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Clinical Image

The Assembled Ossein-Osteoid Osteoma

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Preface

Osteoid osteoma is a miniature, benign, bone -forming tumefaction which manifests a nidus of vascular osteoid circumscribed by sclerotic bone and constitutes an estimated 10% of benign bone tumours. Osteoid osteoma was initially scripted by Jaffe in 1935 [1].

Osteoid osteoma demonstrates cogent clinical symptoms such as pain or limited tumour evolution and frequently implicates long bones such as femur or tibia whereas lesions within the foot or ankle are infrequent. Elongation of incriminated limb occurs with consequent limb length discrepancy in osteoid osteoma implicating the epiphyseal region.

The neoplasm classically engenders severe pain at night which is relieved by nonsteroidal anti-inflammatory drugs (NSAIDs). Occasionally, osteoid osteoma resolves spontaneously in the absence of therapy. The neoplasm lacks a potential for malignant metamorphosis or localized infiltration into adjacent soft tissue. The benign osteoid osteoma is accompanied by a favourable prognostic outcome.

Disease characteristics

An estimated 50% of neoplasms are discerned within long bones such as femur and tibia although virtually any bone can be incriminated. Around 2% to 10% of osteoid osteomas incriminate the foot wherein talus is commonly affected [2,3].

Majority of osteoid osteomas occurring within the foot are commonly of cancellous or sub-periosteal subtypes and exemplify a minimal periosteal reaction. Magnitude of vascularized nidus segregates osteoid osteoma from an osteoblastoma. Osteoid osteoma generally displays a tumour magnitude of below < 2 centimetres and a nidus of beneath < 1.5 centimetres. Tumefaction is categorized into cortical, cancellous and sub-periosteal subtypes [2,3].

As osteoid osteoma comprises of around 10% of benign bone tumours, the neoplasm is characteristically discerned in children, adolescents and young adults between 5 years to 25 years. A male preponderance is observed with a male to female proportion of 3:1 [2,3].

Osteoid osteoma may arise as intra-cortical, subcortical or medullary tumefaction or may appear upon the bone surface. Tumours arising within long bones such as femur or tibia are frequently intra-cortical. Vertebral tumours are usually confined to the neural arch [2,3].

Disease pathogenesis

Of uncertain aetiology, osteoid osteoma is posited to be a benign neoplasm. Alternatively, it is hypothesized to arise on account of trauma or an inflammatory process.

The neoplasm may be configured as a component of a neoplastic process or occur as a consequence of preceding trauma to the specified area. History of prior trauma is documented in an estimated one-third instances [3,4].

Nerve fibres are identifiable within the tumour nidus which may be highlighted by pertinent immunohistochemistry. Also, nerve fibres appear to accumulate within zones of tumour sclerosis en-

compassing vascularized tumour nidus. Nerve fibres are activated by enhanced vascular outflow to specified tumour area on account released prostaglandins wherein prostaglandin levels are elevated by a 100 times to 1000 times, in contrast to prostaglandin levels within normal bone, thereby engendering localized pain within the tumour area. Intense pain exemplified in osteoid osteoma is engendered due to production of prostaglandin E2 and nerve fibres entrapped within the reactive bone [3,4].

Clinical elucidation

Implicated subjects frequently demonstrate intermittent, intense, localized pain which exacerbates during night-time. Pain arising due to osteoid osteoma can be relieved by aspirin or non-steroidal anti-inflammatory drugs (NSAIDs). Bone and soft tissue swelling is common and is secondary to enhanced vascularity of the neoplasm engendered due to exodus of prostaglandins within tumour nidus. Juxta- articular neoplasms are associated with arthritis or joint dysfunction whereas vertebral tumours are accompanied by scoliosis.

Additional symptoms such as bone deformity, muscle atrophy and disturbances of gait may appear [3,4].

Synovitis, joint effusion, arthritic alterations and muscle contractures may arise in intra-articular neoplasms or tumour situated adjacent to a joint. Osteoid osteoma arising within the femur and tibia may engender a discrepancy of limb length, possibly on account of augmented vascular contribution to neoplasms arising adjacent to an open growth plate [3,4].

Histological elucidation

On gross examination, a miniature, circumscribed vascular nidus is encompassed with foci of bony sclerosis. The neoplasm may be obtained as reddish, gritty specimen of bone and soft tissue [4,5].

Microscopically, centric nidus of the tumefaction is composed of extensively vascularized bone intermingled with osteoid. Bony remodelling occurs due to significant osteoblastic activity. Peripheral nidus demonstrates a distinctive area of translucency emerging on account of bone resorption secondary to osteoclastic activity. New bone formation circumscribes the nidus and is distinguished as foci of sclerotic bone [5,6].

The miniature, circumscribed neoplasm is composed of irregular, anastomosing trabeculae or solid tumour foci with a vascularized nidus and peripheral bony sclerosis. Foci of woven bone with variable mineralization are fringed by a singular layer of osteoblasts admixed with several osteoclasts. Cellular component is encompassed within a loose, fibro-vascular stroma and a perimeter of dense, sclerotic bone. Juxta-articular neoplasms may be accompanied by synovitis along with an extensive infiltration of lymphoid and plasma cells [5,6].

Osteoid osteoma demonstrates structural alterations of 22q13.1 genomic region [5,6].

Figure 1: Osteoid osteoma depicting a vascular nidus surrounded by sclerotic, woven bone and a mild lymphoid and plasma cell infiltrate [12].

Figure 2: Osteoid osteoma delineating a vascularized nidus circumscribed by a haemorrhagic stroma admixed with foci of reactive bone [13].

Figure 3: Osteoid osteoma exhibiting a vascularized stroma intermixed with foci of reactive, sclerotic bone and lymphoid cell exudate [14].

Figure 4: Osteoid osteoma enunciating a vascular stroma with haemorrhagic nidus, plasma cell and lymphocytic infiltrate and peripheral sclerotic bone [15].

Figure 5: Osteoid osteoma displaying a matrix of woven bone, osteoclasts and peripheral rimming by osteoblasts [16].

Figure 6: Osteoid osteoma demonstrating osteoclasts, fragments of woven bone rimmed by osteoblasts and a circumscribing vascularised stroma [17].

Figure 7: Osteoid osteoma exemplifying a vascular nidus intermixed with fragments of woven bone with peripheral osteoblasts and a mild lymphocytic, plasma cell infiltrate [18].

Figure 8: Osteoid osteoma depicting a vascular, centric tumour nidus admixed with foci of reactive bone with peripheral sclerosis [19].

Differential diagnosis

Osteoid osteoma requires a segregation from neoplasms such as Osteoblastoma is a neoplasm which demonstrates anastomosing trabeculae of osteoid and woven bone layered by singular layer of benign, activated osteoblasts. Several osteoclasts are disseminated within a loose, fibro-vascular stroma which is intermixed within the bony trabeculae. However, tumour cell permeation of bony trabeculae is absent. Mitotic activity is minimal. Few fragments of woven bone may depict a centric nidus [6,7]. Osteosarcoma is a tumefaction depicting cellular permeation with replacement of medullary spaces, erosion of native bone trabeculae, cortical destruction and infiltration of adjacent soft tissue. Neoplastic cells are pleomorphic, hyperchromatic and depict multiple morphologies as epithelioid, plasmacytoid, spindle-shaped, miniature spherical, clear cell and multinucleated tumour giant cells. Foci of neoplastic osteoid are deposited upon bony trabeculae. Non neoplastic giant cells may be scattered within the tumour parenchyma [6,7]. Chondroblastoma is a neoplasm composed of polyhedral chondroblasts imbued with abundant eosinophilic cytoplasm, variable pigmentation, definitive cellular outline and hyper-lobulated, grooved nuclei. Foci of chondroid differentiation are observed. Tumefaction may be significantly cellular with intracytoplasmic glycogen, mitotic activity, focal necrosis and osteoclast-type multinucleated giant cells. Up to 50% neoplasms depict secondary aneurysmal bone cyst-like areas [7,8]. Reactive bone is engendered by endochondral or intramembranous ossification. Endochondral ossification of epiphyseal plate generates longitudinal growth of long bones whereas periosteal deposition contributes to length and thickness of long bones. Besides, endosteal bone deposition ensures growth of trabecular bone and endosteal cortex. Immature bone demonstrates a random distribution of collagen fibres which are generated during bone growth, healing, repair, infections and certain neoplasms [7,8].

Additionally, osteoid osteoma requires a segregation from conditions such as bone infarction, Brodie's abscess, stress fracture, chronic osteomyelitis, focal cortical bone abscess, glomus tumour, sclerosing osteitis, solitary enostosis and preliminary stage of Ewing's sarcoma [7,8].

Investigative assay

Plain radiography is the initial, preferred investigative modality for assessing bone tumours. On plain radiograph, an osteoid osteoma classically delineates a miniature, spherical, radiolucent nidus encompassed by bony sclerosis. Tumour nidus may depict foci of calcification [9,10].

Vascularized tumour can be radiolucent, ossified or enveloped within a radiolucent halo and is usually below < 1 centimetre magnitude. Nidus is generally circumscribed by dense foci of reactive osteo-sclerosis.

Three-phase skeletal scintigraphy is employed where conventional radiographs appear inconclusive. A "double density sign" upon three-phase bone scintigraphy is characteristic of osteoid osteoma and can emerge as foci of intense centric uptake encompassed by zones of minimally intense peripheral uptake of radioactive substance [9,10].

Thin-slice computerized tomographic (CT) imaging is the preferred and recommended imaging modality. CT scans are efficacious for appropriate discernment of anatomic location of vascular tumour nidus which typically appears as a target-shaped nidus [9,10].

Magnetic resonance imaging (MRI) exhibits oedema of the bone marrow which can eclipse typical features engendered by the tumefaction. Thus, CT is contemplated as a superior imaging modality for discerning osteoid osteoma, in contrast to MRI. However, MRI is a precise diagnostic methodology for determination of cancellous lesions [9,10].

Therapeutic options

Osteoid osteoma can be managed conservatively. Adoption of non steroidal anti-inflammatory drugs (NSAIDs) is optimal for treating pain associated with osteoid osteoma. Adequate resolution of clinical symptoms may occur within three years following commencement of conservative therapy. However, reappearance of cogent clinical symptoms may ensue following cessation of NSAIDs employed upon appearance of pertinent side effects. Tumour reoccurrence may ensue [10,11].

Surgical extermination of the neoplasm is a preferential modality for treating osteoid osteoma. An open, en bloc, curative surgical eradication was previously employed with resection of vascular nidus. Notwithstanding, an en bloc bony resection within a weight-bearing area is associated with excessive and extensive resection of normal, circumscribing bone which engenders weakened bone,

extended immobilization with restriction of physical activity, possible emergence of a pathological fracture and requirement of bone grafting with internal fixation [10,11].

Minimally invasive surgical options are optimally adopted in order to decimate deterioration of circumscribing normal bone [10,11].

Computerized tomography (CT) guided percutaneous radiofrequency ablation is a contemporary, recommended treatment modality with a favourable outcome in around 90% instances. CT guided radiofrequency electrode is inserted within the nidus with consequent thermal ablation. Radiofrequency ablation adopted to treat osteoid osteoma may engender complications such as cellulitis, thrombophlebitis, nerve damage, cutaneous burns and reflex sympathetic dystrophy. Radiofrequency ablation is recommende for lesions exceeding > 1.5 centimetres distant from a neurovascular bundle and > 1.0 centimetre from adjacent cutaneous surface in order to decimate possible damage to abutting cutaneous surface or neurovascular bundles [10,11].

Postoperative course of benign bone tumours has altered signi icantly with the adoption of contemporary treatment methodolc gies and optional surgical resection. Percutaneous techniques such as radiofrequency ablation induce minimal damage to circumscrib ing normal bone and soft tissue with concurrent weight bearin and normalization of daily routine.

Comprehensive surgical eradication of the neoplasm is curativ in instances where conservative management is ineffective. Loca ized tumour reoccurrence is exceptional although inadequately resected neoplasms may reappear [10,11].

Conclusion

Osteoid osteoma is a miniature, benign, bone -forming tumefac tion manifesting a nidus of vascular osteoid circumscribed by scle rotic bone. Osteoid osteoma may arise as intra-cortical, subcortical or medullary tumefaction or may appear upon the bone surface. C uncertain aetiology, osteoid osteoma is posited to arise on accour of trauma or an inflammatory process. The neoplasm is associated with intermittent, intense, localized pain which exacerbates durin night-time and is relieved by aspirin or nonsteroidal anti-inflam matory drugs (NSAIDs). The miniature, circumscribed neoplasm is composed of irregular, anastomosing bone trabeculae or solid tumour foci encompassing a vascularized, centric nidus and peripheral bony sclerosis.

Osteoid osteoma requires a segregation from neoplasms such as osteoblastoma, osteosarcoma, chondroblastoma, reactive bone, bone infarction, Brodie's abscess, stress fracture, chronic osteomyelitis, focal cortical bone abscess, glomus tumour, sclerosing osteitis, solitary enostosis and preliminary stage of Ewing's sarcoma. On plain radiograph, osteoid osteoma classically delineates a miniature, spherical, radiolucent, occasionally calcifies nidus encompassed by bony sclerosis. Surgical extermination of the neoplasm is a preferential modality for treating osteoid osteoma.

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12. Image 1 Courtesy: Spine Journals.

13. Image 2 Courtesy: Libre Pathology.

14. Image 3 Courtesy: Orthobullets.com.

15. Image 4 Courtesy: Pathology Outlines.

16. Image 5 Courtesy: Science Direct.

17. Image 6 Courtesy: Orthopaedics one article.

18. Image 7 Courtesy: Wikipedia.

19. Image 8 Courtesy: Europe pmc.com.