CASE REPORT

Radiological diagnostic features of uremic leontiasis ossea: a case report

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Uremic leontiasis ossea (ULO), which occurs in the craniomaxillofacial region, is a sign of terminal stage osteitis fibrosa cystica or brown tumors and primarily caused by secondary hyperparathyroidism induced by renal failure. Pathophysiological changes include osteoclasts or osteoblasts proliferation, bone resorption, bone decalcification, and connective tissue proliferation. In this paper, we report a case of a 24-year-old female patient, who was diagnosed with ULO and presented with multiple facial swellings. Imaging features included zonal patterns with alternating rings of hypo- and hyperattenuated craniomaxillofacial bones, and diffused mixed sclerotic tissues with lytic changes in CT imaging. T_1 weighted image and T_2 weighted image in MRI were characterized by alternating rings of low and intermediate signal intensity patterns. To the best of our knowledge, this case is the first example of pathologically proved ULO with maxillofacial MRI.

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Introduction

Renal osteodystrophy is a common complication of end stage renal failure. The most severe osseous complication of renal osteodystrophy is termed as uremic leontiasis ossea (ULO). ULO was coined by Kienböck in 1940,¹ and it is characterized by the presence of a massive thick cranial vault and facial bones. Recent studies have shown that ULO is associated with secondary hyperparathyroidism, which may result from the failure of kidneys, liver, or intestine.¹⁻⁵ Hyperparathyroidism results in significant bony changes such as the subperiosteal erosion, chondrocalcinosis, brown tumors, and metastatic calcification of the soft tissues. Typically, such changes occur in the ribs, long bones, spine, and craniomaxillofacial bones.² However, terminal stage brown tumors are confined to the craniomaxillofacial region, which causes thickening of craniofacial bones, bulging of malar bones, flaring of nares, and the separation of teeth. Leontiasis ossea (LO) is characterized by a

“lion-like” mark that appears on the face, also known as the “lion-face.” This may result in facial disfigurement, dysphagia, speech impairment, respiratory distress, and blindness. All these symptoms are attributed to the deformation of maxillofacial bones, caused by abnormal calcium–phosphorus metabolism. The treatment for ULO usually includes: (1) reduction of phosphate levels, (2) treatment for hyperparathyroidism, and (3) surgical contouring of the enlarged facial bones if needed.⁴ Given the widespread use of dialysis, calcimimetics, and phosphate binders, ULO is rare these days.³ Non-uremic etiology of LO is more common, such as the Paget’s disease of bone, fibrous dysplasia, and reactive inflammatory bone disease.² In this respect, it is crucial to differentiate uremic from non-uremic causes of LO with similar clinical appearance. Typically, such conditions are distinguished based on the combined analysis of clinical and laboratory reports.⁴ The presence of renal impairment can indicate the underlying etiology of LO, which expedites the treatment process. For the first time, MRI was used to document the maxillofacial imaging findings for a ULO patient who was

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Figure 1 Chest CT revealed multiple osteolytic lesions in multiple ribs (arrow) and the sternum (arrowhead).

diagnosed with secondary hyperparathyroidism caused by chronic renal failure.

Case report

A 24-year-old Chinese female was referred to our oral and maxillofacial surgery unit due to multiple swellings of her facial bones without hemorrhage for 10 months. There was no family history of renal failure and related bone disease. The patient was diagnosed with chronic renal failure and has been on peritoneal dialysis for 4 years. A detailed intraoral examination revealed maxillary and mandibular swelling, tenderness, wide interdental spacing, and a palpable mass expanding buccolingually. Furthermore, the patient developed oral ulcers with a purplish-red mucosa and lost both right and left mandibular first premolars. No lymph node

Figure 2 Soft tissue VR showed a lion-like facial signature. (b) Bone VR showed deformities of the mouth and nose, enlargement of the mandible, maxilla and calvaria, overbite and overjet. Diffuse mixed sclerotic and lytic changes to all visualized osseous structures is apparent. VR, volume reconstruction.

enlargement was found in the submandibular region. However, a 1.5 cm lymph node was detected at the lower level of the thyroid cartilage. The patient presented with noticeable craniofacial deformities and developed a funnel-shaped chest.

Laboratory investigations revealed an elevated level of the parathyroid hormone (PTH) ($2948.00 \text{ pg ml}^{-1}$; normal range: $12\text{--}88 \text{ pg ml}^{-1}$), and serum alkaline phosphatase (2350.00 U l^{-1} ; normal range: $30\text{--}120 \text{ U l}^{-1}$). Both results are markers of high bone turnover. Additionally, the inorganic phosphate level was also high (2.45 mmol l^{-1} ; normal range: $0.78\text{--}1.65 \text{ mmol l}^{-1}$). However, the calcifediol (25-hydroxyvitamin D), and the serum calcium levels were within the normal range, *i.e.* 8.62 ng ml^{-1} (normal range: $10\text{--}52 \text{ ng ml}^{-1}$), and 2.28 mmol l^{-1} (normal range: $2.08\text{--}2.65 \text{ mmol l}^{-1}$), respectively.

CT scan of her chest showed the presence of pericardial effusion and mild ascites. Moreover, multiple osteolytic lesions were observed in her ribs and sternum (Figure 1). CT bone volume reconstruction (VR) showed deformities of the craniofacial bone, including enlargement of the mandible, maxilla, and calvaria. As illustrated in Figure 2, diffuse mixed sclerosis and lytic changes were found in all the visualized osseous structures. A “salt and pepper” appearance of the skull was also prominent on the axial and coronal CT imaging along with diffuse cortical resorption (Figure 3). In this respect, the “salt” referred to the sclerotic bone tissue, and the “pepper” referred to the cystic changes of the bone. The CT imaging exhibited hyperattenuation (average CT value ≈ 137 Hounsfield unit) and hypoattenuation bands (average CT value ≈ 33 Hounsfield unit) in the swelled-up jaw lesions (alternate bands). These zonal patterns surrounded a central region to form a concentric ring-like image.

MRI exhibited zebra-crossing-like zonal patterns with rings of low and intermediate signal intensity referencing to the diploic bone surrounding a central area, in both T_1 weighted imaging ($T_1\text{WI}$) and the T_2 weighted imaging ($T_2\text{WI}$). $T_1\text{WI}$ showed an intermediate and low signal intensity within the masses on the right side of the mandible, which was consistent with alternating intermediate and low signals in $T_2\text{WI}$ (Figure 4). It is noteworthy that low signal intensity region on $T_1\text{WI}$ also exhibited low signal intensity on $T_2\text{WI}$ and *vice versa*. Comparing MRI with CT image (Figure 4c) implied that the hyperattenuating regions on CT scan corresponded to the low-signal areas on MRI, whereas the hypoattenuating regions on CT corresponded to the intermediate signal intensity areas of MRI. Ultrasound showed diffused lesions within the thyroid gland, especially the presence of a mixed echogenic mass on the left thyroid lobe with calcification (Figure 5a, b). Multiple hypoechoic masses in the bilateral parathyroid regions were noted (Figure 5c). Based on these results, the patient was diagnosed with ULO.

Figure 3 (a) “Salt and pepper” appearance (arrow) of craniofacial bones revealed by CT along with diffused cortical resorption. (a) Axial CT imaging showed maxilla and mandible bone swelling. (b) Coronal CT imaging showed zonal patterns with alternating rings of hypo- and hyperattenuation surrounding a central area (arrowhead).

An excisional biopsy was performed on the right mandible of the patient. Pathological analysis revealed the presence of proliferated fibroblasts with areas of infiltrating multinucleated giant cells, characteristic of the brown tumor (Figure 6). Parathyroidectomy and thyroid adenoma resection followed by histopathological examination confirmed parathyroid adenoma and papillary carcinoma in the left thyroid lobe. Subsequently, PTH levels decreased to 2.55 pg ml^{-1} after resection.

Discussion

The zonal pattern on the CT imaging is due to the osteoclast and osteoblast activity. Active osteoclasts cause the appearance of a hypoattenuation multilocular cyst, which exists either as an isolated mass, or multiple lesions located in the mandible, clavicle, ribs, and pelvis. The cystic components include the fibrous tissue, osteoclasts, necrotic tissue, and blood. On the other hand, excessive deposition of mineralized tissue

Figure 4 Zonal patterns with alternating rings of low and intermediate signal intensity surrounding a central area could be seen in MRI. (a) T_1 WI showed intermediate and low signal intensity masses on the right side of the mandible. (b) T_2 WI also showed alternating intermediate and low signal intensity. The signal in T_1 WI and T_2 WI was consistent (arrow). (c) The hyperattenuation part of CT corresponds to the low signal intensity part of T_1 WI and T_2 WI (arrow), and the hypoattenuation part of CT corresponds to the intermediate signal intensity part of T_1 WI and T_2 WI. T_1 WI, T_1 weighted imaging; T_2 WI, T_2 weighted imaging.

Figure 5 Ultrasound images of the thyroid (a, b, c) and a parathyroid (c). (a) A $6 \times 6 \times 7 \text{ mm}$ mixed echogenic mass (arrow) could be found on the left thyroid lobe, and it proved to be thyroid carcinoma. (b) Multiple strong echo spots (arrow) indicating calcification could be seen in the lesion. (c) A $12 \times 8 \times 14 \text{ mm}$ hypoechoic lesion could be seen on the left parathyroid, and it proved to be parathyroid adenoma.

forms a hyperattenuation band pattern. Compared to healthy bone, the bone mineral density is typically high, which results in osteosclerosis. Necrosis and cystic degeneration alternate with osteosclerosis which results in an alternating image pattern of hyper- and hypoattenuation, usually found in the axial bones. Previous studies have reported X-ray imaging of the vertebral body showing horizontal stripes that resembled rugby shirt's shade-to-shade pattern, known as “rugger jersey” spine.⁶ In our study, the presence of brown tumors in CT was characterized by alternating hyper- and hypoattenuation, similar to “rugger jersey” features. Lee et al presumed that such nodular patterns represented

Figure 6 Histopathologically, the lesion in jaw is identical to the central giant cell granuloma infiltrating with multinucleated osteoclast-type giant cells. In some areas, the lesion also shows proliferative woven bone (arrow) with a fibroblastic background (HE $\times 10$).

concentric layers of reparative cells, pre-existing trabeculae, and blood derivatives which surrounded an involuted sclerotic brown tumor; and, the observed central regions corresponded to the areas of nodular sclerosis on the CT scans.² In our study, the MRI findings also supported the assumptions mentioned above.

Besides secondary hyperparathyroidism, the patient also had thyroid cancer. Study has shown that differentiated thyroid cancer is more common in patients with hyperparathyroidism than the general population.⁷ While, other studies claimed that the association between thyroid carcinoma and hyperparathyroidism is coincidental.⁸ This is because, during parathyroidectomy, some thyroid tissue may also be removed and pathologically examined, increasing the detection rate of thyroid carcinoma for hyperparathyroidism patients.

Our patient was discharged after total thyroidectomy and parathyroidectomy and was medically managed with thyroxine supplements, olmesartan ester, nifedipine sustained-release tablets, arotinolol hydrochloride, and calcitriol to maintain thyroid function and blood electrolyte balance. The progress of craniofacial deformities was controlled, and the patient was stabilized within 3 months follow-up period.

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