Bone: Enchondroma

Twinkal C Pansuriya, Judith VMG Bovée
Dept of Pathology, Leiden University Medical Center, P.O. Box 9600, 2300 RC Leiden, The Netherlands (TCP, JVMGB)

Published in Atlas Database: July 2008
Online updated version: http://AtlasGeneticsOncology.org/Tumors/EnchondromaID5333.html
DOI: 10.4267/2042/44526

This work is licensed under a Creative Commons Attribution-Noncommercial-No Derivative Works 2.0 France Licence.
© 2009 Atlas of Genetics and Cytogenetics in Oncology and Haematology

Identity

Alias
Solitary enchondroma; Central chondroma

Note
Enchondroma is a common benign hyaline cartilaginous neoplasm that develops within the medullary cavity of bone. As the name suggests, it is located within the bone, either centrally (80% of cases) or eccentric (20% of cases). Most affected bones in order of frequency are phalanx of the hand, femur, metacarpal, humerus, tibia and rib. Enchondromas are mostly found in the diaphyseal or meta-diaphyseal region of the long bones while it is rarely observed in epiphyseal location. Thirty-five percent of enchondromas develop in the hand whereas its malignant counterpart is extremely rare at this location. In general, malignant transformation of enchondroma is extremely rare (overall risk <1% of cases). In rare instances, multiple enchondromas are found to occur in a syndrome (enchondromatosis). At gross specimen the enchondroma tissue looks white-grey and opalescent while yellow or red foci represent areas of calcification or ossification.

Clinics and pathology

Phenotype / cell stem origin
The origin of enchondroma is controversial. Previously, it was considered a dysplasia as deformities may be present due to huge masses of unresorbed cartilage. Virchow et al. speculated that tissue derived from the epiphyseal plate could be responsible for the formation of enchondroma as they found accumulation of uncalcified cartilaginous tissue in metaphyses. This theory was further supported by Milgram who postulated enchondroma to originate from prolonged columns of epiphyseal cartilage. They also proposed anomalous cartilaginous growth plate sequencing leads to formation of cartilage cell rests, which later on would appear as lesions in patients having enchondromatosis. Weinmann and Sicher initially reported that enchondromas form from the undifferentiated connective tissue as new islands of cartilage. Later on, Aigner proposed the origin of chondrogenic neoplasms presumably to be multipotent mesenchymal precursor cells instead of (remnant) cartilage cells. He showed occurrence of neoplastic cells which show a chondrocytic cell shape and the similar gene expression profile like mature fetal chondrocytes responsible for the formation of characteristic hyaline cartilage like extracellular tumor matrix.

Epidemiology
Enchondroma accounts for 10-25% of all benign tumours. Both sexes are equally affected and it shows a wide age range from 5-80 years.

Clinics
The differential diagnosis between enchondroma and low grade chondrosarcoma is difficult and therefore, it is based on a combination of clinical, radiological and histological parameters. Usually, enchondromas of the long bones are asymptomatic and detected incidentally after a fracture or bone scans for other reasons. In case of long bones, calcified enchondromas are found. In contrast, enchondromas of the small bones of the hands and feet lack the calcification and may give palpable swellings, with or without pain. Enchondromas can be easily observed in radiographs since normal
Bone: Enchondroma

A) Radiograph of left femur demonstrates intramedullary lesion in the diaphysis of the bone with irregular calcification.
B) MR image shows high signal intensity on T2 weighted images. The bone cortex is intact.

C) Cartilaginous tumour with very low cellularity and abundance of chondroid matrix. Atypical cells and mitoses are absent.

Bone is replaced by mineralized or unmineralized hyaline cartilage. Radiographically, enchondromas are lytic lesions mostly in the center of the bone, can be mildly expansile with well defined, minimally thickened bony margins, along with intralesional calcification and diaphyseal expansion and minimal
scalloping and may lead to cortical thinning. There is evidence of cartilaginous matrix (rings and arcs or popcorn-like calcifications).

**Pathology**

Microscopically, enchondromas are hypocellular, non-vascular tumours with abundant hyaline cartilage matrix. The nuclei are small and round with condensed chromatin. Occasionally, binucleated cells without cytologic atypia are found. There is no mitotic activity. Myxoid matrix and endosteal erosion can be present in few tumors. There is often encasement (deposition of bone at the edges of the lobuli), while entrapment of preexisting host bone is absent and should be regarded a sign of malignancy.

More worrisome histological criteria such as increased cellularity, myxoid change, cytological atypia and nuclear hyperchromasia are tolerated in case of 1) location in the small bones of the hands and feet, 2) in the context of enchondromatosis, 3) in young patients in which the growth plates are still open.

**Treatment**

A wait-and-see policy is justified for asymptomatic lesions considered benign at radiography. Tumor growth can be determined clinically and by means of periodic radiographic examination. Biopsy can be done when asymptomatic lesions become large and symptomatic. Large or symptomatic tumours or borderline cases in which the distinction with low grade chondrosarcoma can not be made histologically nor radiographically can be treated surgically with margin improvement by means of phenol or cryosurgery. Recurrence of enchondroma is highly uncommon after curettage.

**Evolution**

Malignant transformation of solitary enchondroma is extremely rare (<1%). In the context of enchondromatosis (Ollier disease, Maffucci syndrome) the risk of malignant transformation is increased up to 35%. While enchondromas are most common at the phalangeal bones, chondrosarcoma of the phalanx is extremely rare. Local recurrence is uncommon. It rarely recurs as a low grade chondrosarcoma.

**Prognosis**

Enchondroma is a benign lesion. Recurrence is highly uncommon after curettage. Progression towards malignancy is rare (<1%), unless in the context of enchondromatosis (up to 35%). Extensive endosteal erosion and large size can be suspicious for malignancy. Only those tumors that cause symptoms such as increase in size, pain or swelling should be further investigated and treated.

**Genetics**

Array CGH was performed using two enchondromas. There was a gain on chromosome 13q and losses were present on chromosome 16p, 17, 19 and 22 in one enchondroma while in another case losses were observed of chromosome 19 and 22.

**Cytogenetics**

Note

Enchondromas can exhibit a broad range of genetic alteration but chromosome 6 and 12 were found to be more frequently affected. Chromosomal region 12q13-15 was shown to be frequently involved in a subgroup of chondromas. Higher expression of JunB protein was found in low grade chondrosarcoma as compared to enchondromas. Therefore, it can be a potential diagnostic tool in differential diagnosis. The enchondromas that show an abnormal karyotype are shown in table 1.
Table 1: Cytogenetic karyotypes of enchondromas.

<table>
<thead>
<tr>
<th>Karyotype</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 46, XX, t(12;15)(q13;q26)</td>
<td>Bridge et al 1982</td>
</tr>
<tr>
<td>2 46, XY, t(13;14)(q14;q32)</td>
<td>Bridge et al 1992</td>
</tr>
<tr>
<td>3 47, XX, +mar, t(4;16)(q25;p16)</td>
<td>Buddingh et al 2003</td>
</tr>
<tr>
<td>4 45, XX, -12, del(17)(q12;q21)</td>
<td>Buddingh et al 2003</td>
</tr>
<tr>
<td>5 78-91, 3q13-21</td>
<td>Dahlén et al 2003</td>
</tr>
<tr>
<td>6 46, XY, ins(3;12)(q17;q26)</td>
<td>Dahlén et al 2003</td>
</tr>
<tr>
<td>7 46, XX, -1;7(q22;12)(q12;p11), del(6)(q6), +mar, t(17;21)(q12;q22), der(19)(6;19)(q22;q13), der(9)(q11;p11), der(13)(q11;p11)</td>
<td>Dahlén et al 2003</td>
</tr>
<tr>
<td>8 46, XY, del(5)(p12)(q11;20)</td>
<td>Dahlén et al 2003</td>
</tr>
<tr>
<td>9 70-81, 11pter-11q12.1, +mar</td>
<td>Dahlén et al 2003</td>
</tr>
<tr>
<td>10 46, XY, del(12)(p11;q13)</td>
<td>Dahlén et al 2003</td>
</tr>
<tr>
<td>11 46, XY, del(13)</td>
<td>Dahlén et al 2003</td>
</tr>
<tr>
<td>14 46, XY, del(9)(q42), +mar</td>
<td>Mentzahil et al 1990</td>
</tr>
</tbody>
</table>

References


Bovée JV, van den Broek LJ, Cleeton-Jansen AM, Hogendoorn PC. Up-regulation of PTHrP and Bcl-2 expression characterizes the progression of osteochondroma towards peripheral chondrosarcoma and is a late event in central chondrosarcoma. Lab Invest. 2000 Dec;80(12):1925-34


Sandberg AA. Genetics of chondrosarcoma and related tumors. Curr Opin Oncol. 2004 Jul;16(4):342-54


Park HR, Park YK. Differential expression of runx2 and Indian hedgehog in cartilaginous tumors. Pathol Oncol Res. 2007;13(1):32-7


This article should be referenced as such: