics (Cinacalcet) to control secondary hyper-parathyroidism.

DISCUSSION

In progressive chronic kidney disease (CKD), abnormalities in mineral metabolism and bone formation are virtually always discovered[1]. Early on in the progression of chronic kidney disease (CKD), changes in mineral metabolism and bone structure appear, and they progressively get worse as kidney function is lost. Other treatment measures, such as the injection of vitamin D, may also have an impact on the severity of these changes [2]. Renal osteodystrophy is a change in the morphology of the bones in CKD patients. Early on in the progression of CKD, usually when kidney function falls to less than 60 mL/minute/1.73m2, secondary hyperparathyroidism develops. This happens as a result of several anomalies that start and keep up excessive PTH secretion[3].

The main abnormalities that contribute to the pathogenesis of secondary hyperparathyroidism are:

- Phosphate retention
- Decreased free calcium level
- Decreased 1,25-dihydroxyvitamin D (Calcitriol) level
- Reduced expression of vitamin D receptors, calcium-sensing receptors.

By comparing the changes in their levels to the rise in PTH over the course of CKD, it is possible to comprehend the relative significance of these anomalies in initiating PTH production. When the estimated glomerular filtration rate (eGFR) falls below 60 mL/min/1.73m2, elevated PTH levels initially become noticeable. Serum calcium and phosphate levels are normal at that point and remain so until the patient's eGFR falls to around 20 mL/min/1.73m2. However at higher eGFR levels, low calcitriol concentrations are typical. [4],[5]

By increased PTH gene transcription, PTH peptide production, and parathyroid cell proliferation, hyperphosphatemia causes hyperparathyroidism independently of serum calcium and vitamin D levels[6]

The clinical features of above cases are consistent with such findings. Bone pain, myopathy and even muscle wasting are common features in such degree of bone disease. Bowing of weight bearing bones is a common manifestation of bone abnormalities. All long bones may experience variable degrees of metaphyseal region widening depending on the severity of metabolic bone disease and on metaphyseal growth, which varies with age..[7],[8]

Pronounced secondary hyperparathyroidism, hypocalcaemia, and severe osteitis fibrosa promote disintegration of growth plate and increase the risk of epiphysiolysis and subsequent slipping of epiphysis. The most frequent localization is the proximal femur. This in turn leads to serious complications like osteonecrosis, severe deformities and degenerative bone diseases.[9]

Further non-skeletal symptoms of hyperparathyroidism and renal bone disorders exist. A significant consequence called erythropoietin resistant anaemia has a detrimental effect on the treatment strategy and general well-being of the patient. One of the primary causes for increased cardiovascular mortality is excessive vascular calcification. The coronary calcification in more than 90% of young individuals with CKD that started in childhood is already rather advanced. Hyperparathyroidism may present as refractory pruritus. [10],[11],[12].

The main goals of ROD treatment are

a) to maintain serum i-PTH levels between 120 and 150 pg/mL;
b) to bring the phosphate (Pi) concentration under 5.5 mg/dL, Ca concentration between 9.2 and 10.4 mg/dL, and the Ca x Pi product under 55 mg/dL;
c) to bring Al concentration under 20 ug/L; and
d) to target serum bicarbonate levels between 20 and 24 mmol/L.

Dietary inorganic phosphate (Pi) consumption management (1200 mg/day) is one of the key treatment strategies. intestine phosphate binding with sevelamer and calcium salts. Use of calcium salts should not exceed 23 g per day to prevent Ca excess. Mg and Al salts may be administered at a dose lower than 2 g/day for fewer than three months if Pi control is not achieved. Dialysis time and dose (KT/V > 1.2) should be appropriate (consider increased dialysis duration or session number for a week). Depending on the dialysis method and to maintain the proper Ca balance, the Ca concentration in dialysate and infusion fluids may range from 1.25 to 2.00 mmol/L. When i-PTH levels are below 120 pg/mL, serum Ca is above 11 mg/dL, and/or Pi is above 6.5 mg/dl, vitamin D should not be administered. The vitamin D dose should be proportional to PTH levels, with a larger dose given as a bolus (23 ug twice or three times per week). The intravenous route should be preferred in the case of very high i-PTH (> 700 pg/mL) or after 3 months of unsuccessful oral treatment[13].

CONCLUSION

The main goal of managing children with CKD/ESRD should always be to prevent or at the very least delay the development of renal bone disease. This can be accomplished by administering dialysis correctly, receiving regular nutritional counselling, and using phosphate binders and vitamin D derivatives as directed. To have the greatest possible quality of life, early referral to nephrology and transplantation services is necessary for avoiding these severe CKD/ESRD consequences.

REFERENCES

1. National Kidney Foundation. K/DOQI clinical practice guidelines for bone metabolism and disease in children with chronic kidney disease. Am J Kidney Dis 2005; 46(Suppl1):S1.
2. Martin KJ, González EA. Metabolic bone disease in chronic kidney disease. J Am Soc Nephrol 2007; 18:875.
3. Moe S, Drueke T, Cunningham J, et al. Definition, evaluation, and classification of renal osteodystrophy. A position statement from Kidney Disease: Improving Global Outcomes (KDIGO). Kidney Int 2006; 69(11): 1945-1953.
4. Cunningham J, Locatelli F, Rodriguez M. Secondary hyperparathyroidism: pathogenesis, disease progression, and therapeutic options. Clin J Am Soc Nephrol 2011; 6:913.
5. Levin A, Bakris GL, Molitch M, et al. Prevalence of abnormal serum vitamin D, PTH, calcium, and phosphorus in patients with chronic kidney disease: results of the study to evaluate early kidney disease. Kidney Int 2007; 71:31.
6. Almaden Y, Canalejo A, Hernandez A, Ballesteros E, Garcia Navarro S, Torres A et al. Direct effect of phosphorus on PTH secretion from whole rat parathyroid gland in vitro. J

Bone Miner Res 1996; 11(7): 970-76.
7. Claus P. Scmitt and Otto Mehls. Disorders of Bone Mineral Metabolism in Chronic Kidney Disease. In: Denis F. Geary and Franz Schefer. Comprehensive Pediatric Nephrology. Philadelphia: Mosby Elsevier; 2008.p. 773-792.
8. Ritz E, Boland R, Kreusser W. Effects of vitamin D and parathyroid hormone on muscle: Potential role in uremic myopathy. Am J Clin Nutr 1980; 33(7):1522-1529.
9. Mehls O, Ritz E, Kreusser W, Krempien B. Renal osteodystrophy in uremic children. Clin Enocdrinol Metab 1980. 9(1):151-176.
10. Goodman WG, Goldin J, Kuizon BD, et al. Coronary-artery calcification in young adults with end-stage renal disease who are undergoing dialysis. N Engl J Med 2000; 342:1478.
11. Chou FF, Ho JC, Huang SC, Sheen-Chen SM. A study on pruritus after parathyroidectomy for secondary hyperparathyroidism. J Am Coll Surg 2000; 190:65.
12. Rao DS, Shih MS, Mohini R. Effect of serum parathyroid hormone and bone marrow fibrosis on the response to erythropoietin in uremia. N Engl J Med 1993; 328:171.
13. Messa P; Italian Society of Nephrology. Linee Guida osteodistrofiarenale[Renal osteodystrophy Guidelines]. G Ital Nefrol. 2003 Sep-Oct;20 Suppl 24:S83-95. Italian. PMID: 14666505.