

# Solid Tumour Section

## Mini Review

# Soft tissue tumors: Lipoma / benign lipomatous tumors

Nils Mandahl

Department of Clinical Genetics, Lund University Hospital, 221 85 Lund, Sweden (NM)

Published in Atlas Database: May 2000

Online updated version : <http://AtlasGeneticsOncology.org/Tumors/lipoma5050.html>  
DOI: 10.4267/2042/37650

This work is licensed under a Creative Commons Attribution-Noncommercial-No Derivative Works 2.0 France Licence.  
© 2000 Atlas of Genetics and Cytogenetics in Oncology and Haematology

## Identity

### Note

Lipomas are benign adipose tissue tumors with many subtypes, constituting one-third of all soft tissue tumors.

## Classification

**Ordinary lipoma:** the solitary, ordinary lipomas represent the most common soft tissue tumors, with subcutaneous tumors being much more common than the deep-seated ones.

**Epidemiology:** the incidence of lipomas is about one in 1000 inhabitants per year, but is probably underestimated since many lesions cause few problems; they occur most frequently between 30 and 70 years of age, with a peak incidence between 40 and 60 years.

**Clinics:** solitary lipomas are slow-growing masses, most frequently located in the upper back, neck, shoulder, abdomen, and the proximal portions of the extremities.

**Evolution:** surgery is required primarily when the tumors reach large size and cause cosmetic problems or complications due to their anatomical site; there is no risk of progression to malignancy, and recurrences are rare after shelling-out.

**Angiolipoma:** angiolipomas show characteristic histological features and occur primarily as subcutaneous, painful nodules; multiple lesions are much more common than solitary ones; they are usually smaller than solitary, ordinary lipomas and present at an earlier age, with the dominating site being the forearm; an increased familial incidence has been noted.

**Spindle cell/pleomorphic lipoma:** the characteristic feature of spindle cell lipoma is the replacement of

mature fat by collagen-forming spindle cells; these rare tumors typically occur subcutaneously in the neck and shoulders of men aged 45 to 65 years.

**Pleomorphic lipoma** probably represents a highly pleomorphic variant of spindle cell lipoma and show similar clinical features; both of these types of lesions may be confused with liposarcoma.

**Lipoblastoma:** lipoblastoma is a tumor of the infancy; most tumors occur before three years of age and may occasionally be seen already at birth; the site is primarily the upper and lower extremities; there may be a close resemblance to myxoid liposarcoma.

**Hibernoma:** hibernoma is chiefly a tumor of adults, although in average occurring at lower ages than solitary, ordinary lipomas; the most common sites are the scapular and interscapular regions, mediastinum and upper thorax.

**Angiomyo-lipoma:** angiomyolipoma is a hamartomatous lesion in the kidneys of adult patients, with a preponderance of women.

**Chondroid lipoma:** chondroid lipoma is a rare tumor occurring in the subcutis or muscle of adults; it may be confused with liposarcoma and chondrosarcoma, and shows microscopic features of both lipoma and hibernoma.

## Cytogenetics

### Cytogenetics Morphological

**Ordinary lipoma:**

The majority of tumors show fairly simple, structural chromosome aberrations; numerical changes are rare; seemingly balanced aberrations dominate over unbalanced changes, as also indicated by the finding of no copy number changes in smaller series of lipomas investigated by CGH.

In more than two-thirds of cases with karyotypic changes, there is an involvement of chromosome segment 12q13-15, which may recombine with a large variety of other chromosomal segments; so far, more than 80 of the 320 chromosome bands in the standard karyotype have been involved in these rearrangements. The most frequent aberration is t(3;12)(q27-28;q14-15), found in one-fifth of cases with 12q13-15 changes.

Other recurrently involved chromosome segments include 1p36, 1p32-34, 2p22-24, 2q35-37, 5q33, 10q22, 11q13, 12p11, 12q24, 13q12-14, and 21q21-22; all recurrent changes combined represent 75% of cases with 12q13-15 changes and 45-50% of all karyotypically abnormal ordinary lipomas among cases without 12q13-15 changes, one subset of tumors display translocations involving 6p21-23 and another subset have loss of 13q material with breakpoints in 13q12-14 and/or 13q22; many of the latter aberrations are seen as del(13)(q12q22); these 6p and 13q changes are found at similar frequencies, each occurring in 6-8% of ordinary lipomas with cytogenetic aberrations.

Some 15-20% of the aberrant tumors have rearrangements involving neither 6p21-23, 12q13-15, 13q12-14 nor 13q22.

### **Cytogenetics Molecular**

The rearrangements frequently affect the high mobility group protein gene HMGIC in 12q15, with most breakpoints occurring in the large intron 3; the outcome of the 3;12-translocations is the formation of a chimeric gene involving HMGIC and LPP.

LPP is a member of the LIM protein gene family, containing a leucine-zipper motif in its amino-terminal region and three LIM domains in its carboxy-terminal region.

Result of the chromosomal anomaly: the HMGIC/LPP transcripts frequently contain coding sequences for the three DNA-binding domains of HMGIC and two or three LIM domains from LPP; HMGIC/LPP is not specific for lipomas, but has also been identified in a series of pulmonary chondroid hamartomas with t(3;12), and HMGIC is rearranged in a variety of benign tumors.

Another fusion has been with LHFP in a lipoma with t(12;13)(q13-15;q12); the expressed HMGIC/LHFP fusion transcript encoded the three DNA binding domains of HMGIC and 69 amino acids from frame-shifted LHFP sequences.

A candidate gene for rearrangements affecting 6p21 in lipomas is HMG1Y.

### **Cytogenetics Morphological**

**Angiolipoma:** subcutaneous angiolipomas have a normal karyotype as shown by chromosome banding.

**Spindle cell/pleomorphic lipoma:** few cases have been investigated cytogenetically; the characteristic features are losses of chromosome 13 and 16 sequences, in particular involving the segments 13q12 and 16q13-qter, respectively.

**Lipoblastoma:** few cases have been investigated cytogenetically; they have all had rearrangements of 8q11-13 in common; this segment has been found to recombine with a variety of other chromosome bands; preliminary data have indicated that the PLAG1 gene in 8q12 is affected, resulting in a similar promoter swapping as has been described in pleomorphic adenomas of the salivary gland.

**Hibernoma:** the characteristic feature is rearrangements of 11q13, which may recombine with a variety of other chromosome bands; in contrast to ordinary lipomas, no translocations involving both 11q13 and 12q13-15 have been found in hibernomas. FISH analyses have demonstrated that both homologs of chromosome 11, including the seemingly normal one, have deletions encompassing the multiple endocrine neoplasia type I, MEN1, locus and a second region about 3 Mb distal to MEN1.

**Angiomyo-lipoma:** few cases have been investigated cytogenetically; the only recurrent change identified has been trisomy 7; however, interphase FISH analysis did not reveal any significant fraction of cells with +7 in the angiomyolipomas investigated.

**Chondroid lipoma:** a cytogenetically identical rearrangement, t(11;16)(q13;p13), found in the only two cases reported indicate that this is a recurrent aberration.

## References

- Peulve P, Thomine E, Hemet J. Cytogenetic analysis of a rare case of pediatric myxolipoma. *Ann Genet.* 1990;33(4):222-4
- Sreekantaiah C, Leong SP, Karakousis CP, McGee DL, Rappaport WD, Villar HV, Neal D, Fleming S, Wankel A, Herrington PN. Cytogenetic profile of 109 lipomas. *Cancer Res.* 1991 Jan 1;51(1):422-33
- Debiec-Rychter M, Saryusz-Wolska H, Salagierski M. Cytogenetic analysis of renal angiomyolipoma. *Genes Chromosomes Cancer.* 1992 Jan;4(1):101-3
- Fletcher JA, Kozakewich HP, Schoenberg ML, Morton CC. Cytogenetic findings in pediatric adipose tumors: consistent rearrangement of chromosome 8 in lipoblastoma. *Genes Chromosomes Cancer.* 1993 Jan;6(1):24-9
- Mrózek K, Karakousis CP, Bloomfield CD. Chromosome 12 breakpoints are cytogenetically different in benign and malignant lipogenic tumors: localization of breakpoints in lipoma to 12q15 and in myxoid liposarcoma to 12q13.3. *Cancer Res.* 1993 Apr 1;53(7):1670-5
- Tayyeb MT, Neff JR, Bridge JA. A case report of fibrolipoma with t(12;16)(q13;q24). *Cancer Genet Cytogenet.* 1993 Jun;67(2):145-6
- Dal Cin P, Sciot R, De Wever I, Van Damme B, Van den Berghe H. New discriminative chromosomal marker in adipose tissue tumors. The chromosome 8q11-q13 region in lipoblastoma. *Cancer Genet Cytogenet.* 1994 Dec;78(2):232-5
- Mandahl N, Höglund M, Mertens F, Rydholm A, Willén H, Brosjö O, Mitelman F. Cytogenetic aberrations in 188 benign and borderline adipose tissue tumors. *Genes Chromosomes Cancer.* 1994 Mar;9(3):207-15
- Mandahl N, Mertens F, Willén H, Rydholm A, Brosjö O, Mitelman F. A new cytogenetic subgroup in lipomas: loss of

- chromosome 16 material in spindle cell and pleomorphic lipomas. *J Cancer Res Clin Oncol*. 1994;120(12):707-11
- Meloni AM, Spanier SS, Bush CH, Stone JF, Sandberg AA. Involvement of 10q22 and 11q13 in hibernoma. *Cancer Genet Cytogenet*. 1994 Jan;72(1):59-64
- Mertens F, Rydholm A, Brosjö O, Willén H, Mitelman F, Mandahl N. Hibernomas are characterized by rearrangements of chromosome bands 11q13-21. *Int J Cancer*. 1994 Aug 15;58(4):503-5
- Ashar HR, Fejzo MS, Tkachenko A, Zhou X, Fletcher JA, Weremowicz S, Morton CC, Chada K. Disruption of the architectural factor HMGI-C: DNA-binding AT hook motifs used in lipomas to distinct transcriptional regulatory domains. *Cell*. 1995 Jul 14;82(1):57-65
- Bridge JA, DeBoer J, Walker CW, Neff JR. Translocation t(3;12)(q28;q14) in parosteal lipoma. *Genes Chromosomes Cancer*. 1995 Jan;12(1):70-2
- Enzinger FM, Weiss SW. Lipoma In: *Soft tissue tumors*. 3rd ed. Mosby. St. Louis 1995.
- Schoenmakers EF, Wanschura S, Mols R, Bullerdiek J, Van den Berghe H, Van de Ven WJ. Recurrent rearrangements in the high mobility group protein gene, HMGI-C, in benign mesenchymal tumours. *Nat Genet*. 1995 Aug;10(4):436-44
- Ashar HR, Cherath L, Przybysz KM, Chada K. Genomic characterization of human HMGIC, a member of the accessory transcription factor family found at translocation breakpoints in lipomas. *Genomics*. 1996 Jan 15;31(2):207-14
- Fletcher CD, Akerman M, Dal Cin P, de Wever I, Mandahl N, Mertens F, Mitelman F, Rosai J, et al. Correlation between clinicopathological features and karyotype in lipomatous tumors. A report of 178 cases from the Chromosomes and Morphology (CHAMP) Collaborative Study Group. *Am J Pathol*. 1996 Feb;148(2):623-30
- Mandahl N. Cytogenetics and molecular genetics of bone and soft tissue tumors. *Adv Cancer Res*. 1996;69:63-99
- Petit MM, Mols R, Schoenmakers EF, Mandahl N, Van de Ven WJ. LPP, the preferred fusion partner gene of HMGIC in lipomas, is a novel member of the LIM protein gene family. *Genomics*. 1996 Aug 15;36(1):118-29
- Dal Cin P, Sciot R, Van Poppel H, Baert L, Van Damme B, Van den Berghe H. Chromosome analysis in angiomyolipoma. *Cancer Genet Cytogenet*. 1997 Dec;99(2):132-4
- Kanazawa C, Mitsui T, Shimizu Y, Saitoh E, et al. Chromosomal aberration in lipoblastoma: a case with 46,XX,ins(8;6)(q11.2;q13q27). *Cancer Genet Cytogenet*. 1997 Jun;95(2):163-5
- Merscher S, Marondel I, Pedeutour F, Gaudray P, Kucherlapati R, Turc-Carel C. Identification of new translocation breakpoints at 12q13 in lipomas. *Genomics*. 1997 Nov 15;46(1):70-7
- Sciot R, Akerman M, Dal Cin P, De Wever I, Fletcher CD, Mandahl N, Mertens F, Mitelman F, Rosai J, Rydholm A, Tallini G, Van den Berghe H, Vanni R, Willen H. Cytogenetic analysis of subcutaneous angioliipoma: further evidence supporting its difference from ordinary pure lipomas: a report of the CHAMP Study Group. *Am J Surg Pathol*. 1997 Apr;21(4):441-4
- Szymanska J, Virolainen M, Tarkkanen M, Wiklund T, et al. Overrepresentation of 1q21-23 and 12q13-21 in lipoma-like liposarcomas but not in benign lipomas: a comparative genomic hybridization study. *Cancer Genet Cytogenet*. 1997 Nov;99(1):14-8
- Tallini G, Dal Cin P, Rhoden KJ, Chiapetta G, Manfioletti G, Giancotti V, Fusco A, Van den Berghe H, Sciot R. Expression of HMGI-C and HMGI(Y) in ordinary lipoma and atypical lipomatous tumors: immunohistochemical reactivity correlates with karyotypic alterations. *Am J Pathol*. 1997 Jul;151(1):37-43
- Nanjangud G, Naresh KN, Nair CN, Parikh B, Dixit PH, Advani SH, Amare PS. Translocation (11;14)(q13;q32) and overexpression of cyclin D1 protein in a CD23-positive low-grade B-cell neoplasm. *Cancer Genet Cytogenet*. 1998 Oct 1;106(1):37-43
- Petit MM, Swarts S, Bridge JA, Van de Ven WJ. Expression of reciprocal fusion transcripts of the HMGIC and LPP genes in parosteal lipoma. *Cancer Genet Cytogenet*. 1998 Oct 1;106(1):18-23
- Rogalla P, Kazmierczak B, Meyer-Bolte K, Tran KH, Bullerdiek J. The t(3;12)(q27;q14-q15) with underlying HMGIC-LPP fusion is not determining an adipocytic phenotype. *Genes Chromosomes Cancer*. 1998 Jun;22(2):100-4
- Sreekantaiah C. The cytogenetic and molecular characterization of benign and malignant soft tissue tumors. *Cytogenet Cell Genet*. 1998;82(1-2):13-29
- Willén H, Akerman M, Dal Cin P, De Wever I, Fletcher CD, Mandahl N, Mertens F, Mitelman F, Rosai J, Rydholm A, Sciot R, Tallini G, Van den Berghe H, Vanni R. Comparison of chromosomal patterns with clinical features in 165 lipomas: a report of the CHAMP study group. *Cancer Genet Cytogenet*. 1998 Apr 1;102(1):46-9
- Aman P. Fusion genes in solid tumors. *Semin Cancer Biol*. 1999 Aug;9(4):303-18
- Gisselsson D, Domanski HA, Höglund M, Carlén B, Mertens F, Willén H, Mandahl N. Unique cytological features and chromosome aberrations in chondroid lipoma: a case report based on fine-needle aspiration cytology, histopathology, electron microscopy, chromosome banding, and molecular cytogenetics. *Am J Surg Pathol*. 1999 Oct;23(10):1300-4
- Gisselsson D, Höglund M, Mertens F, Dal Cin P, Mandahl N. Hibernomas are characterized by homozygous deletions in the multiple endocrine neoplasia type I region. Metaphase fluorescence in situ hybridization reveals complex rearrangements not detected by conventional cytogenetics. *Am J Pathol*. 1999 Jul;155(1):61-6
- Petit MM, Schoenmakers EF, Huysmans C, Geurts JM, Mandahl N, Van de Ven WJ. LHFP, a novel translocation partner gene of HMGIC in a lipoma, is a member of a new family of LHFP-like genes. *Genomics*. 1999 May 1;57(3):438-41
- Thomson TA, Horsman D, Bainbridge TC. Cytogenetic and cytologic features of chondroid lipoma of soft tissue. *Mod Pathol*. 1999 Jan;12(1):88-91

---

*This article should be referenced as such:*

Mandahl N. Soft tissue tumors: Lipoma / benign lipomatous tumors. *Atlas Genet Cytogenet Oncol Haematol*. 2000; 4(3):135-137.

---