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Case Report

Pediatric hyperparathyroidism and ossification of the ligamentum flavum: A case report ☆,☆☆

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ABSTRACT

Hyperparathyroidism (HPT) is a rare endocrine disorder in the pediatric population. Patients often present with bone pain and abnormal gait along with biochemical findings of hypercalcemia, hypophosphatemia, and elevated parathyroid hormone (PTH). HPT is most commonly due to the unregulated secretion of PTH from a parathyroid adenoma. Diagnosis is usually identified with sonography and scintigraphy to localize parathyroid anomalies. Treatment traditionally involves parathyroidectomy with postoperative monitoring of serum calcium and phosphate levels. Here we present a case of a preadolescent girl with metabolic bone disease secondary to hyperparathyroidism.

Introduction

Hyperparathyroidism (HPT) is a rare endocrine disorder in the pediatric population, characterized by hypercalcemia due to the overproduction of parathyroid hormone (PTH) by the parathyroid glands. HPT is often associated with bone disease, a prototypical complication that can arise from long-standing overstimulation of the parathyroid-bone-kidney axis. Bone resorption is most notable subperiosteally at the distal interphalangeal joints and throughout the cranium; however, in advanced stages has been found to impact long bones such as the humerus and femur. Rare findings associated with the condition include the ossification of the ligamentum flavum. To our knowledge, there are a limited number of these cases in adults with hyperparathyroidism and no previous reports of this phenomenon in pediatric patients [1,2].

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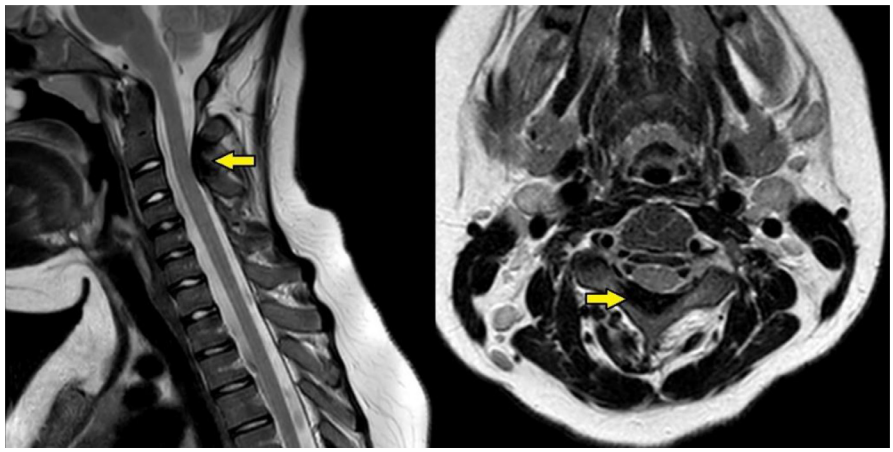

Fig. 1 – Sagittal and axial T2-weighted MRI of the cervical spine reveals extradural dark signal within the posterior spinal canal from C2-C4.

Case report

An 11-year-old female presented to the emergency department with left thigh pain and gait abnormality. Her medical history was significant for vitamin D deficiency and Sever's disease (calcaneal apophysitis).

Over the 2 years prior to her presentation in the emergency department, the patient reported recurring bilateral heel and lower extremity bone pain, and abnormal gait described by her mother as "limping" for which she was followed by orthopedics. She was ultimately diagnosed with Sever's disease, but despite treatment, her abnormal gait persisted.

An MRI of the total spine was obtained and showed well-defined, linear plaque-like extradural hypointensity in the posterior spinal canal from the C2-C4 levels (Fig. 1).

To better evaluate the abnormality within the posterior spinal canal, a CT of the cervical spine was performed which revealed fluffy posterior epidural ossification within the spinal canal from C2-C4 that corresponded to the MRI abnormality (Fig. 2).

Neurosurgeons felt that the extradural cervical spine ossification was probably not the cause of the patient's gait abnormality. However, the patient continued to report left proximal leg pain, and the physical exam was notable for decreased range of motion of the left ankle and hip with bilateral lower extremity weakness. Pelvis radiographs were ordered and demonstrated widening of the proximal femoral growth plates bilaterally (Fig. 3) raising the suspicion that metabolic bone disease was the source of the patient's continued leg pain and abnormal gait.

Laboratory studies were notable for moderate hypercalcemia and significantly elevated alkaline phosphatase, Vitamin D 1-25 (D3), and parathyroid hormone (PTH). Urinalysis was positive for the presence of calcium oxalate crystals without blood. A renal ultrasound (US) was then performed which revealed slightly echogenic kidneys and multiple nonobstructing stones (Fig. 4). Laboratory testing for genetic syndromes such as multiple endocrine neoplasias

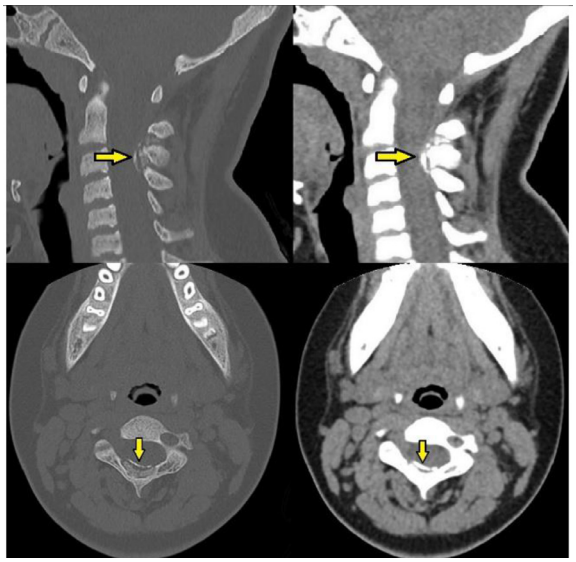

Fig. 2 – Sagittal and axial noncontrast computed tomography of the cervical spine in bone and soft tissue windows demonstrates fluffy epidural ossification within posterior spinal canal at C2-C4 level with scalloping of the adjacent laminae.

was not performed due to the lack of any significant family history.

A thyroid ultrasound was obtained which depicted a hypoechoic, vascular solid nodule posterior to the mid-pole of the left thyroid gland (Fig. 5). These findings were consistent with a parathyroid adenoma and the patient's overall clinical presentation.

Tc99m-sestamibi nuclear medicine scan was performed and showed increased uptake posterior to the left thyroid lobe, confirming the diagnosis of a parathyroid adenoma (Fig. 6).

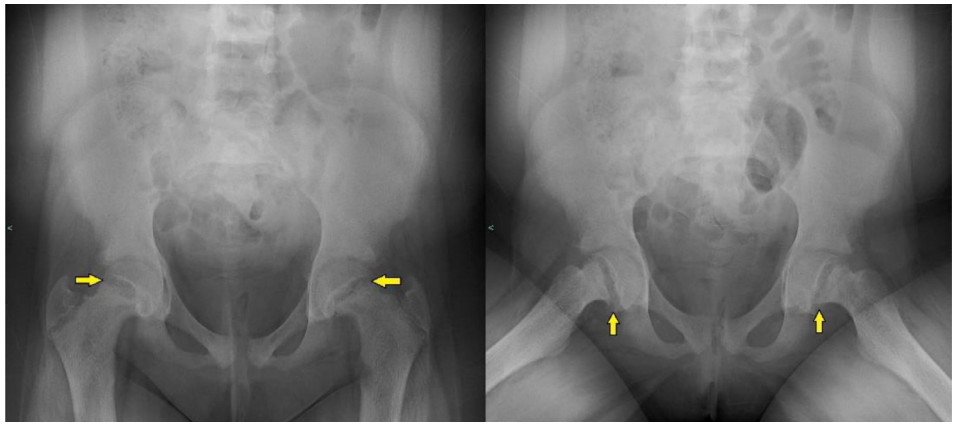

Fig. 3 – AP and frog-leg radiographs of the pelvis illustrating widened growth plates of both proximal femurs (arrows).

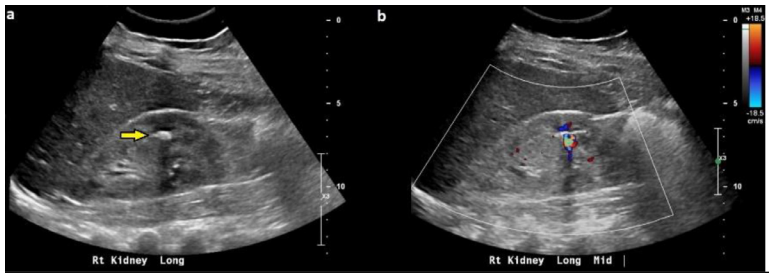

Fig. 4 – Renal ultrasound (US) of the right kidney demonstrating increased parenchymal echogenicity (A, B) and mid/lower calyceal nonobstructing stones (arrow) depicted by twinkle artifact with color Doppler (B).

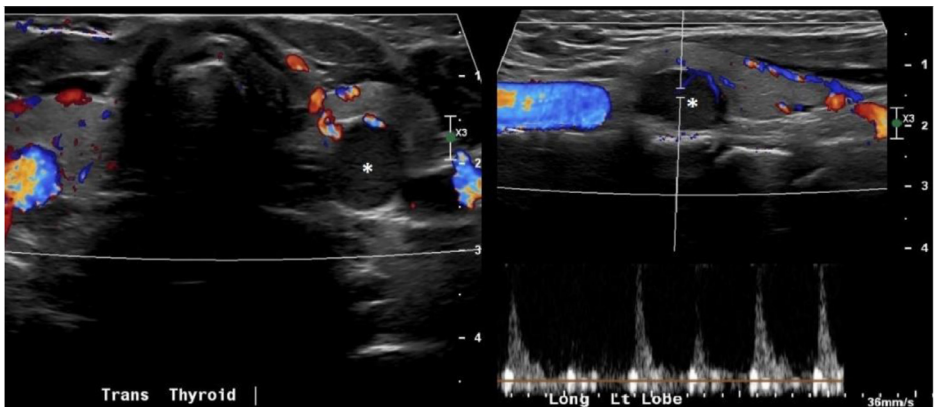

Fig. 5 – Neck ultrasound (US) demonstrates a vascular hypoechoic, homogeneous solid nodule that measures 1 x 1.4 x 0.9 cm posterior to the mid pole of the left thyroid gland (asterisk).

The patient ultimately underwent a successful parathyroidadenomaectomy with eventual normalization of laboratory values and resolution of lower extremity pain.

Discussion

Hyperparathyroidism (HPT) is a rare endocrine condition, first described in a 14-year-old boy by Pemberton and Geddie in 1930 [3]. The condition is uncommonly found in the pediatric population with an incidence of only 2-5 in 100,000 and a tendency to increase in frequency with age [4,5]. Younger patients are often more symptomatic compared to their adult counterparts and present with signs of hypercalcemia, skeletal symptoms, or nephrolithiasis [6].

The pathogenesis of HPT is well understood, defined by a state of autonomous secretion of PTH by the parathyroid glands with the lack of feedback inhibition by serum calcium. The high concentrations of PTH increase systemic bone re-

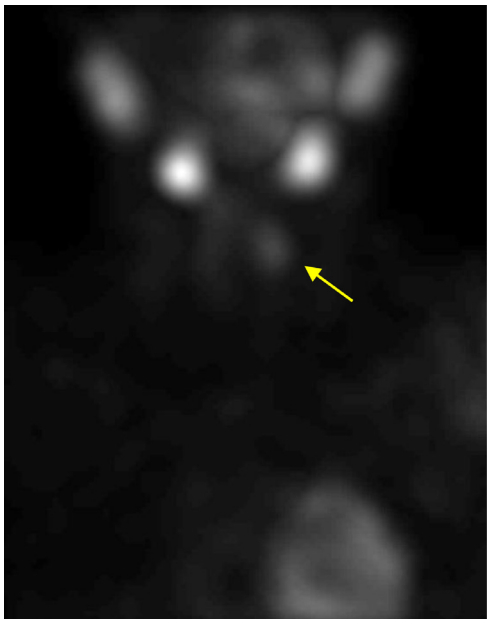

Fig. 6 – Tc99m-sestamibi scintigraphy showed increased tracer uptake at the left superior parathyroid gland (arrow).

sorption driving an elevation in serum hypercalcemia, the hallmark of the condition [7,8]. The most common cause of HPT is a parathyroid adenoma followed by hyperplasia of the four glands with extremely rare cases due to parathyroid carcinoma [8]. HPT due to a single parathyroid adenoma is sporadic in a majority of adult and pediatric cases while 5%-10% can be attributed to multiple endocrine neoplasia syndromes [9].

Serum studies are classically used in the diagnostic evaluation of symptomatic HPT. Elevated parathyroid hormone, alkaline phosphatase, and ionized calcium levels along with decreased vitamin D levels are typical findings associated with the condition [10].

Imaging is also an important part of the diagnostic evaluation of HPT and often provides the first signs of a metabolic syndrome. Symptomatic complaints of bone pain are primarily evaluated using radiographs which may show diffuse osteopenia, pathological fractures, brown tumors, or osteitis fibrosa cystica [4,11,12]. Subperiosteal bone resorption is iconic and most easily recognized in the terminal tufts of the hands, spreading proximally as the disease progresses. More advanced stages of skeletal disease may show scalloping of vertebrae and trabecular resorption within the cancellous or medullary regions of long bones such as the humerus and femur [4]. Rare findings of cervical ligamentum flavum ossification have been reported among adult cases of hyperparathyroidism [12]; but to our knowledge, these findings have not been previously reported in pediatric patients."

Ultrasonography is considered the gold standard in the diagnosis of parathyroid adenoma and is highly sensitive for use as a screening tool. Findings will often describe a vascular hypoechoic homogenous mass, nodules, or a nonhomogeneous lobulated appearance associated with parathyroid carcinoma [3,6]. Renal and adrenal ultrasound may also be performed to assess for renal calculi, hydronephrosis, or adrenal tumors associated with MEN1 [13]. Computed tomography (CT) and magnetic resonance imaging (MRI) may provide further evaluation of the parathyroid glands and their surrounding anatomy [6]. Nuclear medicine technetium (Tc-99m) sestamibi scintigraphy is used for confirmation of the diagnosis of parathyroid adenoma. Postoperative treatment consists of vitamin D analogs such as Calcitriol, calcium and vitamin D supplementation, and routine monitoring of calcium levels [14].

Metabolic bone disease is a serious complication associated with HPT. Clinical consequences such as limited bone growth, bone deformities, and nontraumatic fractures can lead to bone pain and motor deficits in the pediatric population. Promptly recognizing imaging findings associated with metabolic bone disease is fundamental to providing prompt treatment and deterring the sequela of HPT.

Patient consent

Appropriate patient consent has been obtained for this case study.

REFERENCES

[1] Fotakopoulos G, Alexiou GA, Mihos E, Voulgaris S. Ossification of the ligamentum flavum in cervical and thoracic spine. Report of three cases. Acta Neurol Belg 2010;110(2):186–9.

[2] Sampanis N, Gavriilaki E, Paschou E, Kalaitzoglou A, Vasileiou S. Ossification of the cervical ligamentum flavum and osseous brown tumor: late manifestations of primary hyperparathyroidism misdiagnosed in a case of parathyroid carcinoma. Clin Cases Miner Bone Metab 2016;13(1):54–6. doi:10.11138/ccmbm/2016.13.1.054.

[3] Dudney WC, Bodenner D, Stack BC Jr. Parathyroid carcinoma. Otolaryngol Clin North Am 2010;43(2):441–53 xi. doi:10.1016/j.otc.2010.01.011.

[4] Wang Y, Liu J. Severe bone disease caused by primary hyperparathyroidism: a case report and review of the literature. J Int Med Res 2020;48(10):300060520966484. doi:10.1177/0300060520966484.

[5] Bhadada SK, Bhansali A, Dutta P, Behera A, Chanukya GV, Mittal BR. Characteristics of primary hyperparathyroidism in adolescents. J Pediatr Endocrinol Metab 2008;21(12):1147–53. doi:10.1515/jpem.2008.21.12.1147.

[6] Khalatbari H, Cheeney SHE, Manning SC, Parisi MT. Pediatric hyperparathyroidism: review and imaging update. Pediatr Radiol 2021;51(7):1106–20. doi:10.1007/s00247-021-05050-7.

[7] Chang CY, Rosenthal DI, Mitchell DM, Handa A, Kattapuram SV, Huang AJ. Imaging findings of metabolic bone disease. Radiographics 2016;36(6):1871–87. doi:10.1148/rg.2016160004.

[8] Khan A, Bilezikian J. Primary hyperparathyroidism: Pathophysiology and impact on bone. Cmaj 2000;163(2):184–7.

[9] Marini F, Cianferotti L, Giusti F, Brandi ML. Molecular genetics in primary hyperparathyroidism: the role of genetic tests in differential diagnosis, disease prevention strategy, and therapeutic planning. A 2017 update. Clin Cases Miner Bone Metab 2017;14(1):60–70. doi:10.11138/ccmbm/2017.14.1.060.

[10] Cormier C, Koumakis E. Bone and primary hyperparathyroidism. Joint Bone Spine 2022;89(1):105129. doi:10.1016/j.jbspin.2021.105129.
[11] Allo M, Thompson NW, Harness JK, Nishiyama RH. Primary hyperparathyroidism in children, adolescents, and young adults. World J Surg 1982;6(6):771–6. doi:10.1007/bf01655371.
[12] Araújo SM, Bruin VM, Nunes AS, Pereira EN, Mota AC, Ribeiro MZ, et al. Multiple brown tumors causing spinal cord compression in association with secondary hyperparathyroidism. Int Urol Nephrol 2013;45(3):913–16. doi:10.1007/s11255-012-0123-2.
[13] Starker LF, Akerström T, Long WD, Delgado-Verdugo A, Donovan P, Udelsman R, et al. Frequent germ-line mutations of the men1, casr, and hrpt2/cdc73 genes in young patients with clinically non-familial primary hyperparathyroidism. Horm Cancer 2012;3(1–2):44–51. doi:10.1007/s12672-011-0100-8.
[14] Durkin ET, Nichol PF, Lund DP, Chen H, Sippel RS. What is the optimal treatment for children with primary hyperparathyroidism? J Pediatr Surg 2010;45(6):1142–6. doi:10.1016/j.jpedsurg.2010.02.074.