Slipped Capital Femoral Epiphysis and Primary Hyperparathyroidism: A Case Report

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ABSTRACT: The aim of reporting this case is to highlight the association of two disorders, primary hyperparathyroidism (PHPT) and slipped capital femoral epiphysis (SCFE). They are usually seen in two different age groups and rarely together. PHPT is a rare cause of SCFE and only 10 cases have been reported in the literature worldwide. The patient in our report is a 13-year-old girl who presented to our clinic with bilateral knee pain and a waddling gait. Subsequent investigations showed that she had PHPT and SCFE with low bone mass. On admission, a parathyroidectomy was performed; then, the slipped femoral epiphyses were fixed with satisfactory results. A systematic algorithmic approach that was illustrated in a previously published case was used. Such cases should be managed with a systematic approach based on the patient’s clinical status to prevent future morbidity. A literature review was conducted by performing a Medline search of all reported cases of PHPT and SCFEs.

KEYWORDS: hypercalcemia, primary hyperparathyroidism, slipped capital femoral epiphysis

Introduction
Primary hyperparathyroidism (PHPT) is a common endocrine disease that mainly affects the elderly population, especially women.¹ The epidemiology of PHPT in Saudi Arabia has not yet been reported. In a study that aimed to determine the incidence and prevalence of PHPT in a racially mixed population in 2012, the mean annual incidence of PHPT was about 66 per 100,000 women and 25 per 100,000 men; conversely, the prevalence of PHPT was around 233 per 100,000 in women and 85 per 100,000 in men.² Among children, the true incidence and prevalence of PHPT are not currently known.

Slipped capital femoral epiphysis (SCFE) is a relatively common hip disorder among adolescents. The estimated incidence of SCFE is around 11 per 100,000 children annually, with a mean age of 12 and 13.5 years in girls and boys, respectively.³ PHPT and SCFE are rarely concomitant in one individual. Only 10 cases have been reported in the literature to date.⁴–¹² Review of ours and previous published cases should help the physicians to develop an effective approach for the management of such cases.

Patient Report
A 13-year-old Saudi female, previously healthy and not known to have any chronic medical illnesses, presented to our endocrine clinic complaining of bilateral knee pain for 1 year, which was progressive and had disrupted her daily activities; this pain was associated with bilateral lower limb weakness and a waddling gait. There were instances when she could not bear her own body weight. She also complained of right-flank pain. There was no history of trauma, fracture, hematuria, skin changes, hair loss, and loss of appetite or a history of any metabolic disorders. She had never undergone any prior surgeries. Menstruation started at the age of 12 years and 6 months with irregular periods. There was no family history of any endocrine disorders or similar complaints. On examination, the patient looked well; she was not in acute pain or distress. She was alert and oriented to time, place, and person. Her blood pressure was 116/69 mmHg, and her pulse was 110 beats/minute. Body mass index was 28.8 kg/m². Neck examination showed no palpable mass or lymph node enlargement. Bony prominence tenderness was seen bilaterally at greater trochanters, with painful movements but normal range of motions. The muscle power of the upper limbs was normal (5 out of 5), and in lower limbs, it was 4 out of 5 at hip joint bilaterally with exacerbation of pain during movements. The rest of the examination was unremarkable.

The patient’s serum biochemistry revealed a corrected calcium of 2.91 mmol/L (normal range: 2.09–2.54 mmol/L), phosphates of 0.7 mmol/L (normal range: 0.87–1.45 mmol/L), and an alkaline phosphatase level of 2,008 IU/L (normal range: 44–147 IU/L), and her parathyroid hormone (PTH) level was 239 pmol/L (normal range: 1.6–6.9 pmol/L). The patient’s 25-hydroxy vitamin D level was 43.5 nmol/L (normal range: 50–250 nmol/L), and her 24-hour urinary calcium level was 12.64 mmol/day (normal range: 2.5–7.5 mmol/day). Skeletal imaging showed findings suggestive of bone resorption of skull, pelvis, and hands (Fig. 1A–C). The skull demonstrated...
trabecular bone resorption that had resulted in the salt-and-pepper appearance of the calvarium. Similar findings were noted along the subcapital region of the femoral neck with subsequent fracture leading to SCFE. Subperiosteal resorption was noted along the radial and the ulnar aspect of the middle phalanges, more pronounced along the second, third, and fourth bilaterally. Subperiosteal bone resorption was noted at the distal radius and ulna more involving the left side. No signs of chondrocalcinosis were noted.

The finding of PHPT in our patient prompted us to suspect multiple endocrine neoplasia syndrome (MEN-1), but due to the absence of family history of any endocrinopathy and lack of features suggestive of pituitary or pancreatic mass, we did not screen her further.

The patient was reassured of her health status. She was advised to maintain good oral hydration, prescribed vitamin D supplement, and was given a follow-up appointment to our endocrine clinic, where an ultrasound of her parathyroid gland and kidneys was performed.

The ultrasound of the patient’s parathyroid showed a well-defined parathyroid adenoma measuring 3.0 cm × 1.7 cm × 1.2 cm (Fig. 1D). The ultrasound of her kidneys showed a tiny, non-obstructive right renal calculus. Later, a dual-phase parathyroid scan revealed increased focal tracer uptake projecting to the right lower lobe of the thyroid gland, where early tracer uptake and delayed washout were noted, compatible with a parathyroid adenoma (Fig. 1E).

She was referred to the Breast and Endocrine Surgery Clinic for further assessment, where an elective parathyroid adenoma resection was planned.

Meanwhile, the patient visited the emergency department complaining of right hip pain; she was unable to stand and became wheelchair dependent. Her corrected calcium level was 3.11 mmol/L (normal range: 2.09–2.54 mmol/L); her skeletal survey and a computed tomography scan of the pelvis showed a generalized bone demineralization. There was severe subperiosteal resorption at the subcapital region of the femoral neck, bilaterally, with subsequent fracture leading to SCFE. She was advised admission to hospital, which she refused, claiming her elective admission will be in a few weeks later. She was managed with intravenous fluids and was discharged against medical advice.

Three weeks later, the patient was electively admitted for right inferior parathyroidectomy, which was performed without any complications. Her serum corrected calcium level dramatically improved to 2.18 mmol/L (normal range: 2.09–2.54 mmol/L), and her PTH dropped to 5.9 pmol/L (normal range: 1.6–6.9 pmol/L). Nine days after the parathyroidectomy, the patient underwent bilateral femoral head pinning in situ with immobilization and rest for 6 weeks (Fig. 1F). Other investigations included normal electrocardiography and normal thyroid function tests. Her postoperative course was uneventful with marked recovery. She was followed up 1 year later in clinic as an outpatient,
and presently she is able to mobilize without any assistance or gait defects. Her last laboratory investigation showed markedly normal serum corrected calcium of 2.28 mmol/L (normal range: 2.09–2.54 mmol/L), serum phosphate 1.17 mmol/L (normal range: 0.87–1.45 mmol/L), and PTH level 4.8 pmol/L (normal range: 1.6–6.9 pmol/L).

Discussion
Although the coexistence of PHPT and SCFE is rare, a fair association between these two conditions has been reported previously, and it has been further exemplified in the current case report.

PHPT is a rare cause of SCFE, of which only 11 cases—including ours—have been reported. PHPT-induced depletion of bone calcium as a pathophysiological mechanism is well known. But the discovery of PTH receptors in growth plate chondrocytes was a breakthrough one. PTH receptors are present in large numbers in cells of hypertrophied cartilage zone of epiphyseal plate—the same zone where slipping of femoral epiphysis occurs. PTH plays a significant role in the induction of various metalloproteinases for cartilage ossification, and it controls the cartilage matrix degradation during endochondral bone formation. Actions of PTH on growth plate's chondrocytes, through its mediators and metalloproteinases, may get deranged due to any PTH imbalance, resulting in abnormal cartilage mineralization, which elongates the time needed for completion of epiphyseal fusion. This elongated period during which cartilage remains uncalcified may be one of the factors provoking development of SCFE as it is well known that during early years of adolescence, strong shearing stress is exerted on upper femoral epiphysis because of increasing body weight and changes in planarity of growth plate. Any PTH imbalance may trigger the entire process by exposing growth plate to destabilizing effects of other contributing factors (ie, physical activity, body weight, trauma, planarity of growth plate, increased femoral retroversion, etc) for much longer time period.

Vitamin D deficiency is commonly seen in PHPT patients, and hyperparathyroidism becomes exacerbated in its presence. Severe SCFE can be caused by concomitant vitamin D deficiency in patients with PHPT, and vitamin D deficiency itself can be strongly associated with SCFE. In view of serum phosphate and urinary calcium levels, vitamin D deficiency should be considered a coincidence and not a cause in our case. Though, in cases of SCFE with PHPT, it must be treated carefully, as it may worsen the severity of SCFE. Adolescents with unstable SCFE should be managed with caution, as they are at significant risk to develop avascular necrosis of the joint. However, the optimal time when to fix the joint remains controversial. Chronic (stable) unilateral SCFE would benefit from long-term management to prevent further slippage and progression, as in the case of osteonecrosis of the femoral head and chondrolysis. Severe hypercalcemia manifestations and complications should be considered thoroughly if a patient develops cardiac abnormalities, neurological symptoms, and profound musculoskeletal aches. In such conditions, a parathyroidectomy should be prioritized to SCFE fixation. In our case, parathyroidectomy was performed prior to SCFE fixation and repair, which was recommended in previous case reports for unstable SCFE.

In 2012, El Scheich et al reported a case of a patient with concomitant PHPT with SCFE. The authors designed a systematic and structured algorithmic approach for managing such patients. This approach may help clinicians and surgeons in an effective and efficient way to deal with such rare cases. This algorithm was followed in our case, and we recommend to be used in clinical practice.

Conclusion
The coexistence of SCFE and PHPT should not be taken lightly. This rare association and its manifestations should be managed effectively based on the patient’s clinical status to improve the patient’s long-term outcomes and quality of life, with the ultimate aim of preventing any future disability.

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