Adamantinoma; An update

Ashish Gulia[1], Pankaj Kumar Panda[1]

Abstract

Adamantinoma is a rare, malignant biphasic tumor with varied morphological patterns.Adamantinoma mostly occurs in the second to fifth decade and is slightly more common in men than women.The onset is insidious, and its course shows a slow, progressive character.Radiography is the initial and most reliable imaging modality for adamantinoma of bones because of the tumor's classic location and appearance on a plain radiograph.Present management modalitieswhich includeen blocresection (mostly intercalary resection) with limb salvage and limb reconstruction. Chemotherapy and radiotherapy have no established role. Amputation does not improve survival but may be advisable in cases with local recurrence and in cases with few large, recurrent lesions where en bloc resection is not possible.

Keywords: Adamantinoma, malignant biphasic tumor, management.

Adamantinoma

Adamantinoma is a rare, malignant biphasic tumor with varied morphological patterns. It is of unknown histogenesis and accounts for approximately 0.5-1% of all primary bone tumors [1, 2]. This lesion was first described by Maier in 1900, and laterFischer [3] in 1913suggested congenital implantation of epithelial cells to be its origin and named the lesion "adamantinoma of tibia" because of its characteristic resemblance to ameloblastoma, a lesion most commonly seen in jaws. However, recent opinion seems to suggest that adamantinoma is a tumor of epithelial origin, based on ultrastructural and immunohistochemical studies [4].

Adamantinoma and osteofibrous dysplasia

Adamantinoma and osteofibrous dysplasia It has been postulated that osteofibrous dysplasia is a potential precursor of adamantinoma. Similarities in the anatomic location, age distribution, and radiological features of osteofibrousdysplasia also add some deal of evidence to this theory which also suggests the evolution of an underlying adamantinoma [5]. The presence of an identifiable epithelial component in osteofibrous dysplasia lesions helps differentiate it from adamantinoma. The existence of a spectrum with adamantinoma at one end and fibro-osseous lesions like osteofibrous dysplasia at the other end has been supported by Czerniaket al. [5]

Etiopathogenesis

Fischer's congenital implantation of epithelial cells hypothesized the origin to be a cell rest originating during the intrauterine period rather than post-traumatic implantation [5].Post-traumatic implantation theory supported by whilst Ryrie, Dockerty and Meyerding postulated that because of the tibia's superficial location and sharp anterior edge, injury leads to subperiosteal epithelial cell implants with hematoma and subsequent ossification, and it is the irregular repair of this injury which leads to neoplasm formation.Synovial origin theory was supported by Lederer, Sinclair, and Naji. The most widely adopted theory is basal epithelium displacement during embryological development and is supported by the predominantinvolvement of anterior tibia, where enchondrally formed bone is closest to the skin surface. Based on ultrastructural and immunohistochemical studies, the tumor cells show strong positive staining with pancytokeratin antibody immunohistochemically. This suggests the epithelial origin of adamantinoma [6, 7].

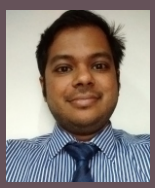
Epidemiology and Clinical Features

Epidemiology and Clinical Features Adamantinoma mostly occurs in the second to fifth decade. It is slightly more common in men than women.The tumor has a predilection for the long bonesand, specifically, the tibia. The initial symptoms of adamantinoma are often non-specific and depend on location and extent of the disease. The onset is insidious, and its course shows a slow, progressive character. Around 60% of 200 cases reviewed by Moon and Mori had a history of trauma[8].

[1]Surgical Oncology (Orthopedic Oncology), 93, Ground Floor, Main Building, Bone & Soft tissue Services (Disease Management Group), Tata Memorial Hospital, Mumbai - 400012, India.

Address of Correspondence
Dr. Ashish Gulia,
Surgical Oncology (Orthopedic Oncology), 93, Ground Floor, Main Building, Bone & Soft tissue Services (Disease Management Group), Tata Memorial Hospital, Mumbai - 400012, India.
Email: aashishgulia@gmail.com

Dr. Ashish Gulia



Dr. Pankaj Panda

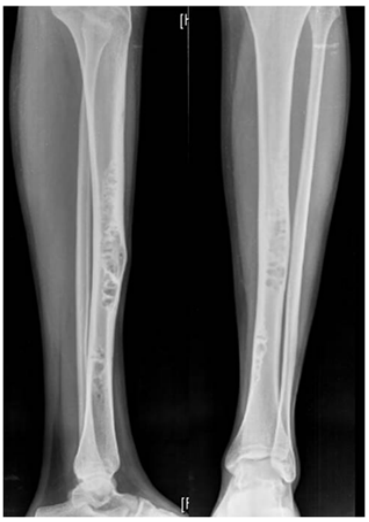


Figure 1: Radiograph (AP and lateral view) of the right leg showing multifocal expensile lytic lesions involving diaphysis and distal metaphysic of tibia. Anterior cortex is expanded and thinned out. Lesion also shows endosteal sclerosis without any obvious periosteal reaction.

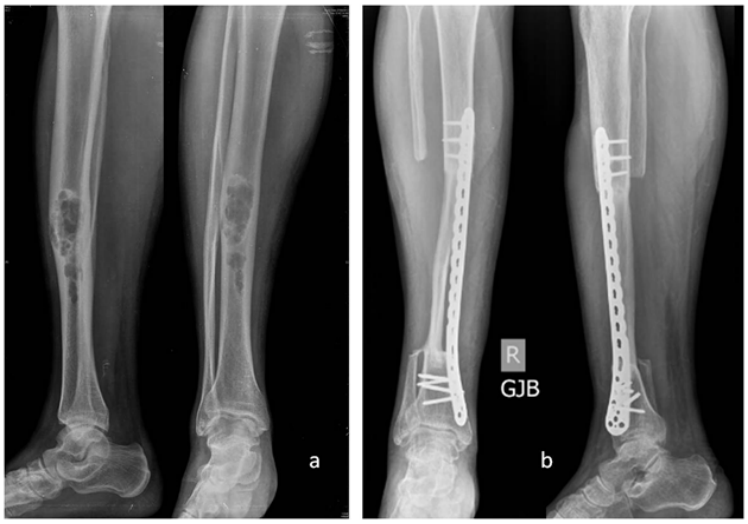


Figure 2: (a)Radiograph (AP and lateral view) showing a well defined lytic lesion with narrow zone of transition endosteal scalloping and mild bowing of tibia.
(b)Post operative radiograph showing intercalary resection and reconstruction with ipsilateral pedicle fibula.

Most of the patients present with swelling with or without pain. The patient may present with bowing deformity of the tibia due to the involvement of anterior tibial surface.

Radiological Features

Radiography is the initial and most reliable imaging modality for adamantinoma of bones because of the tumor's classic location and appearance on a plain radiograph, a typical adamantinoma of the tibia will present as an eccentrically or centrally placed multilocular because of the sclerotic margins of overlapping radiolucencies, expansile, well-defined osteolytic lesion (Figure1) with marginal sclerosis, and variable degree of intralesional septation and opacities.The characteristic "soap bubble" appearance is produced by the multifocal radiolucencies surrounded by ring-shaped densities [9]. Even though adamantinoma is commonly found in thediaphyseal region of the long bones, metaphyseal involvement in the form of extensions from the diaphysis or isolated lesions is not uncommon. The lesion is usually intracortical, but the destruction of the cortex and subsequent involvement of the extracortical soft tissues is seen in few cases [4].

Role of computed tomography (CT)imaging

CT imaging findings in adamantinoma lesions are non-specific. Cortical involvement and the occasional soft tissue involvement are some of the findings on CT imaging. It also helps in detection of pulmonary metastasis and during routine workup [4]. Magnetic resonance imaging (MRI) is useful in determining soft tissue and intramedullary extension of the lesion and picturizing distant cortical foci, thus helping in thelocoregional staging of the tumor. Two distinctive morphological patterns have been described by Van der Woude based on MRI findings, namely, single lobulated and multiple small nodules (Figure 2)[10]. Nuclear medicine is a nascent diagnostic modality for adamantinomas. Few characteristic findings suggestive of adamantinoma are increased blood pooling at the site, increased

Table 1: Adamantinoma- Summary

	Osteofibrous dysplasia	Adamantinoma
Clinical behavior	Benign	Locoregionally aggressive
Age of occurrence	Below 20 years	3-86 years
Site	Long bones(tibia and fibula)	
Clinical presentation	Pain, pathologic fracture, tibial bowing	With or without pain, occasionally pathologic fracture
Pre-disposing factors	Absence of trauma	History of trauma is present
Radiology	· Well-defined intracortical lytic lesion, with variable degree of osteolysis, and osteosclerosis · "Sawtoothappearance" · Anterior tibial bowing · Pathological fractures	· Eccentrically or centrally placed, multilocular lesions · Expansile, well-defined osteolytic lesion · "Soap bubble" appearance Destruction of cortex and involvement of extracortical soft tissue is not uncommon
Histopathology	Loose fibrous background containing spicules of woven bony trabeculae lined by a layer of prominent osteoblasts	Presence of epithelial cells forming small nests/strandsrecognized in H and E
Metastatic potential	No	Yes, usually lung and local lymph nodes
Treatment	· Spontaneous regression at puberty · Careful observation and plain radiography · Optimizing function · Treating pain In cases with pathologic fractures or deformities · Extraperiosteal "shark-bite" excision Curettage,bone grafting, and internal fixation after deformity correction	· En bloc resection (mostly intercalary resection) with limb salvage and limb reconstruction

accumulation of technetium-99m methylene diphosphate. Bone scan imaging is helpful in detecting simultaneous fibular involvement [11].

Pathology

Histologically, epithelial, and osteofibrous components are the two major components of adamantinoma with various other intermingling phases. Ithas classified into two distinct classic and differentiated types. Classic adamantinoma usually occurs after the second decade of life with an aggressive clinical course. Soft tissue or intramedullary involvement is usually seen in this type.Differentiated adamantinoma (osteofibrousdysplasia like adamantinoma) occurs usually in individuals younger than 20 years of age. It has a relatively benign clinical course.

Gross appearance

It presents as a well-defined, yellow-gray or grayish-white and fleshy or firm in consistency, lobulated,and firm to hardcortical lesion with peripheral sclerosis. Differentiated adamantinomas are more solid due to large osteogenic areas.Macrocysticspaces filled with straw-colored or blood-like fluid are occasionally found on gross examination.

Microscopic appearance

The timorous cells of the adamantinoma vary in size. Nuclear atypia and mitotic figures are not commonly seen [12]. Several patterns of growth,namely,basaloid, tubular, spindle cell, squamous, and osteofibrous dysplasia type have been described. Nests of basaloid cells are characteristic of classic adamantinoma. Spindle cells, foci of calcification have also been reported in adamantinomas [13].

Immunohistochemistry

The epithelial component in all histologic subtypes of adamantinoma shows co-expression of basal cell keratins (14 and 19) and vimentin-64. The immunoreactivebehavior of the keratins is independent of the histologic subtypes thereby suggesting a common histogenesis for all them[14-16]

Cytogenetics

The presence of extra copies of one or more of chromosomes 7, 8, 12, and 19 hasbeen reported in both classic and differentiated adamantinomas. The support for an osteofibrousdysplasia and adamantinoma relationship is supported by the presence of extra copies of chromosomes 7,8,and 12 except 19 in cases of osteofibrous dysplasia [17].

Differential Diagnosis

Some of the lesions such asaneurysmal bone cyst, unicameral bone cyst, eosinophilic granuloma, osteomyelitis, chondrosarcoma, epithelial metastasis, osteofibrous dysplasia, fibrous dysplasia, non-ossifying fibroma, chondromyxoid fibroma, and hemangioendotheliomashow similar clinicopathological and radiological features and can be considered as differential diagnosis.

Clinical Behavior

Usually known to be slow-growing, adamantinomas are locally aggressive with metastatic potential. More often recurrence is due to incomplete resection, and the recurrent lesion has profound similarities to sarcomas. Local recurrence rates range from 18% to 32% [18]. 18-30% of the cases metastasize, lung being the most common site followed by regional lymph nodes and nearby bones [18-20].

Treatment

Present management modalitieswhich includeen blocresection (mostly intercalary resection) with limb salvage and limb reconstruction (Figure3) have shown to have lower local recurrence rates and improved overall survival rates. Vascularized fibular grafts are usually the preferred choice for reconstruction even though distraction osteogenesis, allografts, and metallic replacements are also being used [18, 19]. Chemotherapy and radiotherapy have no established role. Amputation does not improve survival but may be advisable in cases with local recurrence and in cases with few large, recurrent lesions where en bloc resection is not possible.

References

1. Dahlin DC. Bone Tumors: General Aspects and Data on 6221 Cases. 3rded. Springfield, IL: Charles C Thomas; 1978. p. 296.

2. Kahn LB. Adamantinoma, osteofibrous dysplasia and differentiated adamantinoma. Skeletal Radiol 2003;32(5):245-258.

3. Fisher B. Primary adamantinoma of the tibia. Z Pathol 1913;12:422-441.

4. Van Rijn R, Bras J, Schaap G, van den Berg H, Maas M. Adamantinoma in childhood: Report of six cases and review of the literature. PediatrRadiol 2006;36(10):1068-1074.

5. Czerniak B, Rojas-Corona RR, Dorfman HD. Morphologic diversity of long bone adamantinoma. The concept of differentiated (regressing) adamantinoma and its relationship to osteofibrous dysplasia. Cancer 1989;64(11):2319-2334.

6. Mirra JM. Adamantinoma and fibrous dysplasia. InBone tumors 1sted. Mirra JM, editor. Philadelphia,PA: Lea &Febiger; 1989. p. 1203-1231.

7. Springfield DS, Rosenberg AE, Mankin HJ, Mindell ER. Relationship between osteofibrous dysplasia and adamantinoma. ClinOrthopRelat Res 1994;309:234-244.

8. Moon NF, Mori H. Adamantinoma of the appendicular skeleton-updated. ClinOrthopRelat Res 1986;204:215-237.

9. Lederer H, Sinclair AJ. Malignant synovioma simulating "adamantinoma of the tibia". J PatholBacteriol 1954;67(1):163-168.

10. Van der Woude HJ, Hazelbag HM, Bloem JL, Taminiau AH, Hogendoorn PC. MRI of adamantinoma of long bones in correlation with histopathology. AJR Am J Roentgenol 2004;183(6):1737-1744.

11. Unni KK. Dahlin's Bone Tumors: General Aspects and Data on 11,087 Cases. 5thed. Philadelphia, Pa: Lippincott-Raven; 1996. p. 333-342.

12. Hazelbag HM, Taminiau AHM, Fleuren GJ, Hogendoorn PC. Adamantinoma of the long bones. A clinicopathological study of thirty-two patients with emphasis on histologic subtype, precursor lesion, and biological behavior. J Bone Joint Surg Am 1994;76:1482-1499.

13. Weiss SW, Dorfman HD. Adamantinoma of long bone. An analysis of nine new cases with emphasis on metastasizing lesions and fibrous dysplasia-like changes. Hum Pathol 1977;8(2):141-153.

14. Bridge JA, Dembinski A, DeBoer J, Travis J, Neff JR. Clonal chromosomal abnormalities in osteofibrous dysplasia. Implications for histopathogenesis and its relationship with adamantinoma. Cancer 1994;73(6):1746-1752.

15. Ueda Y, Blasius S, Edel G, Wuisman P, Böcker W, Roessner A. Osteofibrous dysplasia of long bones-A reactive process to adamantinomatous tissue. J Cancer Res ClinOncol 1992;118(2):152-156.

16. Hazelbag HM, Fleuren GJ, vdBroek LJ, Taminiau AH, Hogendoorn PC. Adamantinoma of the long bones: Keratin subclass

immunoreactivity pattern with reference to its histogenesis. Am J SurgPathol 1993;17(12):1225-1233.

17. Kanamori M, Antonescu CR, Scott M, Bridge RS Jr, Neff JR, Spanier SS, et al. Extra copies of chromosomes 7, 8, 12, 19, and 21 are recurrent in adamantinoma. J MolDiagn 2001;3(1):16-21.

18. Keeney GL, Unni KK, Beabout JW, Pritchard DJ. Adamantinoma of long bones. A clinicopathologic study of 85 cases. Cancer 1989;64(3):730-7.

19. Qureshi AA, Shott S, Mallin BA, Gitelis S. Current trends in the management of adamantinoma of long bones. An international study. J Bone Joint Surg Am 2000;82-A(8):1122-1131.

20. Bovée JV, van den Broek LJ, de Boer WI, Hogendoorn PC. Expression of growth factors and their receptors in adamantinoma of long bones and the implication for its histogenesis. J Pathol 1998;184(1):24-30.

Conflict of Interest: NIL
Source of Support: NIL

How to Cite this Article

Gulia A, Panda P. Adamantinoma – an update. Journal of Bone and Soft Tissue Tumors Sep-Dec 2017;3(2): 16-19.