Chondro-osteoblastic Metaplasia in Canine Benign Cutaneous Lipomas

G. A. Ramírez, J. Altimira, B. García and M. Vilafranca

Laboratorio de Diagnóstico Histopatológico Veterinario HISTOVET, Montserrat 9, 08192 Sant Quirze del Vallès, Barcelona, Spain

Summary

Lipomas are common benign adipose tissue tumours in dogs. Variants of lipomas are characterized by an additional component (e.g. capillaries in angiolipomas or fibrous connective tissue in fibrolipomas). In human medicine, the presence of cartilage or bone within a lipoma is a rare event. Mechanical stress, tropic disturbances, contact with periosteum and other unknown factors may contribute to this transformation. The present report describes the clinical, gross and microscopical findings of four cases of chondrolipoma and two cases of osteolipoma in the canine skin. The possible histogenesis for these tumours in the dog is discussed.

Keywords: chondrolipoma; dog; osteolipoma; tumour

A lipoma is defined in human and veterinary pathology as a benign tumour mass composed of mature adipocytes with no cellular atypia and with uniform nuclei, identical to cells that form adult fat (Weiss and Goldblum, 2001; Goldschmidt and Hendrick, 2002). They occur in about 16% of dogs and are mainly found subcutaneously (Goldschmidt and Hendrick, 2002; Mutinelli et al., 2007). In the World Health Organization (WHO) histological classification of skin and soft tissue tumours of domestic animals there are two types of benign adipose tissue tumour: lipoma, including infiltrative lipoma, and angiolipoma (Hendrick et al., 1998). In contrast, the classification of human malignant and benign adipose tumours remains controversial. In the WHO classification of soft tissue and bone tumours of man there are 14 types of benign adipose tissue tumour: lipoma, including infiltrative lipoma, and angiolipoma (Weiss and Goldblum, 2001; Fletcher et al., 2002; Boltze et al., 2003). Some pathologists prefer to classify these variants of lipoma as benign mesenchymomas. A mesenchymoma is a mixed tumour composed of two or more mesenchymal tissues excluding fibrous elements (Stout, 1948). Fibrous elements are found in all mesenchymal tumours and are not counted as one of the components. According to this classification, chondrolipoma and osteolipoma are rare forms of mesenchymoma in man that contain mature cartilage or bone and adipose tissue (Fletcher et al., 2002; Jones et al., 2003; Candocia and Barley, 2004; Ohtsuka, 2006). The present report describes six dogs with cutaneous lipoma showing cartilaginous and osseous metaplasia (chondrolipoma, osteolipoma). The clinical presentation of the affected dogs is summarized in Table 1. There was no significant sex or breed predilection. The mean age of the animals was 11 years (range 7–17 years). Tumours were clinically similar; they presented as movable, well-circumscribed, non-tender masses located in the subcutaneous tissue at a variety of locations (Table 1). The medical histories were otherwise unremarkable except for case 2, which showed ulceration of the mass. Case 1 had some fibrous adhesions...
between the mass and the subjacent periosteum of the right iliac bone. Haematological as well as biochemical parameters were within normal limits. All masses were completely excised and submitted to Histovet Veterinary Diagnostic Laboratory, Barcelona, Spain for examination. Gross examination showed a similar appearance for cases 1, 2, 3 and 5. These tumours appeared as multilobulated, soft and yellow—white masses with a homogeneous cut surface with focal areas of firm tissue (Fig. 1a). Cases 4 and 6 contained the same homogeneous white adipose tissue surrounding a well-demarcated single central area of firm bone-like (calcified) tissue. The specimens were fixed in 10% neutral-buffered formalin, trimmed, processed routinely and embedded in paraffin wax. Sections (3 μm) were stained with haematoxylin and eosin (HE) and toluidine blue.

Microscopical examination revealed well-demarcated but non-encapsulated masses composed of sheets and lobules of mature adipose tissue separated by fibrous septa (Fig. 2a). Adipocytes showed variable size, no atypia and nuclei were uniform and hyperchromatic. Fibrous connective tissue was abundant in cases 2 and 3, while in case 1 a slightly basophilic, myxoid-like matrix was more commonly encountered (Fig. 3a). In addition, there were focal areas of chondroid metaplasia and occasional circumscribed encapsulated foci of mature hyaline cartilage (Figs. 1b, 2b and 3b). No inflammation or necrosis was found. In case 3, fine mineralized lines of osteoid with a single inconspicuous layer of osteoblasts and osteoclasts were occasionally seen. These bone-like islands showed plaques of adherent fibrous peristeme-like tissue (Figs. 1c and 4a). Cases 4 and 6 consisted of mature, benign-appearing adipose tissue surrounding spicules of mature, lamellar bone with osteocytes (Fig. 4b). Osteoclasts or cartilaginous tissue were not detected in these tumours. Toluidine

![Image](image_url)

**Fig. 1.** Case 3, chondro-osteoblastic lipoma. (a) Cut section of the well-demarcated, ovoid and thinly encapsulated tumour. Surface is greasy, white—yellow in colour, with small bulging foci of firm consistency (arrows). These foci correspond to mature hyaline cartilage (b) or bone-like tissue (c). HE. Bar, 100 μm (a), 200 μm (b).
blue staining confirmed the presence of chondroitin sulphate in the chondroid matrix of cases 1, 2, 3 and 5. These gross and microscopical features were considered to be consistent with a diagnosis of simple lipomas with multifocal cartilaginous and osseous metaplasia (i.e. chondrolipomas [cases 1, 2, 3 and 5] and osteolipomas [cases 4 and 6]). The recovery of these dogs was uneventful and the lesions showed no evidence of recurrence postoperatively.

The presence of cartilage or bone within a lipoma is a rare event in man (Katzer, 1989; Weiss and Goldblum, 2001). Chondrolipomas and osteolipomas are a subtype of benign adipose tumour recognized in the human WHO histological classification of soft tissue and bone tumours, but not in the equivalent classification for domestic animals (Hendrick et al., 1998; Fletcher et al., 2002). Human chondrolipomas and osteolipomas, which take years to develop in middle-aged or elderly patients, tend to be large and to originate subcutaneously or in deep soft tissues. The anatomical distribution is wide, notably in the connective tissues of the trunk and the proximal limbs,
the breast, pharynx and nasopharynx (Katzer, 1989; Weiss and Goldblum, 2001; Boltze et al., 2003; Jones et al., 2003; Candocia and Barley, 2004; Val-Bernal et al., 2007). In dogs, the common lipoma most frequently arises within the subcutaneous tissue of the back, shoulder, neck, abdomen or proximal extremities (Goldschmidt and Hendrick, 2002). Chondrolipomas in the dog have been only reported in the pelvic cavity and within the musculature of the abdominal wall (Tanabe et al., 2005; Mutinelli et al., 2007). Osseous tissue is even rarer than cartilage in human lipomas (Piattelli et al., 2001; Weiss and Goldblum, 2001), and has not been described previously in dogs.

The nomenclature of these lesions is controversial. Alternative denominations have been proposed, including hamartoma or benign mesenchymoma (Stout, 1948; Fletcher et al., 2002; Boltze et al., 2003; Jones et al., 2003; Candocia and Barley, 2004; Ohtsuka, 2006). A hamartoma requires the lesion to be a mixture of tissues normally found at the site involved. Since cartilage or bone present in these lesions is not normally found in cutaneous soft tissues, the diagnosis of hamartoma is excluded. The term benign mesenchymoma should be used to describe tumours containing two or more mature mesenchymal tissues not ordinarily found together, none of which predominates (Stout, 1948; Jones et al., 2003). The chondroid or osseous tissue in our cases represents only a small part of the growth, so that these lesions can still be easily recognized as tumours of adipose tissue origin. Therefore, the term mesenchymoma lacks pathological specificity and should not be used for describing these tumours. The terms chondrolipoma and osteolipoma more accurately describe the composition and nature of these uncommon lesions. In particular, case 3 showed a predominance of cartilaginous tissue so a diagnosis of chondrolipoma is warranted, but encapsulated immature islands of bone were also occasionally found and a diagnosis of chondro-osteoblastic lipoma may be more accurate.

Cartilaginous or osseous metaplasia is mainly encountered in large-sized, long-standing lipomas in man (Katzer, 1989; Weiss and Goldblum, 2001; Boltze et al., 2003). All dogs included in our series were over 7 years of age; in two cases (3 and 5) a slow and progressive, long-standing growth was confirmed. Two explanations for the origin of cartilage/bone in these lesions have been proposed. The cartilage may arise from chondro-osseous metaplasia in the adipose tissue. The pathogenesis of this change in lipomas may be explained by local trauma, together with the natural reactivity of the mesenchyma, which is possibly influenced by proximity to periosteum and joints. Permanent mechanical stress, repeated microtrauma and reduced blood supply can influence the development of metaplasia within a lipoma (Katzer, 1989; Boltze et al., 2003; Val-Bernal et al., 2007). The second possibility is that cartilage may originate from pluripotent mesenchymal cells within the tumour. Studies in human patients have demonstrated that bone marrow-derived mesenchymal stem cells have the ability...
to differentiate into cell types of different origins, such as cartilage, bone, muscle, tendon, myelosupportive stroma or fat. The migration of these cells to subcutaneous tissue via the systemic circulation may enable them to reach the appropriate tissue and to acquire the specific phenotype of that particular cell compartment (Caplan and Bruder, 2001). Tumours in the present series were located subcutaneously next to osseous prominences and very close to bone peristeme (Table 1) and were therefore exposed to continuous and repetitive trauma. Bearing this in mind, it is likely that the chondromatous transformation in these canine lipomas represents metaplasia rather than neoplasia. In those tumours that arise in body cavities or far from trauma exposed areas it is also possible that cartilage or bone develops from pluripotential stem cells.

The differential diagnosis of chondro- and osteolipoma includes benign tumours such as lipoma, fibroma, neumroma and other tumours with calcified or ossified components, and malignant tumours such as liposarcoma and chondrosarcoma (Weiss and Goldblum, 2001). Histological examination is required for definitive diagnosis. Liposarcoma and chondrosarcoma were ruled-out in the present series since microscopical examination revealed no atypia or immature lipoblasts or chondroblasts. In addition, chondrolipomas should be clearly distinguished from human chondroid lipomas. Chondroid lipoma is defined as a rare, benign, fatty neoplasm in which, in addition to mature white adipose tissue, focal chondroid metaplasia and cartilage as well as fetal (brown) fat or hibernoma components must also be present (Weiss and Goldblum, 2001; Boltze et al., 2003). The presence of mature chondrocytes without multivacuolated cells may assist in distinguishing a chondrolipoma from a chondroid lipoma (Mutinelli et al., 2007). Neither fetal-like fat nor multivacuolated chondrocytes nor lipoblasts were observed in the lesions of the present series.

The treatment of choice for these tumours is surgical excision. Recurrence is rare and only occurs in cases of incomplete removal (Piattelli et al., 2001; Candocia and Barley, 2004; Tanabe et al., 2005; Mutinelli et al., 2007; Val-Bernal et al., 2007). Complete removal was performed in all cases of the present series. No recurrence or other clinical signs related to the tumours were observed after surgery. The prognosis appears to be favourable - as occurs with the equivalent human tumours.

In summary, canine cutaneous chondrolipoma and osteolipoma are rare variants of lipoma. These lesions are not included in the WHO histological classification of mesenchymal tumours of skin and soft tissues of domestic animals. It may, therefore, be appropriate to include them in the classification and in the differential diagnosis of soft tissue neoplasms of the dog.

### References


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