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PATHOLOGICAL CHARACTERISTICS OF CANINE LIPOMA

Submitted by

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Contents

Abbreviations

C	Cervical vertebra
cm	centimetres
CT	Computed Tomography
ECG	Electrocardiogram
FNA	fine needle aspiration
g	grams
HE	haematoxylin eosin
HPC	hemangiopericytoma
IHC	immunohistochemistry
L	Lumbar vertebra
mm	millimetres
mmHg	millimetres of Mercury
MRI	Magnetic Resonance Imaging
PAS	Periodic acid Schiff Staining
T	Thoracic vertebra

Introduction

Lipomas are benign tumours composed of white adipose tissue. These tumours are very common in ageing dogs. Usually these are found subcutaneously, and increase in size and number over the years. Obese dogs seem to be more prone, while some studies show that females are also more inclined to these lipomatous neoplasms. Labrador Retrievers, Doberman Pinschers, and Miniature Schnauzers have a high predilection for these growths (Hammond et al., 2008).

Most often lipomas are simply composed of mature adipose tissue only. However, as more veterinarians use histopathology as a diagnostic tool, one notices more and more multiplex cases in dogs. In humans 14 histotypes of lipomas have been described; these are fibrolipoma, chondrolipoma, osteolipoma, angiolipoma, thymolipoma, hibernoma (tumour of brown adipose tissue), myxolipoma, and myelolipoma well as others. Many occur due to metaplasia of the fatty tumor, while in some cases it occurs vice versa.

Lipoma could also be shown to be **non-infiltrative** and **infiltrative**. Infiltrative are the more aggressive type of tumours that have a high tendency to grow back even after full resection. But it is important to note these even though aggressive; they do not metastatize (Lee et al., 2010).

Another method of classification of lipoma tumours is by its **anatomical location**. Both these methods will be used in this review.

These tumours do not usually cause specific symptoms, but cause compressions of tissues or organs, as they grow, causing clinical signs. Most case studies, as mentioned below, will only use surgical removal as a treatment and no chemotherapy is used.

It should be pointed out that unlike in dogs and humans (in which it is very common), lipomas are occasionally observed in cats (Ligget et al.,2002), horses (Szabo et al.,2011) and budgerigars, but are very rare in other domestic animals.

In **Human Medicine**, lipoma case studies are found by the hundreds. They are very common incidence of simple lipomas, found not only subcutaneously but also, for instance, within the intra-thoracic cavity, within interosseus spaces, in cerebellum, within the buccal cavity. More attention has been placed on these incidences in Human Medicine and much more literature was

found for this evaluation. These cases are not often reported in Veterinary Medicine; hence they are hard to come by (Ramirez et al., 2010).

The purpose of this review is to give an overview of these benign lipomas, to show the pathological and histopathological diagnosis made by other vets, as well as ourselves, and compare which is the best methodology of dealing with these tumours. A comparison of the latest research and case studies recovered from veterinarians from around the world, as well as from Szent Istvan University, with Human Medicine cases was made. This was to make a thorough evaluation of the characteristics of this commonly overlooked neoplasm.

Survey of literature

(Case Reports)

Anatomical classification of lipoma.

The following cases have been described according to their anatomical location and positioning. The classification is made as described in Lipomatous Tumours of Soft Tissue (Abushiha et al., 2007). The gross pathological report has also been added in significant cases. This will be later compared to the histological classification and descriptions made later on in the chapter.

In canine cases:

A) **Subcutaneous lipoma**: Cases are often brought in with slow growing masses, with no reported clinical signs. Masses are grossly described as multilobulated, and yellow soft in appearance. A focal area of white nodules which is firm in consistency was noted. Metaplasia often occurs within the tumour itself. In this case bone like or cartilaginous centres are found (Ramirez et al., 2010).

- **Mast cell tumour in subcutaneous lipoma (Tumour in tumour)**

B) One specific case on the axillar area was found, containing a tumour within tumour. Once it was surgically removed it was presented to be a well differentiated Grade I mast cell tumour in a cutaneous lipoma. This was found on a boxer. This breed has a predilection for neoplasm, especially mast cell tumours. This tumour was well-circumscribed, freely moveable mass with a soft consistency. It was a 42 x 20mm ovoid mass. This is one of the first cases of tumour within a tumour presented in dogs (Jakab et al., 2009).

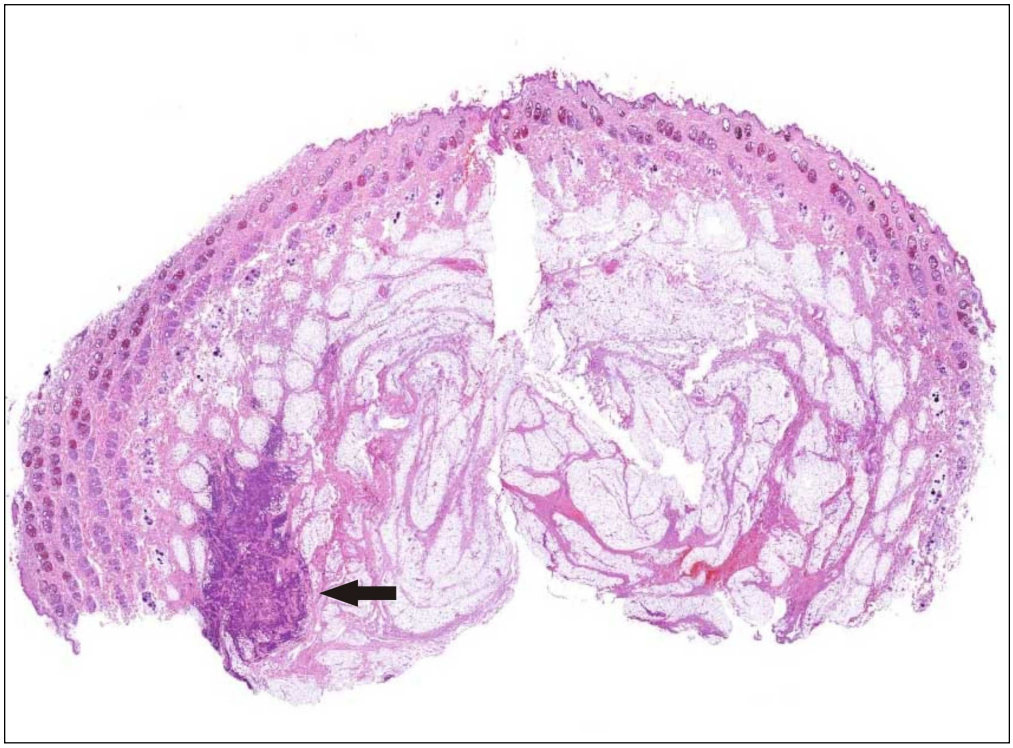


Figure 1. The cut surface of the canine lipoma. In the left lower pole of the lipoma the solid island of the neoplastic mast cell proliferation can be seen (black arrow). Haematoxilin and eosin (H.-E).2X. (*picture by Csaba Jakab*)

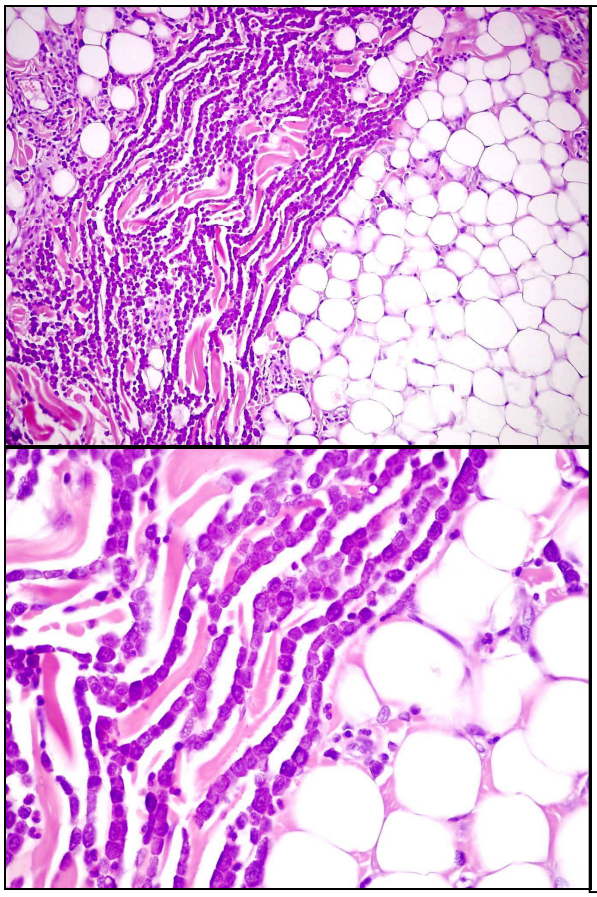


Figure 2-3. At the left side of the histopathological picture the well-differentiated mast cells an arranged in rows. At right side of the picture the benign lipocytes proliferation can be seen. HE.100x, 200 x. (*pictures by Csaba Jakab*)

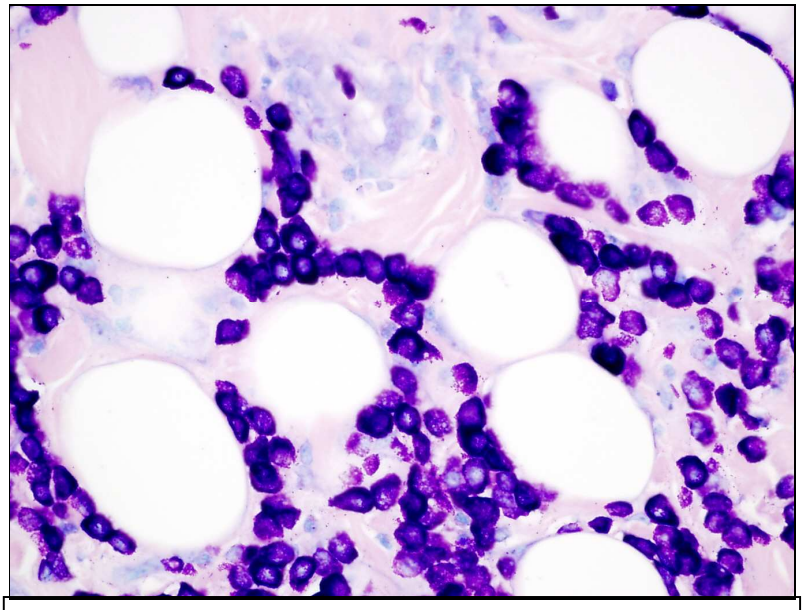


Figure 4. Metachromic, medium-sized intracytoplasmic granules found in the cytoplasms of the neoplastic mast cells. Giemsa-stain. 400x. (*picture by Csaba Jakab*)

C) **Deep lipoma**:

Intrathoracic: In a Labrador Retriever presented with dyspnoea, coughing, lethargy and inappentance. Blood biochemistry shows pyrexia, granulocytes and hyperglobaemia. Once the mass was surgically removed, it was confirmed to be a necrotic lipoma measuring 11.5cm length, and the maximal diameter 8 cm. A fibrinoid ovoid external mass with an internal massof 4cm. The external mass reticulated. Smaller mass was homogeneousand composed of a thick caseous material with no odour (Miles et al., 2001).

In a Rottweiler cross was found with incidental findings nocturia and urinary incontinence. Radiography revealed mass at left apex of the heart. Lung tissue near mass was atelectatic. When surgically removing the mass, it was found to be pericardial. It was concluded to be a *pericardial lipoma* with adjacent pericarditis. The mass measured 2.2 cm in diameter. It was round and turgid in consistency (Ben-Amotz et al., 2007).

Two cases were presented with histopathological findings of *Thymofibrolipoma.* Case 1; a cross breed dog was found accidentally after a trauma.No heart and lung sounds on left hemithorax were found. While Case 2; A pit bull terrier was found to have tachypnoea and weak arterial pulse. Muffled Heart and lung sounds were also heard. Radiography for both revealed large mass in thoracic cavity. Case1: Surgically removed. Case 2: was observed under necropsy. Case 1: Spherical mediastinal mass of 20x 25cm. Mass appeared encapsulated. Cut surface revealed a firm mass, which was mostly dark red with grey trabeculae. A small area was yellowish grey. Case 2: The mass was presented in the anterior mediastinum. It was white elongated and lobulated and circumscribed (Morini et al., 2009).

A spayed female miniature pinscher was presented with a rare case of *thymolipoma.* Clinical signs were shown to be chronic coughing and open mouth breathing. Patient also showed dyspnoea. Radiography and exploratory thoracotomy revealed a mass surrounding the pericardium. A uniform mass contained large blood vessels and black spots. It was well circumscribed. It did no adhere to any tissue. It was 1.8 x 3.6 x 1cm with a fibrous capsule, and a homogenous, soft yellow to tan, with divided lobules (Ramirez et al., 2008).

A patient with *angiolipoma* was first presented with progressive coughing, and exercise intolerance. Bronchovesicular sounds were absent and cardiac sounds were dull over

entire left hemithorax. Several subcutaneous mass were also found. Radiography and exploratory thoracotomy were used to identify and remove the position of mass. 25x 20cm mass in mid-ventral and left thoracic cavity was found. It appeared to originate from the ventral mediastinal fat. No further attachments to surroundings were found (Mayhem et al, 2002).

A female intact Rottweiler, aged 9-years, showed signs of dyspnoea and coughing. During post-mortem examination the cachetic dog, was found to have the presence of a cervicothoracic simple lipoma as well as cecal leiomyosarcoma (Jakab et al., 2013).

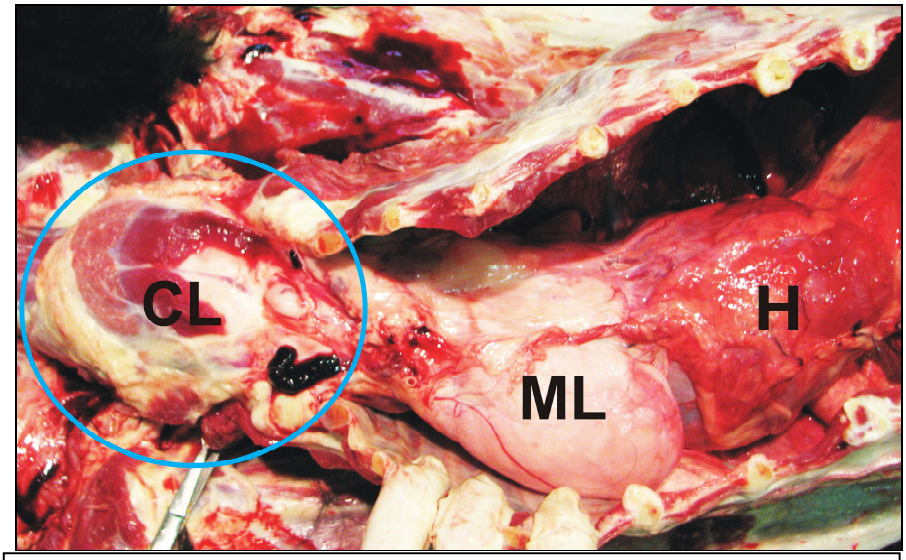


Figure 5. Grossly picture about the cervicothoracal lipoma in a dog. CL= cervical lipoma; ML = mediastinalis lipoma; H = heart. (*picture by Csaba Jakab*)

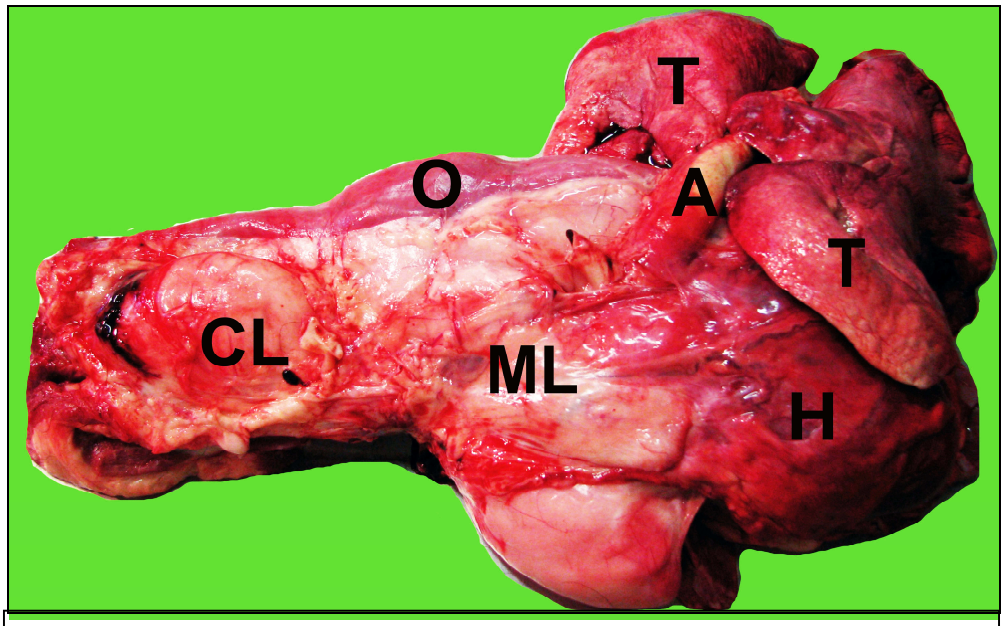


Figure 6. Isolated cervical and thoracal organs from dog. CL = cervical lipoma; O = esophagus; ML = mediastinal lipoma; A = aorta; H = heart; T = lungs. (*picture by Csaba Jakab*)

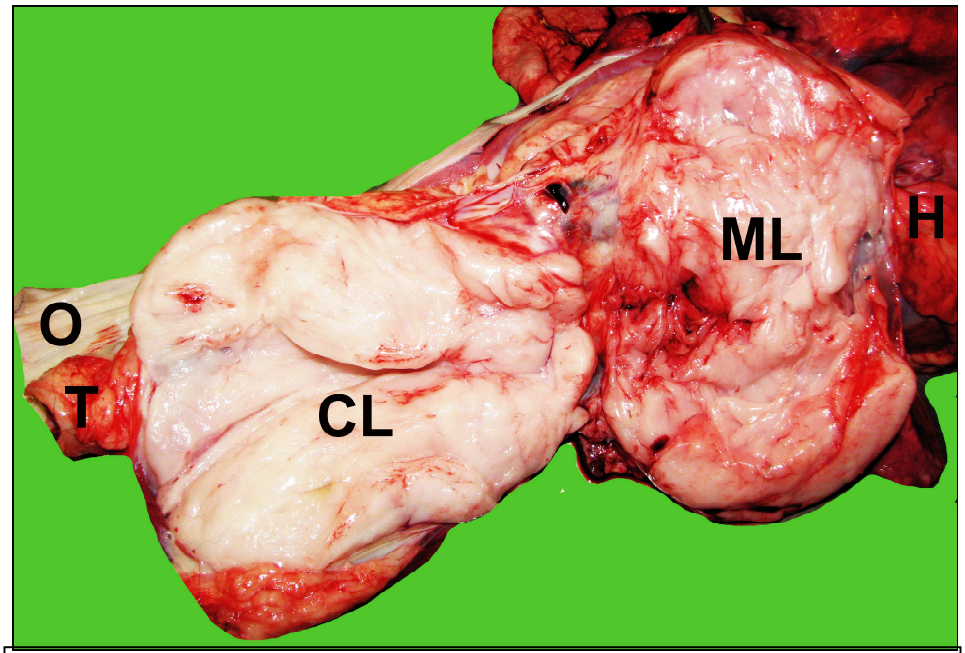


Figure 7. Cut surface of the cervicothoracal lipoma in a dog. O = esophagus; T = trachea; CL = cervical lipoma; ML = mediastinal lipoma; H = heart. (*picture by Csaba Jakab*)

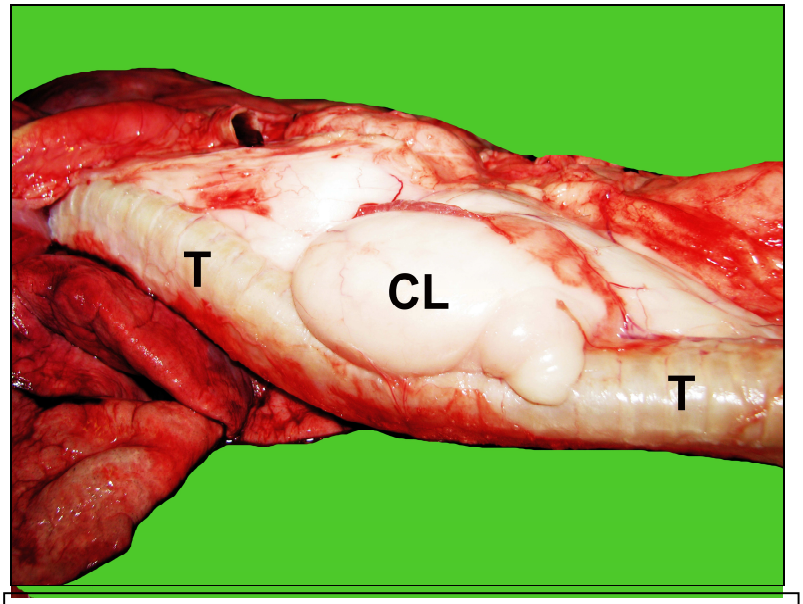


Figure 8. Lateral picture of the paratracheal lipoma. T = trachea; CL = cervical lipoma. (*picture by Csaba Jakab*)

Intra-Abdominal: A female Miniature Schnauzer with Lethargy, inappentence, urinary incontinence, vomiting, pollakiuria and a history of hyperadrenocorticism. Radiography presented a hypoechoic mass with marbled appearance. It was removed surgically. In surgery mass did not seem to arise from any surrounding tissues. Mass was well circumscribed, approx. 5x5.6 cm. Histopathology and cytology confirmed *necrotic lipoma with focal fibrosis* (Hammond et al., 2008).

A male Rough Collie mix was presented with lethargy, and dysuria with inguinal swelling. On palpation a large non-painful abdominal mass was found. Its penis and prepuce were also found to be diverged to the right. Radiography revealed a fat- dense mass in the caudal, mid- abdomen. It was surgically removed. A 3.8 kg mass was found, with no attachments or infiltrations in surrounding tissue. Histopathology established it was a *simple lipoma with large necrotic areas* (Mayhew et al., 2002).

A female Beagle with gradual abdominal distention and intermittent vomiting was reported to have a large, non painful mid-abdominal mass. Abdominal radiography showed a large, mid abdominal fat dense mass displacing the small intestines cranially. While thoracic

radiography revealed displacement of the diaphragm. The 5.5 kg mass was removed surgically, and was found to have attachments to the umbilicus. A second mass was found infiltrating the sheath of transverses abdominis on the left side. Two years later the dog was returned to the hospital with abdominal distention. After radiography confirmed, another mass was removed surgically this time of weight 4.4kg. The mass had infiltrated the peritoneum and left transverse abdominis and rectus abdominis muscles (Mayhew et al., 2002).

A dog, with a past cytoreductive surgery on a lipoma that had invaded the left side, had been referred. A large fat dense mass was found displacing the small intestine and liver cranio-dorsally. The mass was removed surgically and it was described to be 3.97kg in size, and extending from the retroperitoneal fat and though the body wall. It was found to have been compressing the left kidney.

A Beagle was presented with vomiting. It was revealed to have a mass found in the greater omentum and the spleen. With blood work a liver disorder was suspected, but after the condition of the patient got worse, the mass was removed. The mass was described as large, soft, and spheroidal measuring 5.0 × 4.5 × 4.5 cm. It was attached to the greater omentum and was encapsulated and well circumscribed. The cut surface showed solid dark red colour appearance, with bone marrow- like similarity. The spleen and the liver were also biopsied for comparison with histopathology of the tumour. The tumour was found to be a *multicentric myelolipoma* (Kamiie et al, 2008).

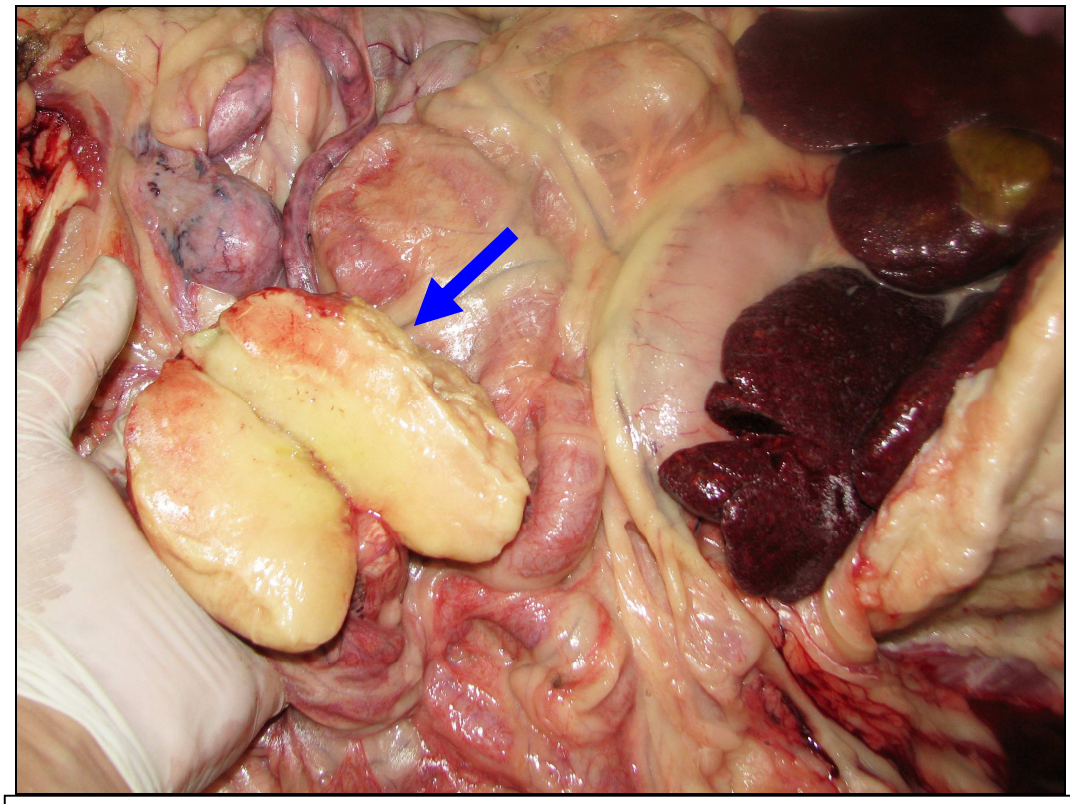


Figure 9: Intra-Abdominal lipoma case dissected at the SZIE-AOTK Pathology Department. The tumour arrived from the omentum (incidental necropsy finding = incidentaloma). (*picture by Csaba Jakab*)

A dog with signs of anorexia, vomiting and progressive abdominal distention was presented. On physical examination the veterinarian noted enlarged submandibular lymph nodes and a mid-abdominal mass was also palpated. Radiography, ultrasonography, and fine needle aspiration was done to confirm the location and the origin of the mass. Cytology was also taken from the liver. On removal of the tumour it was confirmed to be a *splenic myelolipoma* (Al-Rukibat et al., 2006).

A Labrador Retriever was presented with suspected hepatic disease and Cushings disease. An enlarged left adrenal gland was found after the owner requested an adrenolectomy. It was (25 x15x 15 mm) with a focal nodule protruding from the external cortical surface. On the cut surface, normal adrenal gland architecture was seen with a moderatelywell-demarcated, firm, white-tan nodule with its surrounding areas with signs of hemorrhage. Histopathology confirmed that it was an *adrenal myelolipoma* (Tursi et al., 2005).

A dog with progressive enlarged abdomen, lethargy, anorexia, and vomiting was examined. The physical examination revealed pale mucous membranes, polypnea and palpable large abdominal mass. Radiography revealed a hydronephritic right kidney and urethral dilation, of the same side, due to a large abdominal mass. CT also made, showing that most of the abdominal viscera was displaced. The 5kg mass was surgically removed, and was found to have originated from the suspensory ligament of the ovary. The report notes that the mass was suspected to have been a liposarcoma but histological findings revealed that it was *lipoblastoma.* This is the first reported case of lipoblastoma in dogs (Finotello et al., 2011).

Intra-pelvic: A dog with dysuria-stranguria and with acute onset of anuria. The mass was surgically removed from the perioneal area. A well-demarcated mass yellow and firm mass was found of 7.5 x 4.5 x 3.2cm. Its cut surface was with dark foci and grey red areas (Mutinelli et al., 2007).

A male Golden Retriever was presented with a 6-month history of tenesmus. During physical examination a subcutaneous mass was found on the right flank. Also on digital rectal examination a smooth pain free mass on the ventral pelvic canal was palpated and revealed to be a source of compression if the rectum. A smooth tan coloured mass of size 9 x 3.5cm was ressected surgically. It was found to be adjacent to the rectum, and was closely associated with the right sciatic nerve.

Another case was also brought in with faecal tenesmus, this time for 4 months. This patient had multiple subcutaneous masses on the ventral trunk. These were revealed to be of adipose tissue origin after fine needle aspiration was used for testing. Digital rectal examination revealed a soft, pain free extraluminal mass on the right side of the pelvic cavity. This mass was compressing the rectum. In surgery a large, well-encapsulated mass was found adjacent to the distal colon casing compression of the viscera in the pelvic canal. The removal of the mass had resolved the clinical signs (Mayhew et al., 2002).

Extra-Thoracic: In another case, a male Doberman was presented with a mass on its lateral thorax was a mass involving the superficial muscles of the thorax was initially diagnosed as a mixed intermuscular hemangioma. It was later confirmed to be an *infiltrative angiolipoma*, with histopathology. It was described to unencapsulated, with vascular tissue invading the bundles of striated muscle. It measured 9 x 7 x 7 cm in size (Ligget et al., 2002).

Extra-Abdominal: A patient was described with gradual distention of abdomen. CT showed that the mass was 13 x 13 x1 0cm, displacing viscera to the right. During surgery it was found to be between the peritoneum and rectus and transverses abdominalis muscles. Histopathology confirmed it was a *chondrolipoma with calcification* (Shigeyuki et al., 2005).

Orbital: A white mass was found in the dorsal conjunctival fornix. Engorged conjunctival vessels were observed, while corneal ulceration and ocular irritation were also present. Ultra sonification showed a well-demarcated lesion. The mass was surgically removed and histopathology confirmed it was an *orbital lipoma*. The mass found measured 4 x 2 x 1cm in size (Williams et al., 2006).

Another orbital lipoma was presented in a 4-year-old castrated male Pekingese weighing 8kg. He was referred with impaired vision of the left eye and pain of unknown origin. The dog's behaviour changed over time and the owner claimed that the dog was rubbing its eye and becoming anorexic. The physical examination revealed descemetocele and presence of a milky substance in the anterior chamber, extremely engorgement of the episcleral vessels and oedema of the left eye. The left eye pressure was measured at 42mm Hg as opposed to the right at 26mm Hg. All clinical findings confirmed glaucoma with uveitis in the left eye. The left intraocular pressure was reduced. After 7days of treatment the uveitis and the intraocular pressure cleared up but without change to the size of the milky substance. Surgical resection was used with preoperative treatment with atropine. Histopathology results of the mass confirmed lipoma. The symptoms completely disappeared and no reoccurrence was reported (Fattahian et al., 2008).

Submandibular: A Black and Tan Coonhound had a mass removed that was described as an *infiltrative angiolipoma*. Due to large invasive growth and the mass encompassing the carotid artery, the surgeon did not completely remove it. The author also added that the bulk of the mass was external to the muscle (Ligget et al., 2002).

A 6-year-old castrated Boerboel female weighing 43.5kg was examined with a mass found caudal to the right angle of the mandible and below the ear. The mass had been growing over 18 months and at examination measured 10 x 5 x 5cm. US revealed salivary glnad infection and reactive lymphadenopathy. Fine needle aspiration Biopsy of the mass was taken while also an incisional biopsy was taken from the mass. Macroscopically, the mass was covered

by a thin pseudocapsule. On the fibrous type capsule small spots of purple colour were described which may be indicating infiltration of the tumour. Once the mass was resected it was described as measuring 1.5 x 1 x 0.5cm, yellow-white in colour and nodular in shape. During the surgery the mass appeared to infiltrate the sternothyroideus and sternohyoideus muscle. The parotid gland was viewed as enlarged. Histopathology confirmed the mass diagnosis as Infiltrative Angiolipoma, infiltration being shown in surgery. This is the first case reported in dogs as an infiltration of the parotid gland (Kitshoff et al., 2010).

Pharyngeal: A Hungarian Vizsla was reported to have an *angiofibrolipoma* found within the oropharyngeal cavity. The tumour was hindering food intake and ingestion, and causing retching. The mass was removed surgically and taken for histopathological examination. It was approximately 5cm in size and was grey white, grey red in different regions of the pedunculated mass. Macroscopically it was described to have signs of inflammation, due to the mechanical stress caused by the postioning of the lipomatous growth. This is when the origin of the mass was revealed. After surgery all described clinical signs were resolved (Jakab et al., 2009).

Laryngeal: A *chondrolipoma* was described to be found in the supraglottic area, protruding into the cavity causing upper respiratory obstruction, in a Boxer patient. The tumour was lobulated and grey white in colour. After it was removed it was found to be 3 x 2cm in size (Jakab et al., 2010)

Figure 10. The endoscopic picture of the laryngeal chondrolipoma, obturating the entrance of the larynx. (*picture by Roland Psader*)

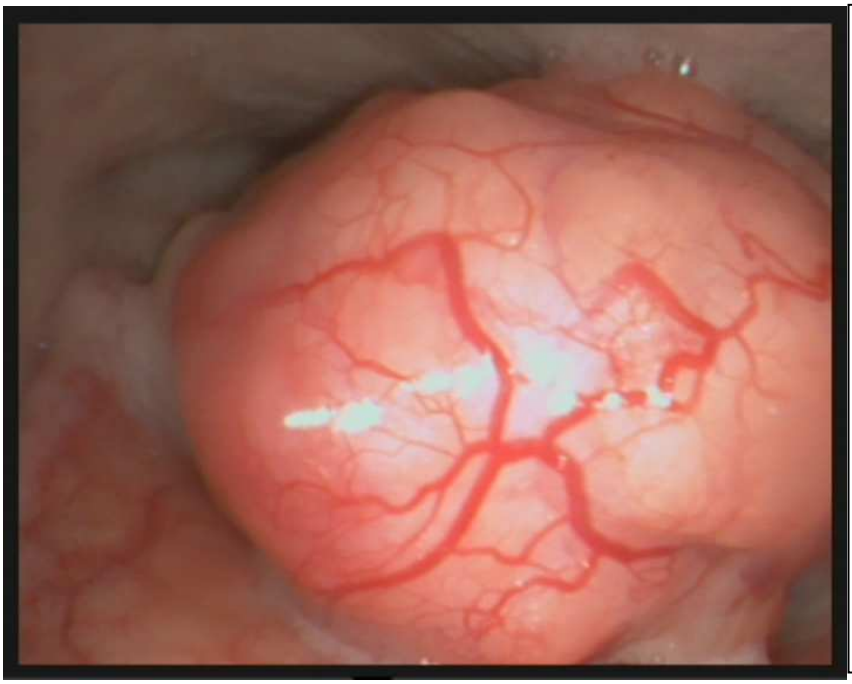


Figure 11. The laryngoscopical picture of the exophytic laryngeal chondrolipoma from sarplaninac dog. (*picture by Roland Psader*)

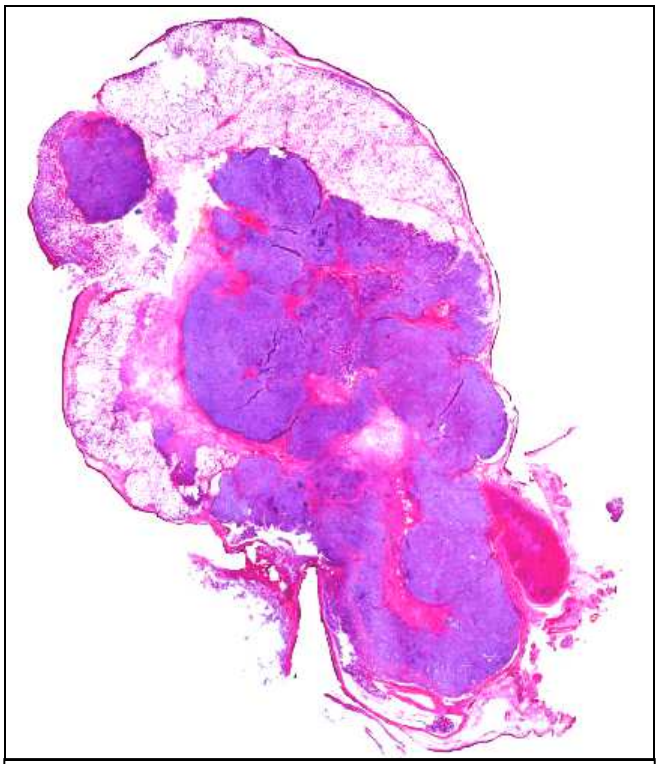


Figure 12. The cut surface of the laryngeal chondrolipoma from sarplaninac dog HE, 0.22X. (*picture by Csaba Jakab*)

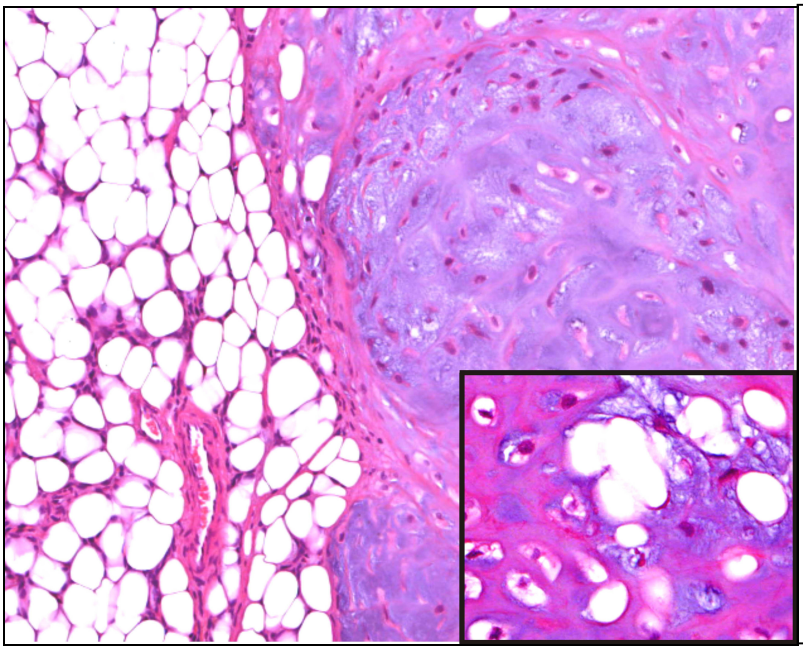


Figure 13. At the left side of the picture the lipoma and at the right side the proliferation of the chondrocytes and accumulation extracellular matrix can be seen. The low part of the lipoma two intratumoural vessels can be seen HE, 10X; Insert: Mixed population of the lipocytes and chondrocytes at higher magnification HE, 40X (*picture by Csaba Jakab*)

Intercarpal: An English Springer Spaniel was reported to have signs of carpal canal syndrome, after long complaint of lameness, worsening with exercise. Signs of moderate pain at flexion were also observed. CT was used to find the location of the tumour. With fine needle aspiration it was found to be a *non-infiltrative lipoma*. The tumour was found to be extending into the carpal canal from the antebrachial joint compressing the nerves. The tumour ressected was 30 x 20 x 10mm in size (Szabo et al., 2011).

Cardial: A significantly young dog (3-year-old) mixed breed dog was referred with exercise intolerance and dyspnoea. Pulmonary and cardiac sounds were slightly muffled, while ECG showed low QRS deflections. Thoracentesis and pericardiocentesiswere performed and results revealed mild reactive pericardial and thoracic effusion. At this time atrial endocardial thrombus was suspected. Due to worsening condition the dog was euthanized and a necropsy was performed. During the necropsy diffuse pulmonary atelectasis was found, along with a large thrombus occluding approximately 70% of the cranial vena cava and the right atrium. The mass was elastic and included a large coronary artery. Ulceration due to the firmly attached fibrocellular thrombus was also noted. The mass was described as not encapsulated but well defined. The necropsy concluded that the venous congestion had occurred due to *a primary right atrial cardiac lipoma* (Brambilla et al., 2006).

Uteral: An 11-year-old cross Pomeranian Female was found to have a large mass in one of her uterine horns near the body of the uterus. When initial examined it was anorexic and it had fever. On surgical exploration the mass was found. An ovariohysterectomy was performed. The tumour weighed 375g and measured 7 x 9 x 11cm. On gross description it looked multinodular and was soft and yellow. The author also described areas of cartilaginous and bony tissue islands. Histology diagnosed the tumour as *angiolipoleiomyoma* (Boisclair et al., 2001).

Perianal: A Female boxer was reported to have developed an encapsulated tumour on the dorsal perianal area. It was removed surgically and measured 0.6 x 3mm in size. It was described grossly as a whitish coloured mass, containing greyish and dark spots (Jakab et al., 2009).

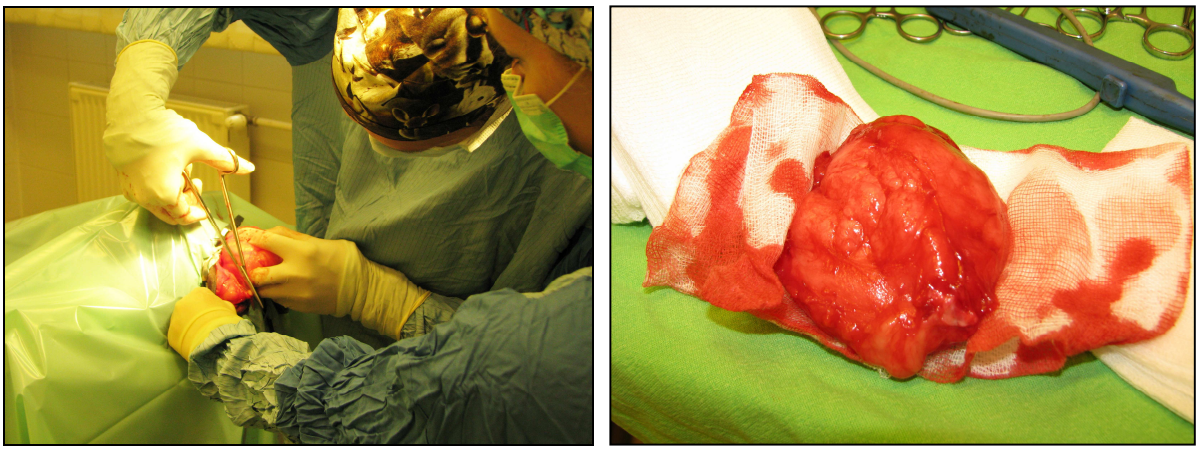


Figure 14-15: Surgery of the perianal lipoma, Intraoperative, and postoperative pictures. (*pictures by Csaba Jakab*).

Intermuscular: 11 cases were described, and all were surgically removed. Generally, no clinical signs are seen with these slow growing tumours. Often these tumours only cause increased discomfort due to their positioning, usually on the medial side of the femur. These masses are predilected to Labrador Retrievers, found, most often than not, between the Biceps, the Semitendinous, or the Semimembranous muscle. These tumours are easily ressected with no invasion of surrounding areas. Necrosis could occur when left to enlarge over a period of time. These types of tumours are very frequently seen (Thompson et al., 1999).

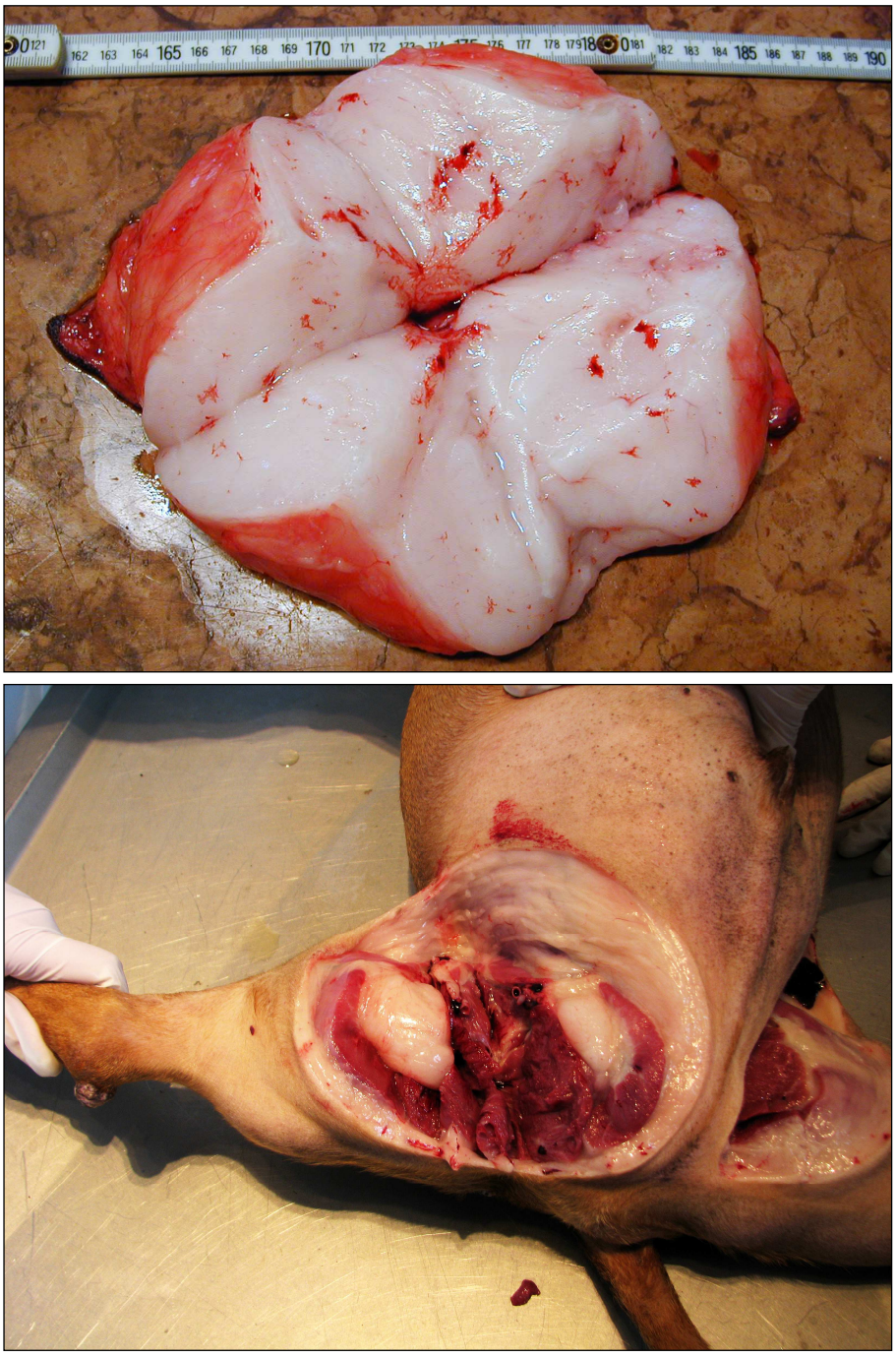


Figure 15-16: Intramuscular lipoma examined from 2 different dogs. Cut surface and intramuscular positioning seen respectively *(pictures by Csaba Jakob*).

Extra-dural: An Alaskian Malamute was examined after a 1 year history of difficulty of rising and deficit limb gait of the pelvic limbs. Physical examination revealed that the dog was pyretic, and paraplegic in the rear limbs with retention of deep pain sensation. All postural reflexes were absent, while spinal reflexes were exaggerated. Radiography revealed compression of the extradural region, as well as hip dysplasia and ossification of the cervical and lumbar dura. During surgery a tan brown mass was found over the L1 dorsally and extending over to the caudal aspects of L2 segments. Histopathology confirmed that this mass was an *extradural myelolipoma* (Newman et al., 2000).

A 12-year-old Labrador retriever was examined with an anamensis of hindlimb weakness. Shoulder and neck pain was noticed by the owner, which could have been related to a past car accident. At the time of the accident, paraparesis was observed. The dog had multiple subcutaneous lipomas at the time, and it was reported that there was hip joint pain along with crepitation of both stifle joints. Proprioception was noted to be less in both pelvic limbs but least on the right side. Patellar reflexes were also decreased. Due to the history of neck pain an initial possible diagnosis was made of multifocal spinal cord lesion. Biochemistry analysis results showed slight hyperglobineamia, with spinal cord radiographs indicating decreased bone density of the vertebral bodies. Spondylosis was seen all through the thoracic and lumbar region. This resulted in fusion of the 13th thoracic vertebra to the 5th lumbar vertebra. CT scans revealed a mass in the extradural space and occupied the vertebral bodies of L2 and L3. The lamina of L2 was perforated and rigorous bone remodelling was reported. The dog was treated with prednisolone and after 2 months was euthanized due to progressive paraparesis. Necropsy revealed a white gelatinous mass filling the extradural space, and was found to surround most of the lumbar section of the spinal cord. It was mostly observed in the dorsal part of the spinal canal. A similar mass appeared in the bodies of L2 and L3 vertebra, causing bone lysis and growth of the bodies themselves. The histopathological examination diagnosed it as *extradural angiolipoma* (Reif et al., 1998).

Significant Human Cases:

B) **Deep Lipoma**

Mediastinal: An 83-year-old man with sinus rhythms on ECG, and some paroxysmal atrial fibrillation, was examined. CT revealed a large tumour, mediastinally. It was removed through sternotomy. Tumour was encapsulated, with no invasions to surrounding tissues. It had a tight adhesion at the pericardial mediastinal fat tissue. It measured10 x 15cm and its cut surface showed multiocular structures with fibrous septa. Microscopy revealed it was a *simple lipoma* (Minematsu et al., 2010).

Vesicular breathing sounds on the left found after a trauma. Radiography revealed opacity at the mediastinum and left hemithorax. It was removed surgically. It was found to be a *thymolipoma.* Mass covered the heart and its vessels. It was also causing lung collapse. It was encapsulated, elastic in consistency, with white, yellow tissue (Mourad et al., 2009).

Orbital: A 65-year-old man complaining painless left proptosis, and diplopia on extreme right gaze. Computed tomography revealed a well circumscribed, moderately enhancing mass in the medial of the orbit. At first surgically removal was denied, but as the patient becaome more symptomatic as the mass enlarged, the patient agreed to remove it. The mass was removed, and measured 35 x 25 x 19mm in size and had a brownish yellow appearance and was encapsulated (Davies et al., 2002).

A 41-year-old woman was examined after a 4 month history of a slow growing, left groin mass. It was not very tender, approximately 10cm, pulsatile and painless found within the deep soft tissue of the thigh. Using CT a mass with fatty consistency and focal regions of calcification were seen. Grossly the mass measured 9 x6 x 8.5cm and was found adjacent to the deep femoral artery. The cut surface was described as tan-white and rubbery in consistency with mostly fatty like appearance. Results through histopathology and Immunohistochemistry revealed a *lipomatous hemangiopericytoma* (Cerbello et al., 1999).

Figure 17: Macroscopic picture of an Orbital HPC (Davies et al, 2002). Davies describes it as "well encapsulated" and "firm".

Buccal: 59-year-old woman was examined complaining of a polyp-like mass within the buccal cavity. According to the patient that it had been present for around 20 years but only started to grow larger about 3 years earlier to referral. The mass was encapsulated, freely movable but not pendunculated. The consistency was elastic and non tender. Histopathological examination revealed that the mass was an *angiofibrolipoma* (Brkic et al., 2010).

A 49-year-old female was examined for a painless mass found on the left lateral margin of the tongue. The patient had noticed the mass 8 years before. She had noticed that it had become slightly uncomfortable while chewing, lately. During intraoral examination the mass was described grossly as oval, wellcircumscribed, non- tender and hard. The mass was removed completely and measured 0.8cm in diameter. Histopathologically it was described as *osteolipoma* (Piatelli et al., 2001).

A mother of a 6-year-old boy brought in her son claiming that the patient could not close his mouth. An intraoral examination revealed a well-defined, of pedunculated growth on the right side of the buccal cavity. It was grossly described as a faintly yellow colour, while the periphery

region bore teeth indentations. The mass was firm and measured 3cm x 1.5 cm in size. Histopathology revealed a diagnosis of *lipoma* (Venkateswarlu et al., 2011).

Hypopharyngial: A 52-year-old woman was referred due to a feeling of thickness in the throat and an appearance of a mass while retching. She described that she has had this complication for 5-6 years but the mass could only be seen in the past 2. After the mass was stabilized it was found to originate from the left sinus of the pyriformis. MRI revealed a polypoidal structure of 6cm x 5mm at the level of the arythenoid cartilage. The mass was removedand was described as yellow in colour, smooth surface, and well capsulated. Pathological examination diagnosed the mass as a *myxoid type spindle cell lipoma* (Evcimik et al., 2011).

Oropharyngeal: Foreign body sensation in throat for 6 months. No pain or swelling. It was removed during surgery without the tonsil. Histopathology revealed it was *Fibrolipoma*. On examination, 3x1cm polypoidal mass were seen, at the upper part of the left tonsil. It was non-tender (Nandukamar et al., 2010).

Auditory tube: A 34-year-old Asian woman presented with a 6-year history of 'persistent' otitis media and tinnitus. 5 years earlier the patient had removed a choanal polyp in the right nasopharynx. With endoscopy the mass was seen as yellow-coloured and encapsulated. The mass was completely removed by endoscopy. The tumour was found to arise from cartilaginous portion of the Eustachian tube. The macroscopic description was a well-encapsulated yellow-coloured tumour, with a soft consistency. Histopathology revealed that a *fibrolipoma* was removed. No signs of recurrence or symptoms had occurred (Lui et al., 2011).

Endobronchial: A 74-year-old man was examined with shortness of breath and an irritant cough and incidents of fever. He had a history of recurrent pneumonia. Decreased respiratory sounds were heard on the right side. Radiography showed atalectasis on the right, also showing pleural effusion. A well - circumscribed mass was observed on the right main bronchus using bronchoscopy; of polypoid -like form. The mass was exercised surgically. It measured 1.5x 4.5cm in size, and had a yellow colouring. The patient recovered totally after surgery. A 44-year-old woman also was admitted with history of an irritant cough. The mass was also found on the right side, this time on the right lower lobe and showed pleural effusion. Irreversible lung damage

was made by the mass due to suppurative infection. Histopathology showed in both cases endobronchial lipoma (Cao et al, 2011).

Cardiac: A 62-year-old male with history of Cowden syndrome and hypertension, was referred due to a cardiac mass inside the right atrium. The mass was found after an episode of atrial flutter. MRI confirmed that the tumour was infiltrating the atrial septum, causing septal aneurysm. The mass was completely removed during surgery. Histological examination confirmed that the mass was a *primary cardiac lipoma* (Karangelis et al., 2010).

Cerebral: A 12-day-old boy was referred due to diagnosed of ventriculomegaly. No seizures or facial dysmorphism was reported. Cerebral ultrasound examination showed asymmetric dilation of the occipital and temporal horns of the lateral ventricles. The frontal horn was of normal size but separated more from the midline. The corpus callosum was completely absent. The ultrasound examination revealed a cerebral lipoma of 4.5 x 3 x 2.5 cm in the interhemispheric fissure, anterior to the corpus callosum. The patient was put under observation and conservative treatment at the neurology department (Popa et al., 2010).

Duodenal: A 60-year-old woman was experiencing general symptoms of fatigue, and being unwell. She was found to be anaemic, but did not report any weightless, pain or vomiting. Following and endoscopy, a large polpy was found in the anterior duodenum. A transduodenal resection was performed due to the size of the mass. Histopathology described it as a *submucosal lipoma* (Kadaba et al., 2011).

Interscapular: A 21-year-old man was examined when an interscapular pain free mass. The patient was asymptomatic. The overlying skin was freely moveable. The mass was completely ressected and examined histopathologically. The mass was described as tan-brown in colour and encapsulated. Results revealed that the mass was a *hibernoma* type tumour (Kosem et al., 2001).

Inguinal: It was removed surgically. After pathological examination it was concluded: *Angiofibrolipoma*. The mass was found on the spermatic cord. It was non-tender and elasticated in its description. The cut surface was multilobular cyst filled with blood (Lui et al., 2009).

Intermuscular: A 41-year-old woman was examined after a 4 month history of a slow growing left groin mass. It was not very tender, approximately 10cm in size, pulsatile however painless; found within the deep tissue of the thigh. Using CT a mass with fatty consistency and focal regions of calcification were seen. The mass grossly measured 9x6x8.5cm and was found adjacent to the deep femoral artery. The cut surface was described as tan-white with a rubbery consistency of mostly fatty appearance. Histopathology and immunohistochemistry revealed *lipomatous hemangiopericytoma* (Ceballos et al., 1999).

Parosteal: A 70-year-old man was examined with a firm mass, attached to the left femur. MRI showed a well-defined lobulated lipomatous mass on the ventral-lateral side of the femur. The tumour was removed easily during surgery, and in recovery no nerve palsy was present. The mass was described as encapsulated measuring 9.0 x 7.5 x 4.0cm with thin vascularised fibrous capsule. On the cut surface a yellowish fatty tissue was described, with bone like structure within. Also fibrous streaks were described. Histopathology diagnosed this mass as an *osteochondrolipoma* (Rau et al., 2006).

Intraosseous: A 27-year-old man was examined with complaint of a cough for a week.Chest radiography revealed a mass involving C1 and C2 vertebral bodies. MRI measured 8x5x4cm mass growing into the pharyngeal soft tissue. An open biopsy was performed, but no tumour resection was performed. The tumour was diagnosed as an *intraosseous lipoma*. These usually occur after a trauma or bone infraction. The differential diagnosis is parosteal lipoma growing from the soft tissue (Zhu et al., 2010).

Intercarpal: Complaints of parasthesis and pain in hand including fingers. MRI helped locate the tumour. Fusiform enlargement of the median nerve within the carpal tunnel was seen. The tumour was removed surgically. Though imagining it was diagnosed as *neurofibrolipoma* (Diwakar et al., 2011).

Intra-articular: Recurrent swollen, painful knee over 6 months without trauma. There was a limited range of motion. MRI and arthroscopy were used. It was completely removed. Histopathology concluded that it was *angiolipoma.* They revealed a 20 x 20 x 10mm polypoidal nodule consisting of synovial fluid and lipoma (Nishimori et al., 2010).

Uteral: A Postmenopausal woman complaining of white discharge from vagina. US showed multiple leiomyomas. Vaginal hysterectomy was performed. Histopathology revealed it was *lipoleiomyoma.* It tumours measured approx. 3 x 3 x 2cm and were found intramurally and subserosaly. They were described as grey white with whorled appearance (Sudhamani et al., 2010).

Omental: A 2-year-old girl was admitted with a large abdominal mass and abdominal distention. Ultrasound examination showed an unilocular mass of uncertain origin. Computed tomography showed that the mass was intraperitoneal and well encapsulated. During surgery the mass measuring 15 x 12 x 6cm was found, to be originating from the omentum. Pathological examination gave a diagnosis as a *lipoblastoma* (Mallick., 2007).

A 13-year-old girl with a painless abdominal mass and it has been progressively increasing in size. She started to notice weight loss and easy satiety when eating. She also started having colicky abdominal pains. A preoperative diagnosis was lymphoma. Ultrasonography and guided fine needle aspiration cytology showed that the mass was of lipomatous consistency. The mass was removed surgically. The mass was well-encapsulated 34x 24 x 22cm and yellowish in colour. The mass originated from the omentum. The proximal third of the transverse colon was also adherent to the mass. The cut surface was described as pale yellow and lobulated, with focal areas of calcification (Abubakar et al., 2009).

Hepatic: A 50-year-old woman was referred with mild gastro-oesophageal reflux. Abdominal US revealed a mass in the right lobe of the liver. MRI and CT were also performed to try to diagnose the mass. The mass was removed with the excised liver segment. The mass measured 8x4x8 cm3 and was described as well-circumscribed and unencapsulated tumour. The cut surface was yellowish-red and soft. The diagnosis given after histopathology was *Angio-(myo)myelolipoma* (Chatziioannou et al., 2002).

Retroperitoneal: 56-year-old woman was admitted due to progressive abdomen distention. After physical examination it was confirmed that the cause was a palatable large mass. Ultrasound showed a huge, solid, mass occupying most of the abdominal and pelvic cavity. The tumour was

ressected and it measured 27 x 23 x 13cm. The mass was well encapsulated with elastic to hard consistency. The cut section was described as white to bright yellow in colour. Histopathology confirmed the mass was a *lipoleiomyoma* (Oh et al., 2001).

Renal: A 76-year-old man underwent total right side nephrectomy due to a 20 cm large renal mass. Originally it was described as a renal epithelioid angiomyolipoma. Within 9 years a 17cm mass was found on the renal fossa while also continuing on its vena cava. The liver was also found to be hypodensities. Immunohistochemistry was performed on the biopsied lesions. They resulted to be *recurrent epithelioid angiomyolipoma* (Varma et al., 2011).

Adrenal: A 54-year-old woman was examined with a 10 year history of mild long term post prandial abdominal pain. CT scans of the retroperitoneal space identified a large mass of adrenal gland origin. The patient has a clinical history of hypertension, diabetes mellitus and hypercholesterolemia and markedly obese. Using the CT scan results a lapratomy was preformed, removing the entire left adrenal gland. The mass was partly covered by adrenal gland cortex and measured approximately 16 x 14 x 17 cm and weighed 950g. It was overall described as smooth, soft surface with homogenous and yellow brown colour, with occasional red-brown lesion. These represented the small focal haemorrhages within the cortex marginal to the adipose tissue. After the procedure the patient recovered and her symptoms of pain were resolved. Adrenal gland *simple lipoma*s are very rare, fond without megakaryocytes, immature leukocytes or erythrocytes; ruling out myelolipoma (Kapetanakis et al., 2011).

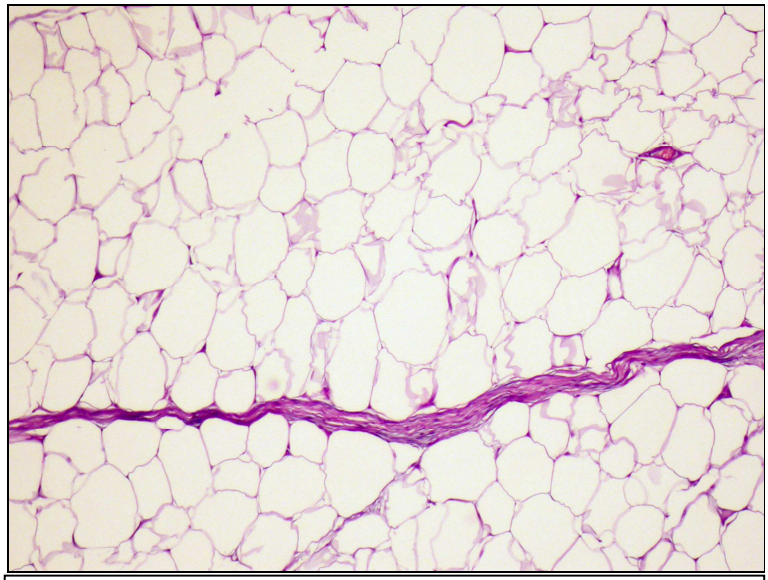
Extra-luminal: A 49-year-old man with edema and with early skin changes in his left limb. The initial diagnosis from the ultrasound results was isolated thrombosis. CT showed no obstruction but revealed a lesion with cystic adjacent to the right common femoral vein. The symptoms worsened and the patient was taken in for exploratory surgery. This revealed a lipoma under the femoral sheath, compressing the femoral vein. The mass was encapsulated, and was taken for histopathological examination, which confirmed that the mass was a lipoma (Gasparis et al., 2009).

Histotype descriptions in both human and canine cases:

Simple Lipoma: These mass may be very hard to distinguish from normal physiological fat, if no fibrous tissue or capsule is present (Lee et al., 2010).

Description in human; an abundance of fat droplets, which were differentiated with low cellular density and little vascular proliferation is seen using H.-E. staining (Minematsu et al., 2010).

Another description is of mature adipose tissue surrounded by a thin fibrous capsule (Sakurai et al., 2011).



Figures 18. Simple (conventional) lipoma in a dog. Biopsy sample. H.-E., 100x. (*pictures by Csaba Jakab*)

Described in dog; the adipocytes showed signs proliferation without infiltration of surroundings, seen using Fine Needle Aspiration and histopathology (Szabo et al., 2011)

- **Necrotic Lipoma**:

Descriptions in dogs; Based on needle aspiration the mass consisted mostly of clear unstained lipid vacuoles and consists of non unified atypical spindle cells with moderate anisocytosis, multiple irregular nucleoli and rare atypical mitotic figures. There wereareas of inflamed, necrotic fat within fibrous septae (Hammond et al., 2008). Histopathology results revealed fat necrotizing which was encompassed by a layer of chronic inflammation. In the solid outer area there were adipocytes. The soft reticular inner region consisted of fibrinoid debris. There were also lipofuscin pigment deposits in this area (Miles et al., 2001).

- **Infiltrative Lipoma**:

These mass usually infiltrate or invade muscle or fibrous tissue surroundings (Lee et al., 2010). These tumours are very hard to distinguish from a simple lipoma during cytology or histopatholgy, because more often than not, microscopically they cannot be distinguished. Often these are diagnosed in imaging for instance MRI (Morgan et al., 2007). Often during resection the surgeon would take note of any invasions of surrounding areas.
Description in dogs; in histopathology lobules of well-differentiated adipose tissue was seen (Morgan et al, 2007). Also described separately; as adipocytes and blood vessels, with a fibrous stroma. Necrotic tissue was expanding into the muscle layer (Ligget et al., 2002).

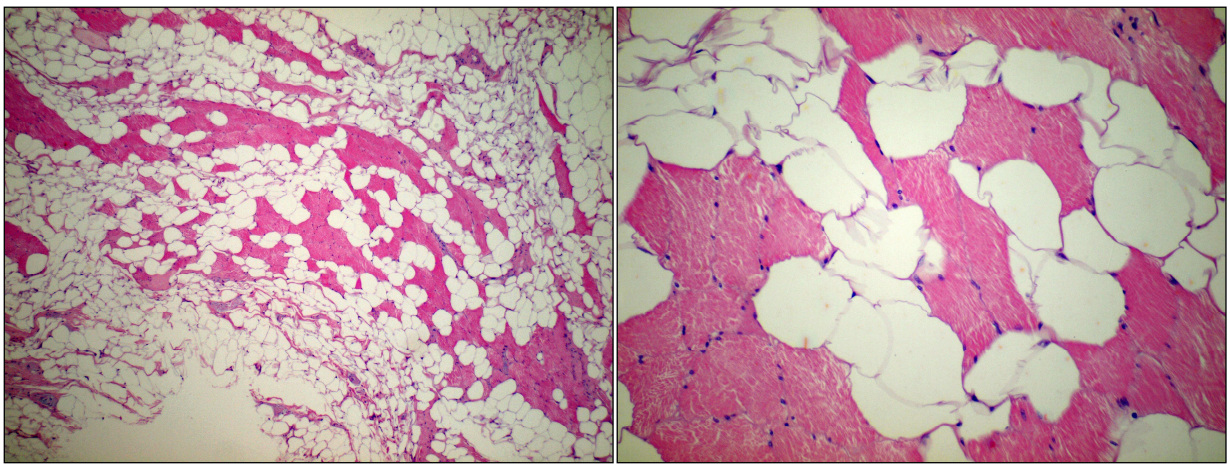


Figure 19-20: Infiltrative intramuscular lipoma in a dog. Biopsy sample. H.-E., 40x, 2400x.

(*pictures by Csaba Jakab*)

- **Giant Lipoma**

Described in dogs as a mass larger than 15cm in diameter in any plane. It could be unilobulated or multilobulated (Hunt et al., 2011).

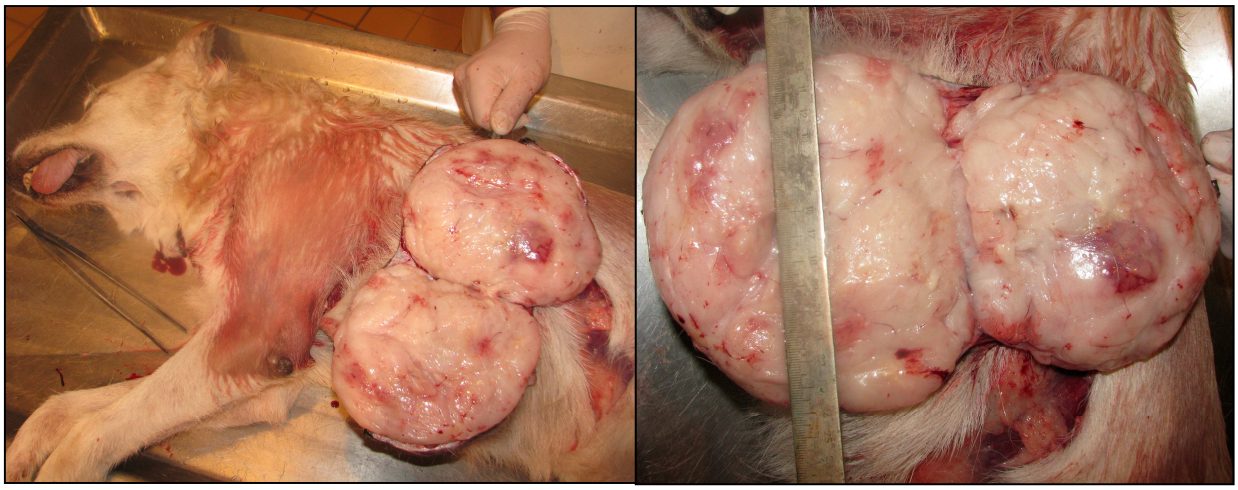


Figure 21-22: Subcutaneos giant lipoma in a dog. (*pictures by Csaba Jakab*).

Angiolipoma:

As described in humans; with H.-E., mature adipose cells mixed with aggregated and complicated blood vessels were seen (Nishimori., 2010).

As described in dogs; with H.E. examination revealed a multifocal, single or clusters of narrow walled blood vessels. These areas were interspersed with adipose tissue and intervascular fibrous connective tissue stroma. Because this mass was within a salivary gland, serous salivary glandular tissue remnants were found, with multifocal ducts. Fibrin thrombi occupied a few vessel lumens (Kitshoff et al., 2010). Another author describes this as thin blood vessels interspersed throughout the lobules of well-differentiated adipose tissue. Endothelial cells line the many vessels, in which some are branched and contain erythrocytes. Fibrin clots are also noticed occasionally in vascular spaces (Ligget et al., 2002).

- **<u>Infiltrative Angiolipoma</u>**:

Differentiation of a simple lipoma, angiolipoma and hemangioma which has been infiltrated by adipose tissue may be difficult. Large vessels are not seen in smple lipoma, and the presence of fibrin thrombin are used in human hemangiolipoma as a diagnostic tool, is absent in true lipoma. A study in a human group of angiolpoma and simple lipomas examined that angiolipoma have normal karyotype (supporting hamartomatous origin) while other simple lipomas show clonal chromosomal nature (Ligget et al., 2002).

Described in dogs; often seen to have a male predilection. The Adipose tissue was mature, with vascular tissue that was proliferating bundles of muscle striated fibres. In one area the tumour was composed only of vascular tissue. Muscle fibres were invaded and replaced by adiocytes and small vessels. Another case also had fibrin thrombi in the vascular areas. They usually have a cavernous-like description (Ligget et al., 2002).

Description in human; they rare grow larger than 2cm, and like canines they tend to be common in the subcutis, trunk, neck, breasts, and spinal cord areas. Some studies say that they can potential occur anywhere because of their mesodermal origin (Ligget et al., 2002).

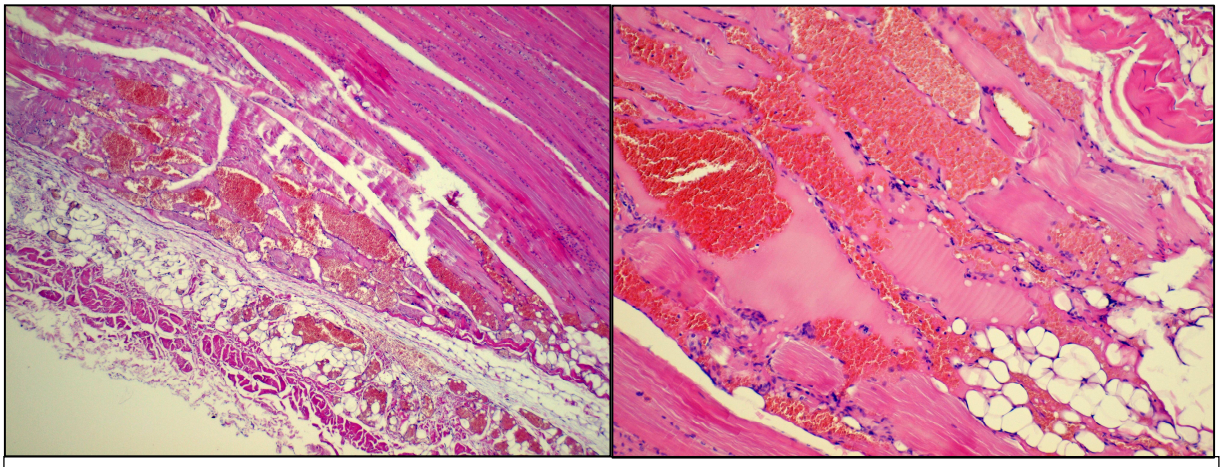


Figure 23-24: Infiltrative angiolipoma in a dog. Biopsy sample. H.-E., 40x, 200x. (*pictures by Csaba Jakab*)

- **<u>Angiofibrolipoma</u>**:

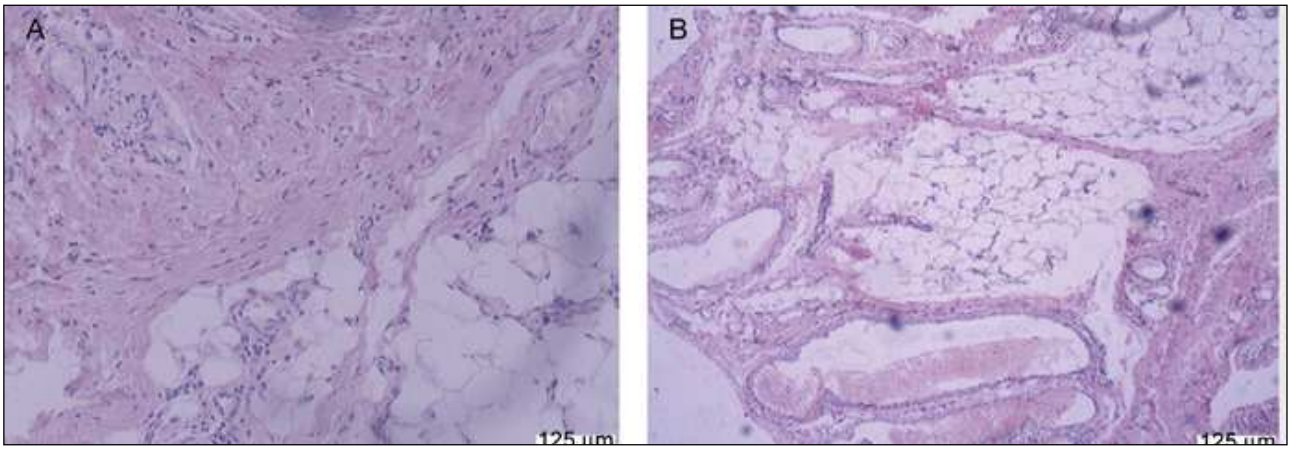


Figure 25 -26: Angiofibrolipoma in H.-E staining. Characteristically showing mature adipocytes, blood vessels and collegenous tissue (Lui et al, 2009)

Described in dogs; Using Haematoxylin and Eosin (H.-E.) and Azan-staining was used to view the mass microscopically. Indirect Immunhistochemistry analysis (IHC) was also used to confirm diagnosis from histopathology. During H.-E. examination lipocytes, capillaries, small muscle type arteries and collegen fibres were distinguished amoung the adipocytes. With Azan staining the collagen fibres appeared blue while lipocytes and bloodvessels were stained red. In IHC endothelial cells of the blood vessels positively reacted with klaudin-5. S-100 reacted positively to the mesenchymal type tissues and Ki-67 proliferation was found to be in little amount. These reactions are done because hemangioma, fibroma and lipoma masses can often be confused for eachother. IHC helps to avoid this confusion (Jakab et al., 2011).

Described in humans; as mature adipocytes, blood vessels, and collagenous dense tissue were present, with no signs of mitosis or pleomorphism, seen in H.-E. (Lui et al., 2009).

- **<u>Angiomyxolipoma</u>**:

The mass was described in humans as paucicellular myxoid tissue with mature adipose tissue including congested vascularisation. This was identified using H.-E. staining.

Immunohistochemistry stained positive with vimentin and CD34 to identify the spindle cells and dendritic cells (Kim et al., 2010).

Pleomorphic/ Spindle cell lipoma:

Described generally in humans; as a mainly lipomatous tumour with stranded collagen and *bizarre* pleomorphic cellular elements. Giant cells are also present, resembling a flower with intensely eosinophilic cytoplasm and hyperchromatic nuclei. These tumours are generally hard to diagnose using FNA and maybe thought of as liposarcomas. Foamy macrophages may also case difficulty in diagnosis when found in these tumours. Lipoblast are not present in these tumours but are generally described as multinucleated cells and prelipoblastic mesenchymal cells (Aravind et al., 2011).

Another case describes spindle cell lipoma stained with hematoxylin eosin as spindle cell strands mixed with fibromyxoid matrix and with mature fatty cells. Immunohistochemistry locates androgen receptors with nuclear expression representing spindle cells. Spindle cell lipoma tends to have a strong predilection to male patients as opposed to simple lipoma tumours being found in female patients resulting in a point mutation in a mitochondrial gene (Syed et al., 2008).

Myolipoma:

- **Angiomyolipoma:**

The lesion was described as having inconsistent and thick blood vessels, made of wide endothelial cells, surrounding smooth muscles cell bundles. Fatty tissue islets are also seen, typical of the tumour (Singh et al., 2009).

- **Epithelioid angiomyolipoma**:

Immunohistochemistry was performed on a recurrent mass found on the kidney and liver. The tumour cells were observed by intense reactivity of melanomcytic markers; HMB45 and A103,

while also positive for smooth muscle cells. Similar results were seen in colon specimens taken and later in the lung showing metastatic disease (Varma et al., 2011).

Fibrolipoma:

Described in humans; as mature adipocytes, interspersed with fibrous stands. Several septal capillaries were reported. It was covered by a non- keratinized stratified squamous epithelium. Lymphoid follicles with germinal centres were also noted along with chronic inflammatory cell infiltration. These were viewed in H.E. (Nandukamar et al., 2010).

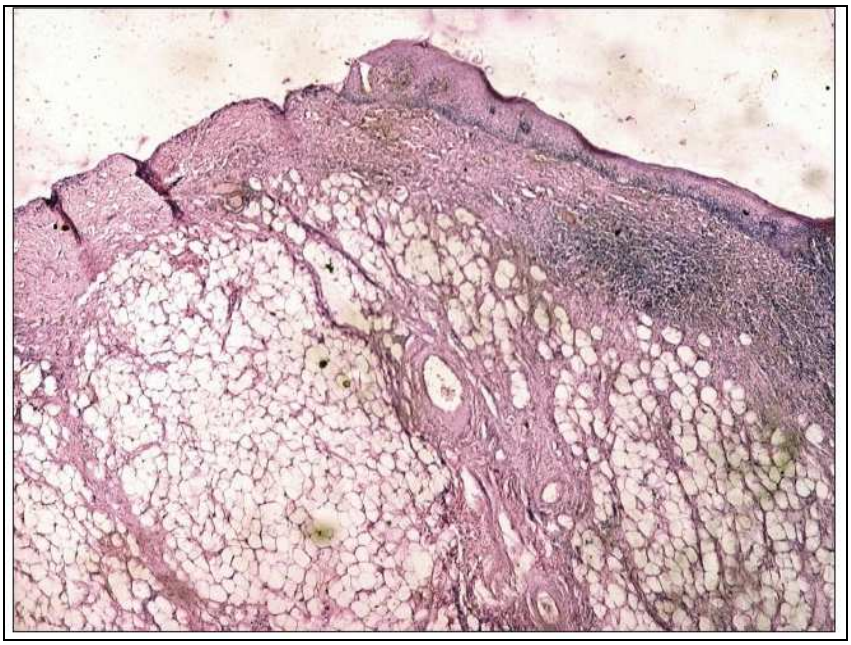


Figure 27: Fibrolipoma in a tonsil. Seen in H.-E. staining x200 (Nandukamar et al., 2010).

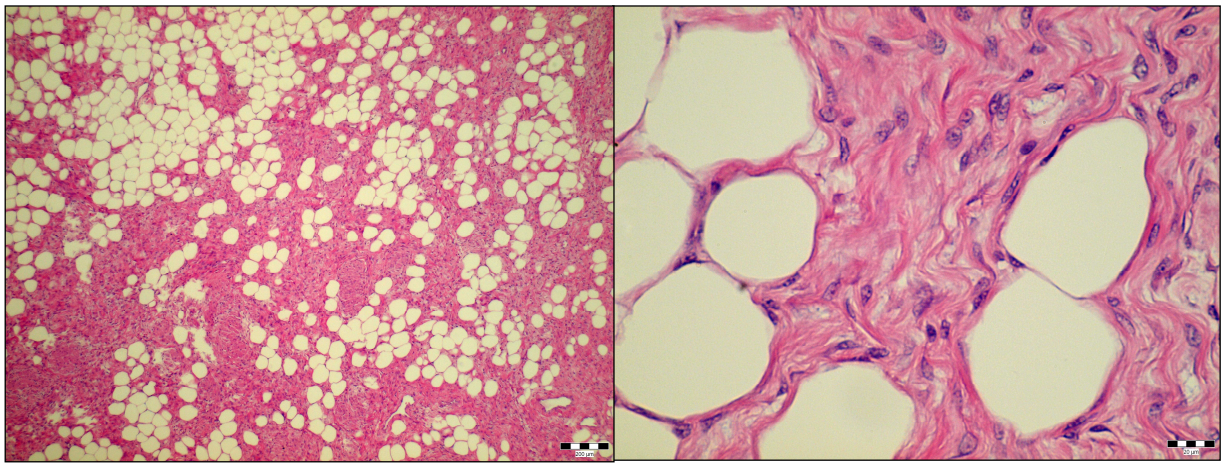


Figure 28: Fibrolipoma in a dog. Biopsy sample. H.-E., 40x, 200x. (*pictures by Csaba Jakab*)

Chondrolipoma:

Described in dogs; Using Haematoxylin and eosin, and periodic acid-Schiff, along with Masson trichrome and toluidine blue, histopathology described a non encapsulated tumour containing islets of hyaline cartilage, mixed with mature adipose tissue, myxoid and fibrous tissue. Immunohistochemistry was used also. PAS demonstrated chondrocytes, while Trichrome gave a slight positive stain for cartilage matrix. The collagen fibres, chondroid matrix, and cellular hyaline cartilage were also positive. IMC showed chrondrocyte positive reactions to S-100 protein, markers being present in both the cytoplasm and the nucleus. Most myxoid surrounded the cartilage and fibroblasts also reacted to S-100 protein, and vimentin labelling (Mutinelli et al., 2007). Ramirez also described using Toludine blue stain to confirm the presence of chondroitin sulphate in the chondroid matrix.

Described in humans; using a correct FNA technique and taking a good sample of a cell block, HE stain was used. Groups of cells were seen with many small vacuoles within the cytoplasm and which resembled lipoblasts cells. Groups of spindle cells, adipocytes and vascular cells were also reported. It was noted that there was a predominately myxochondroid and partially hyalinalized matrix. No cellular atypia, mitosis or necrosis was identified on the smear. IHC was postive for

S100, CD68, and pancytokeratin confirming that the biopsy was of tumourous origin. The author noted that these are typical characteristics of a chondroid lipoma (Yang et al., 2001).

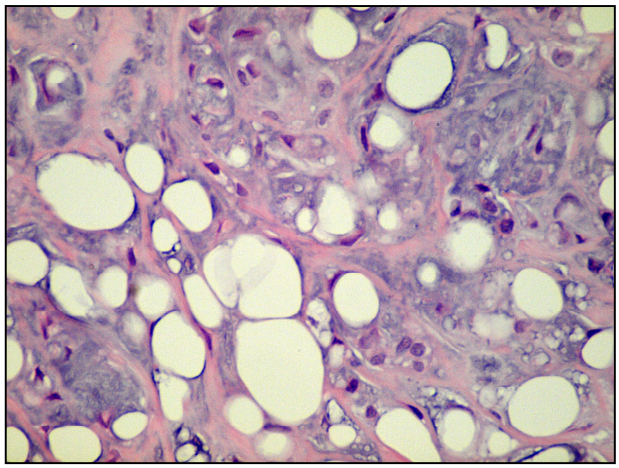
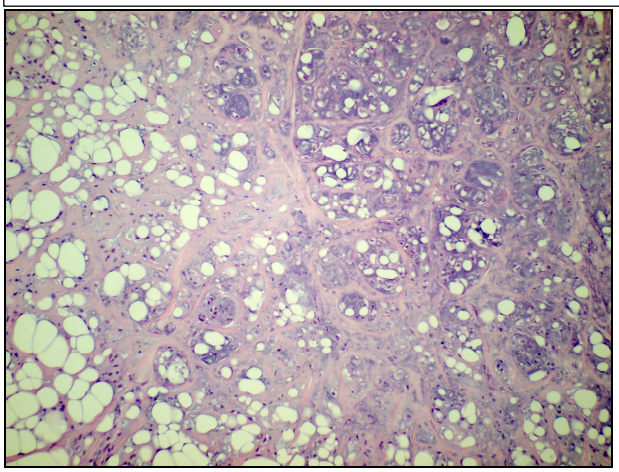


Figure 29-30: Chondrolipoma in a dog. Biopsy sample. H.-E., 40x, 200x. (*pictures by Csaba Jakab*)



<u>Osteolipoma</u>:

As described in dogs; Using H.-E. analysis areas of mature lamellar bone with osteocytes and peristeal-like fibrous connective tissue are seen. (Ramirez et al., 2009).

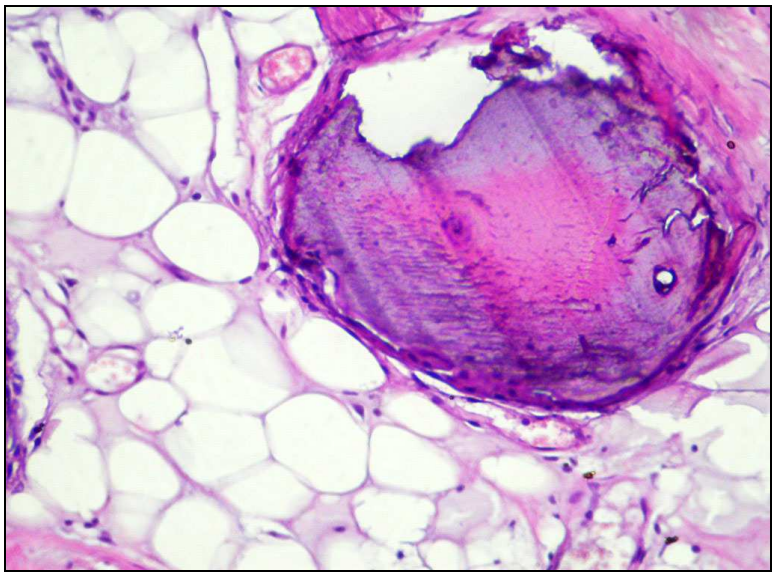


Figure 31: Histopathology of osteolipoma in a dog. Biopsy sample. H.-E., 200x.

(*pictures by Csaba Jakab*)

- **Chondro-osteoblastic lipoma**:

As described in Dogs; Using H.E. it was described as bone like structural islets showing periosteum- like areas of fibrous tissue (Ramirez et al., 2009).

- **Osteochondrolipoma**:

Described in humans; Histopathology revealed vacuolated mature adipocytes with strands of connective tissue, containing few fibroblastic cells. Also bony osteocytes and few osteoblasts were seen along the many ossified structures. H.-E. staining was used, while immunohistochemistry was used to examine the fibrous septae; which were only described in 1% of the mass (Rau et al., 2006).

Myelolipoma:

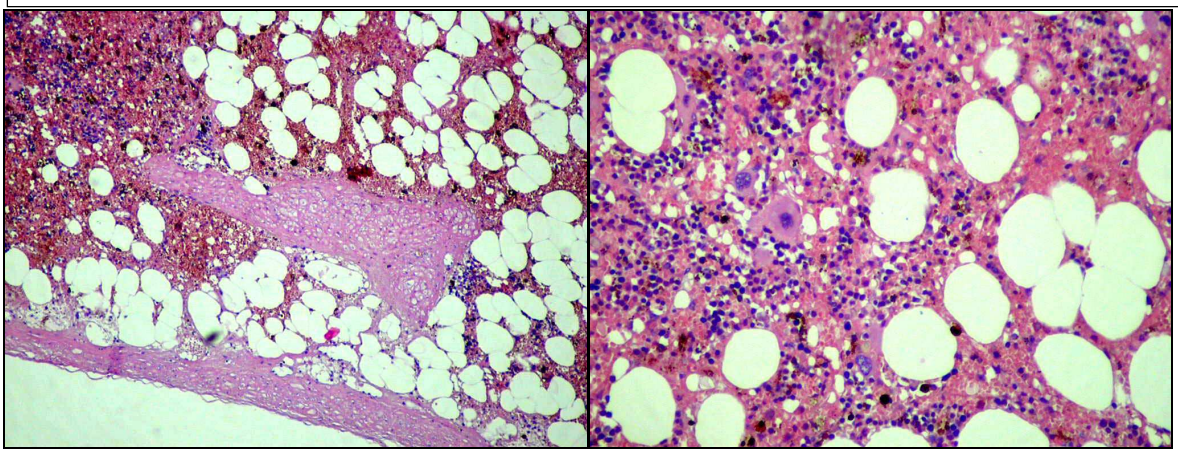
As described in dogs; Histopathologic examination using Wright's staining, of a splenic mass revealed a large, non-encapsulated mass. The mass consisted of normal marrow hematopoietic tissue and adipose tissue (Al-Rukibat et al., 2006). It was also described as well differentiated adipose tissue that was also found to continue into the level of the zona fasciculata of the adrenal cortex. It was surrounded by hematopoietic elements that included megakaryocytes; with

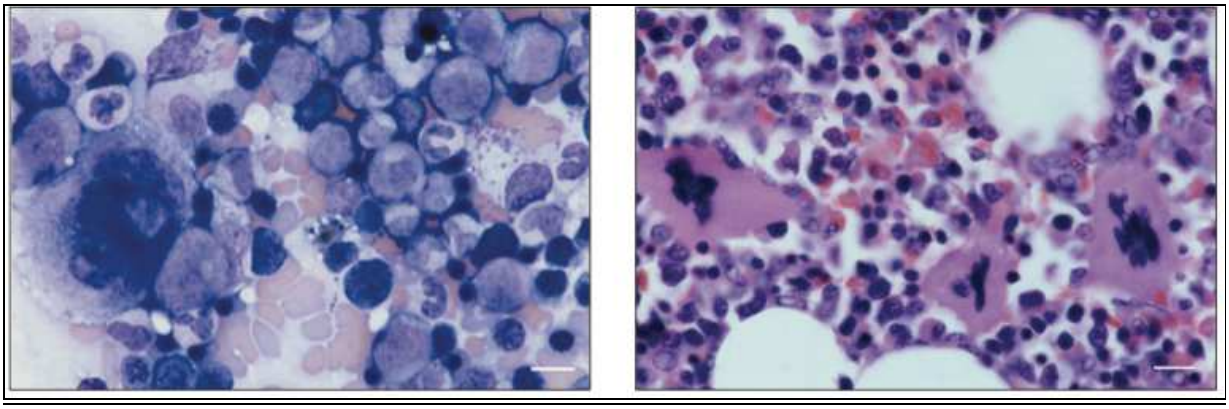
erytenoid and myeloid, with progressive growth stages. Also, in some regions, megakaryocytes, lymphocytes, plasma cells, hemosiderin filled macrophages and foci of mild hemorrhages were also present in the adrenal cortex (Tursi et al., 2005).

It can also vary in ratio of adipose tissue and hematopoietic cells. The mass consisted of a large amount of erythroid and myeloid cells intermixed between the fatty cells (Zimmer et al., 1983).

Figures 32-33. Splenic myelolipoma in a dog. Biopsy sample. H.-E., 100x, 200x.

(*pictures by Csaba Jakab*)





Figures 34-35. Splenic myelolipoma in human. Wright's Stain (Fig. 29) and H.-E. Stain (Fig. 30). (Raida et al., 2006).

Thymolipoma:

As described in humans; Hyperplastic thymic structures with Hassall's corpuscles in fatty adipocytes tissues (Mourad et al., 2009).

As described in dogs; well -encapsulated mass consisting of thymic tissue and mature adipocytes of approximately 2:3 ratio. The thymic tissue consisted of lymphocytic cells, along with numerous Hassall's bodies. Cystic degeneration of epithelial corpuscles was seen thought the mass. Cysts were filled with protein-like material, and lined with squamous or ciliated cuboidal-to-columnar cells. The adipocytes were well differentiated and were surrounded by thymic islands, separated by fibrous septa (Ramirez et al., 2008).

- **Thymofibrolipoma**:

Described in dogs; H.-E. routine staining was used to microscopically review this mass. It was found to have areas of necrosis and haemorrhage. The tissue was mostly consisting of collengen bundles intermixed with epithelial srands and lymphoid aggregates. This tissue was consistent with thymic remanats and was surrounded by fibroconnective tissue. This birous tissue positively stained by Masson trichrome. IHC was also used. Lymphoid cells reacted with CD3, vimentin and CD79 alpha. Fibroblasts and adipose tissue also reacted towards vimentin (Morini et al,

2009). Another case described microscopically, fibroconnective tissue septae, thymic consistent tissue and adipocyte in ratios of 70%, 20% and 10% respectively. The thymic tissue was composed of multifocal aggregates and small polygonal epithial cells. These had a high nuclear to cytoplasmic ratio. Some Hassall's bodies were also present (Morini et al., 2009).

Adenolipoma:

Described in humans; an eccrine duct (single coil) found within the centre of a lobulated fatty mass. The coil was enlarged due to the adipose tissue proliferation. Otherwise the actual duct was unchanged by the tumourous growth. Adenolipoma is a specific lesion that can only occur in subcutaneous ordermis (Del Agua et al., 2011). Ait-Ourhrouil et al, describes the duct as being much deeper within the dermis as compared to normal glands, measuring 40µm compared to 15mm within the mass.

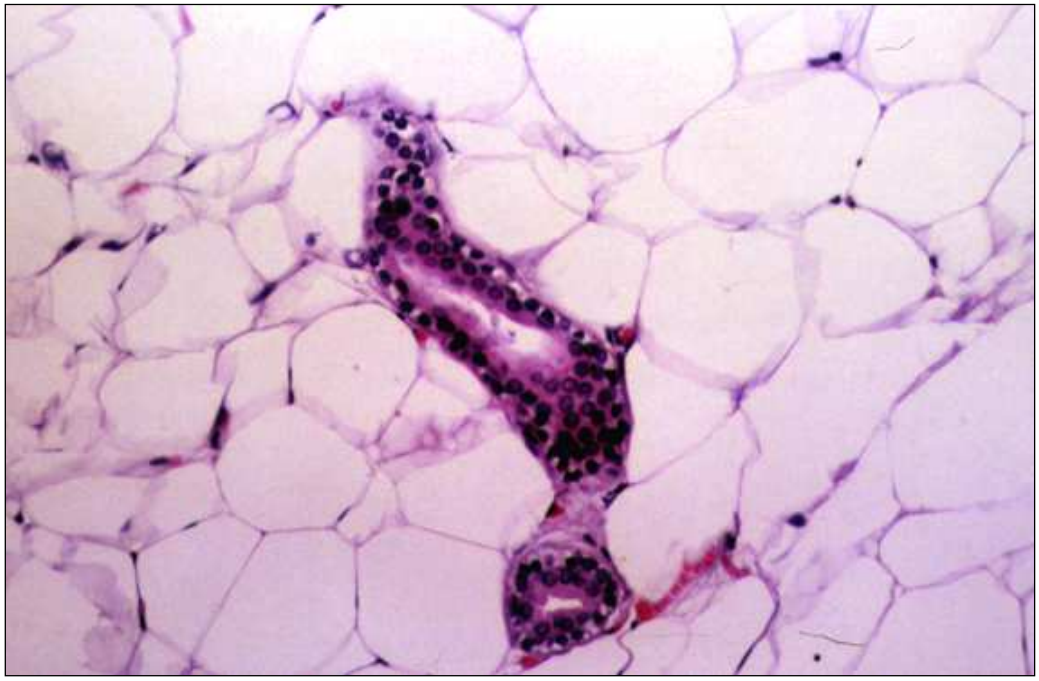
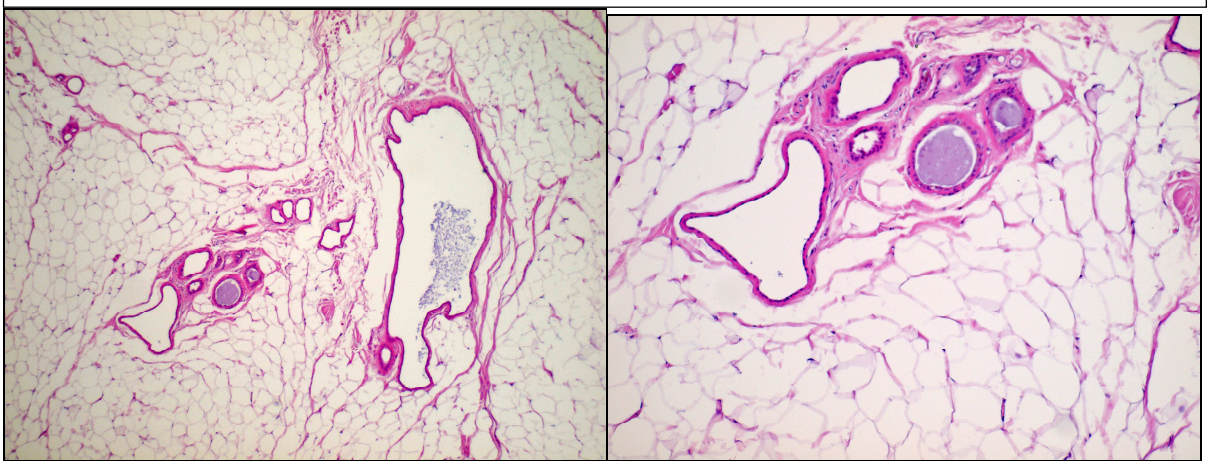


Figure 36: Adenolipoma seen in H.-E. staining and on high magnification. Eccrine gland may be seen surrounded by mature adipoctyes (Del Agua.,2011).

Described in dogs; well- differentiated lipocytes found within the apocrine sweat gland. The glandular tissue has been found to have no tumourous appearance. The final histopathological diagnosis, by the author was “cutaneous microcystic apocrine adenolipoma” (Jakab et al., 2013).

Figures 37-38. Histopathological pictures of cutaneous adenolipoma with central microcystic dilatation of the non-neoplastic apocrine glands, and peripheral benign lipoma cells. H.-E., 40x, 100x. (*pictures by Csaba Jakab*)



Lipoblastoma:

Described in dogs: mature adipocytes many with dimensional pleomorphism. Vascular elements were in abundance, with connective tissue and islands of extramedullary hematopesis. Lipoblasts were also seen surrounded by thin stroma. This was diagnosed as *congenital lipoblastoma.* Because these tumours could be easily mistaken for liposarcoma, or myxoid liposarcoma, histopathology using Masson Trichrome, Van Gieson and Alcian Blue was used, along with IHC analysis. This resulted in rich vascular and cellular proliferation reaction (using CD31 and Ki-67), these were compared to lipoma and liposarcoma sections. In histopathology analysis the mass showed it was surrounded by reticulinic and myxoid stroma, and profusion of

mucopolysaccharides (Alcian Blue), and collagen filaments (Masson Trichrome, Van Gieson positive) (Finotello et al., 2011).

Hibernoma: It is often misdiagnosed of rhabdomyoma or granular cell tumours. These are characterized by the absence of lipomatous tissue. Also, liposarcoma and multivacuolar eosinophilic lipoblasts are often mistaken for these; they bear a resemblance to hibernoma (Kosem et al., 2001).

Described in humans; H.-E. was used to microscopically diagnose this rare tumour. It is distinguishable by its large multivacuolated cells with slightly granular eosinophilic cytoplasm and highly stained nuclei, and univacuolated cells with peripherally found nuclei and smaller round cells with also granular cytoplasm (Kosem et al., 2001).

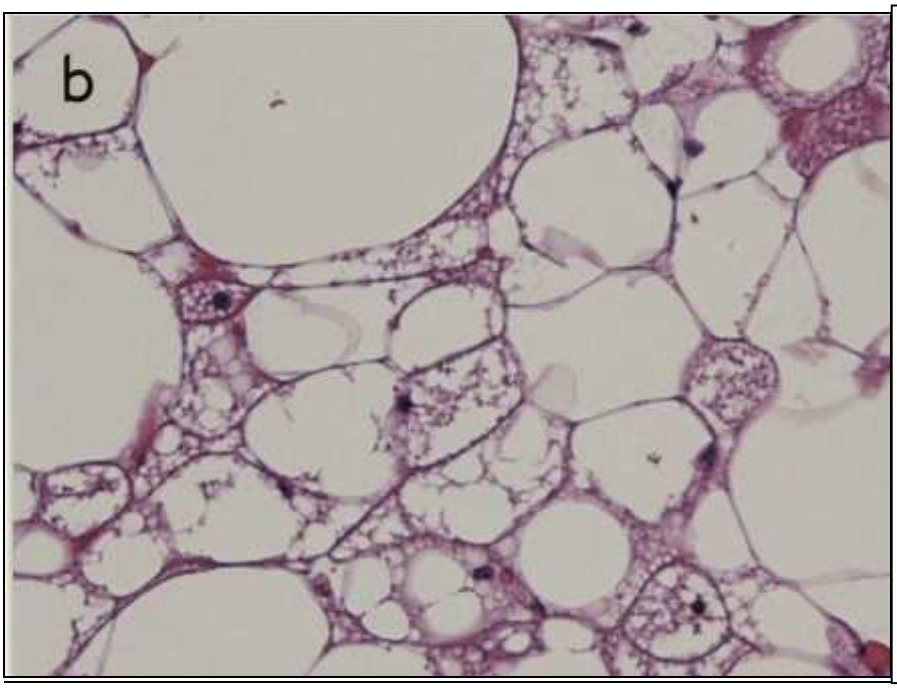


Figure 39: Hibernoma found in human case. Seen in this figure in high magnification and H.-E. Staining (Kanya et al., 2010).

Another article describes; granular cytoplasm with a small centrally positioned nucleus within a brown fatty cell which are multivacuolated. The cells are stained pale eosinophilic (Mavrogenis et al., 2011).

Specific Cases:

- **Angio(myo)myelolipoma**:

Described in humans; microscopically the tumour was described as adipose tissue with thick endothelial vessels, and cellular zones with spindle and epithelioid type cells in the trabecular arrangement. There were also areas of extramedullary hematopoesis. IMC, using HMB-45 was positive with melanosome assocated protein and smooth muscle actin protein. Megakaryocytes were reactive towards CD31 also (Chatziioannou et al., 2002).

- **Angiolipoleiomyoma**:

Described in dogs; the uterine tumour seemed to originate from the myometrium. The histology showed adipocytes separated by connective tissue septa. Smooth muscle cells were also irregularly present in groups. These clusters of cells were interspersed by a typical leiomyoma cells pattern. This means that they coiled in band- like forms. The tumour was described as being multifocal due to the hyalinization made by connective tissue separating the tissue. Islets of mature cartilage and bone tissue, sometimes as large are 5cm in diameter, also appeared in foci. Tumourous vascularisation was identified as being thicker and having irregular lumina, in comparison to the normal blood vessels. Immunohistochemistry positively stained smooth muscle cells with anti-desmin antibodies, while also staining adipocytes and chondrocytes with S-100 positively. Bone and cartilaginous metaplasia is rarely reported. This tumour is often seen in menopausal woman on the wall of the uterine body. They are uncommon even in human cases (Boisclair et al., 2001).

- **Lipoleiomyoma**:

As described in humans; Haematoxylin and eosin methods were used to depict smooth muscle cells, intermingled with mature adipocytes. Uterus showed cystic atrophy also (Sudhamani et al., 2010). Another description is of hypocellular spindle cells interspersed within the adiposcyte islands. The ratio of them were different depending on the sample area, it was mainly 4:1. Blood vessels were also often seen. IHC stained smooth muscle actin positive, confirming that the

spindle cells were of smooth muscle origin. These cells did not react with S-100, and HMB-45. The sample contained sclerotic hyaline cartilage and had no signs of lipoblasts (Oh et al., 2001).

Described in dogs; a mass containing mature adipose tissue along with smooth muscles. No mitotic cells were seen and all tissues were found to be well-differentiated. Immunohistochemistry was used to diagnose the tumour (Radi et al., 2005).

- **Fibrolipoleiomyoma:**

In a canine case: Haematoxylin and eosin staining bundles of smooth muscle, collagen fibre, separated by adipose tissue. The main diagnostic method used is immunohistochemistry to distinguish tissue types and classify the mass properly. Vimentin was stained positively, but desmin was stained variably. Using this method one can see similar quantities of adipose tissue, dense collagen fiber and smooth muscle cells (Woldemeskel et al., 2009).

No vaginal fibrolipoleimyoma type masses were found in humans; only within the uterus and these are very few in number.

- **Neurofibrolipoma** (i.e. neural fibrolipoma, lipofibromatous hamartoma, perineural lipoma, intraneral lipoma and lipomatosis of nerves):

In humans the lesion was described as; proliferation, which separates the nerve bundles. They are believed to develop within; from the fibroadipose tissue of the nerve sheath, perineurium or epineurium. These lesions are said to most often occur with the median nerve (Diwakar et al., 2011).

In another case it was described as a ‘fibrofatty’ element that separated the nerve fascicles and the fibers from each other. It had an undefined lobular pattern of tumourous consistency Macrodactyly is completely interrelated with neurofibrolipoma of the median nerve (Ahmadreza Afshar et al., 2010).

- **Lipomatous hemangiopericytoma**:

The mass was described microscopically as 2 different sections; as the ‘pure’ hemangiopericytoma the tumourous cells were arranged around the blood vessels and were described as spindle shaped. Mitotic cells were meagre in the tissue section. Myxoid tissue also was found separating the spindle cells. The other section was described as mostly mature adipocyte cells. Still, some metaplastic cells had been described as lipoblastic cells showing bone formation. Immunohistochemistry stains showed reactivity got vimentin, CD34, desmin and S100 showing positivity for spindle cells, and smooth muscle cells; helping achieve the final diagnosis (Ceballos et al., 1999).

In a case described by Davies et al, the histology was similarly described, but added that the ‘ prominent stag horn pattern’ typically found in hemangioperictyoma (HPC) was not evident. Though immunohistochemistry typically showed positivity with vimentin, CD34 but negative to S100 and desmin.

Materials and Methods

A detailed summary of significant human and canine lipoma cases was made. These summaries were combined into a classification system that could be used as a standard for lipoma tumour types.

Articles for this literature review were sourced from:

- PUBMED (http://www.ncbi.nlm.nih.gov/pubmed)
- Google Search (http://www.google.com)
- Wiley online library (http://onlinelibrary.wiley.com)
- Indian Journal of Pathology and Microbiology (http://www.ijpmonline.org/)
- IVIS, International Veterinary Information Services (http://www.ivis.org)

The SZIE-AOTK library was used as a VPN given by the informatics department. When a journal reference was found, that could not be sourced through the library VPN, the librarians had found the article for my research and sent the publication by email. Most articles were already existed free in *pdf.* format or published on outsourced websites from PUBMed.

One article was used from the: *Acta Veterinaria Hungarica* for a canine study.

Bar Charts showing publications used:

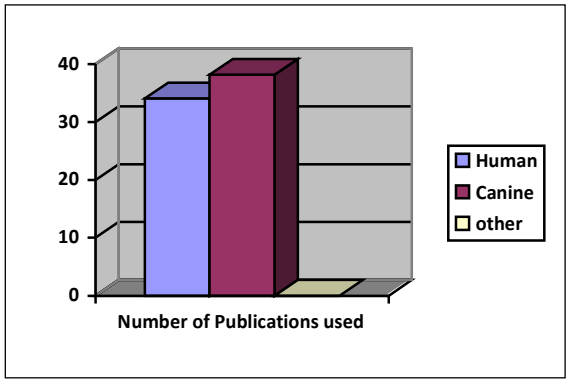


Chart 1: Showing human and canine publications used.

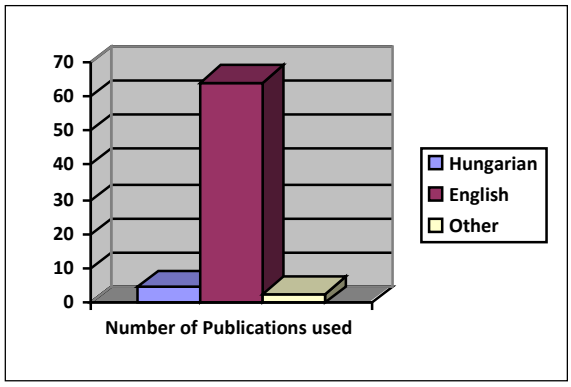


Chart 2: Showing number and language of publications used. English publications include USA, UK, Canadian, Indian, Brazilian, Iranian Korean, Japanese, Italian, Greek, S. African, Chinese authors. Other languages include German, French and Portuguese.

Results:

Proposed lipoma classification:

As an anatomical classification, one should always classify to the organ or region the mass is found on or in. There are many variations found in texts in this case, because it could be very subjective from this point. The more specific point anatomical position should always be preferred, especially that this would help in the histological further classification. For instance, Extra-thoracic should not be used over the classification of Intra/ Inter-muscular, since this is more significant to the type of lipoma, and is also more understandable.

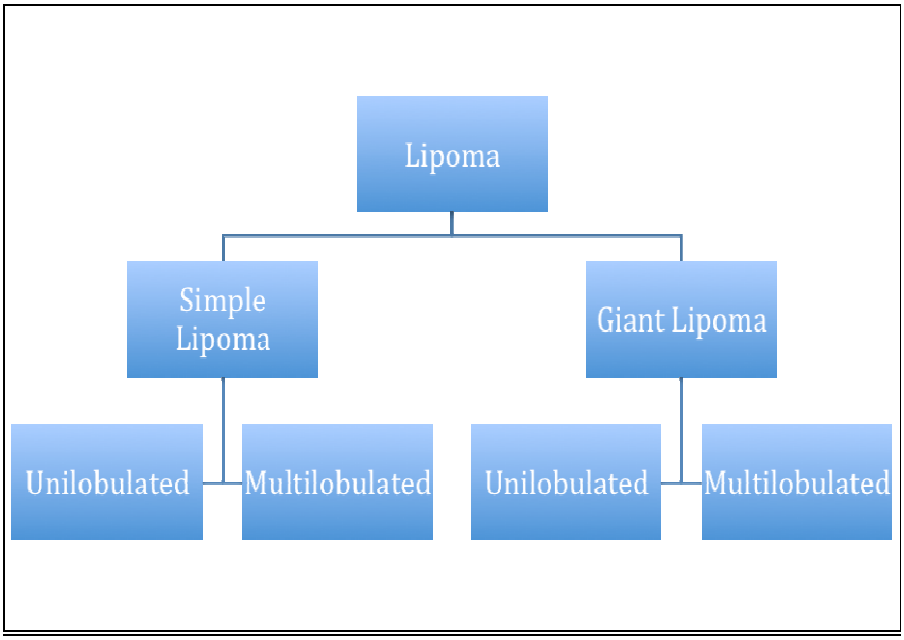


Table 1: General Macroscopic Classification

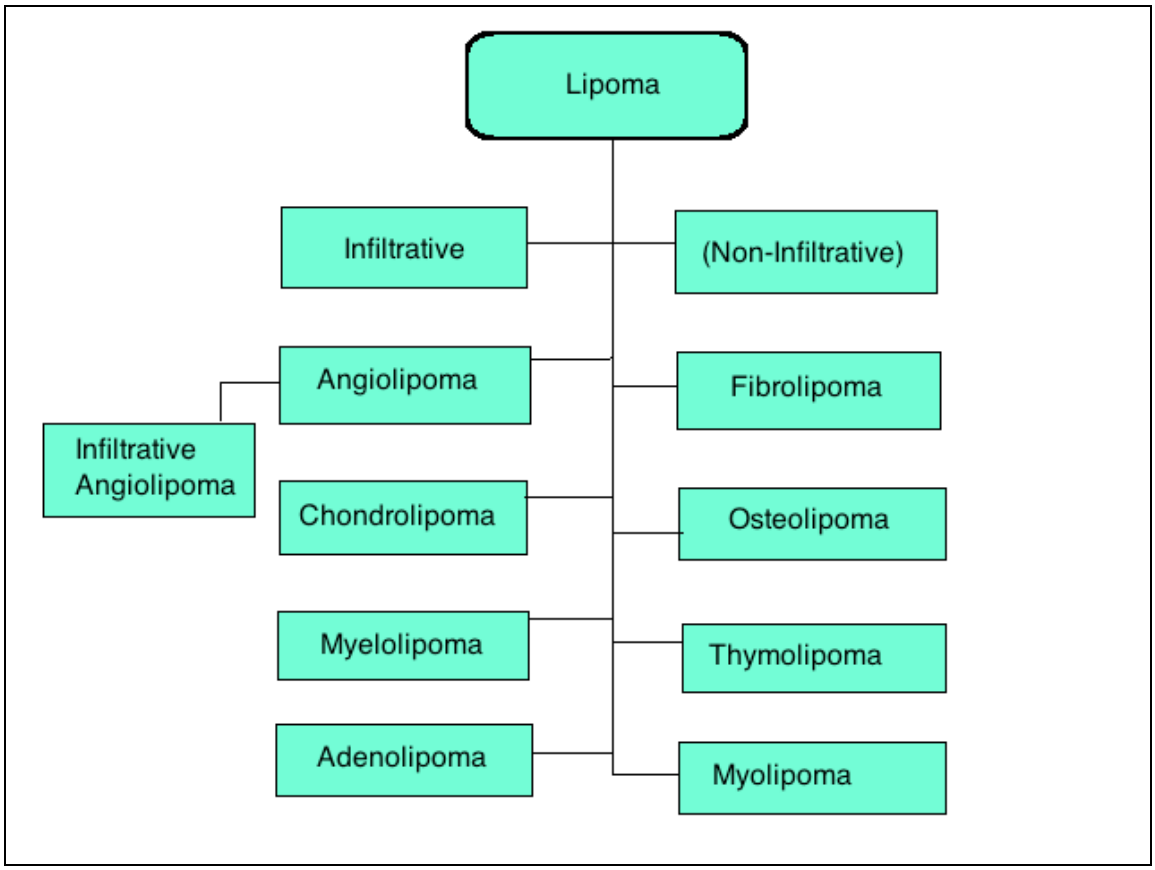


Table 2: General Histopathological Classification of Lipoma.

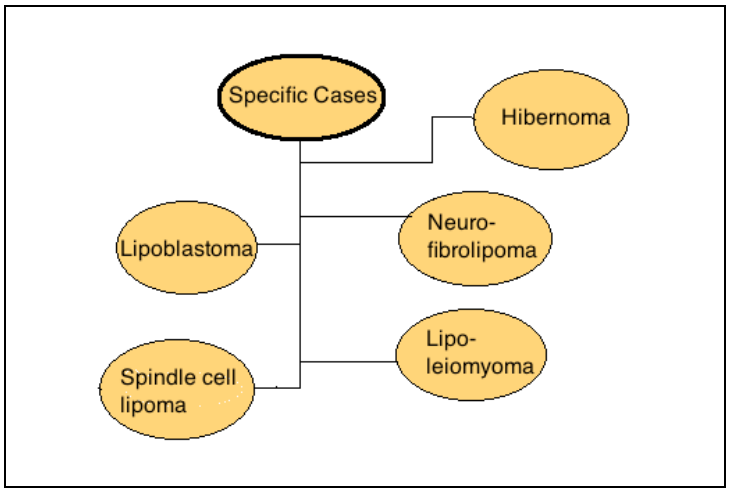


Table 3: Specific cases found in lipoma.

Summary of anatomical classification found in literature

Classification was put in rough anatomical cranial –caudal order.

Orbital			
	Retrobulbar		
	Conjunctival		
Intracavitary			
	Cephalic		
		*Auditory tube lipoma**	
		*Cerebral lipoma**	
	*Buccal Lipoma**		
		*Lingual Lipoma**	
		*Oropharyngeal Lipoma**	
	Cervical		
		*Hypopharyngial Lipoma**	
		Pharyngeal Lipoma	
		Laryngeal Lipoma	
	Intra-thoracic		
		Mediastinal lipoma	
		Cardiac	
			Pericardial lipoma
			Atrial Lipoma
		Pulmonary	
			*Bronchial Lipoma**
	Intra-abdominal		
		*Hepatic Lipoma**	
		Umbilical Lipoma	

		Omental Lipoma	
		*Duodenal Lipoma**	
		Splenic Lipoma	
		*Gastric Lipoma**	
		Retroperitoneal Lipoma	
			Adrenal Lipoma
			*Renal Lipoma**
			Ovary Suspensory Ligament Lipoma
			Uterine Lipoma
			Vulvar Lipoma
			Vaginal Lipoma
		Perineal Lipoma	
	Intrapelvic		
		Extraluminal Lipoma	
		Perirectal Lipoma	
Extracavitary			
	Subcutaneous Lipoma		
		Perianal Lipoma	
		*Supra-patellar Lipoma**	
	Intermuscular Lipoma		
	Interosseus Lipoma		
		Interarticular Lipoma	
			Intercarpal Lipoma
			*Femuro-tibial Lipoma**
		Extradural Lipoma	
	Osseus		

		*Femural Lipoma**	
	Cervical		
		Submandibular Lipoma	
		Parotid salivary gland Lipoma	
	Inguinal Lipoma		
	*Extraluminal(Extravenal) Lipoma**		

Table 4: Comparison of anatomical classification. Cases reported in humans only (*).

Histopathological Classification is more erroneous in the classification used. This is because some institutes try to differentiate if the adipose tissue is rather just a finding within a mass or actually mesenchymal benign tumour cells are present. This is could be a debatable point, especially if the tumour is found within a fatty area of the organ. From literature found in human cases it seems to be preferred to mention these tumours as lipoma type tumour more then lipomatous; which can be found also used in texts. The only cases were an exception could be made, I feel, is in lipomatous hemangiopericytoma; as this mass in its self is a grey area within pathological classification.

Discussion and Conclusion:

Diagnosis and classification of these lipomatous masses could be very difficult sometimes, especially if one is only using hemotoxylin and eosin staining. Immunohistochemistry for these masses should be used regularly to decide what form of lipoma is found, and its likelihood for it to reoccur.

Cytology is often used as a primarily examination of unknown masses. Though cytology could be used, it is often not done well enough for a good assumption of the mass type; while also only a small part of the cell type could be examined, hence one can never exclude metamorphosis or confirm a good diagnosis.

Infiltrative even though still considered to be benign are more aggressive and could be recurring. Infiltrative difference usually can only be identified through MRI or during surgery itself (Morgan et al., 2007).

New treatment methods could also be used as an additional technique to excision. Liposuction of risk patients with superficial giant lipomas could be used (Bottcher et al., 2007). Liposuction is considered to be less invasive, and its aim is usually to decrease the overall body weight in osteoarthritic patients. Mechanical irritation is also relieved, allowing finer healing. During conventional surgery layered healing, seroma formation and nerve injury may occur, while using a liposuction method, decreases these risks.

In cases such as infiltrative angiolipoma surgery is usually the main form of treatment but external radiation has also been used in combination or also without surgery to control infiltrative lipomata.

Lipomatous Hemangiopericytoma has been added to this classification of benign lipoma types, because Cebellos, consider this tumour within the classification because lipoblast-like cells are present within in, similarly to chondroid lipoma and pleomorphic lipomas. These two types are

within the classification already. *Lipomatous HPC* is usually soft tissue tumours found on legs, within retroperitoneum and the chest (Guillou et al., 2000).

In two different articles Enzinger et al, and Middleton et al, separately described that half of these tumours are found to be malignant; showing signs of mitotic activity and polymorphism. Signs of haemorrhage and necrosis could also indicate malignancy. This mass type could be therefore listed within both classifications if one would like to consider it as both, or consider that lipomatous hemangiopericytoma is highly likely to turn malignant.

Androgen receptors, in a human study were found to predominate in spindle cell type lipomas. This may mean that these types of lipoma may have hormonal influence when growing. Though it has been found that these receptors are also found in ordinary lipoma. Henceforth, though there is a significant predominance in men in spindle cell lipoma, in ordinary lipoma, the hormone has been found equally in male and female lipoma cases. One cannot explain exactly in this specific case of lipoma one finds more male cases to female cases (Sajjad et al., 2008). Though in canines this distinction has not been made yet.

The aim of this article is to create a reference system for Veterinarians to make it simple to understand and to refer to past and existing journals about lipomatous benign tumours in dogs. Nowadays, many veterinarians only consider lipomas as cutaneous or intermuscular and do not consider the damage of the underlying tumour. Due to metaplasia, hormonal influence or its origin from a different mesenchial tumour; these tumours could be considerably significant.

In human medicine lipomatous tumours are taken more gravely and one could find hundreds of case studies about these types of masses and their significance in medicine. Visceral cases are not reported often in canine or any other species, very often. In human cases have been reported in most organs. It has also been noted that they have no predilection to age, though certain types tend to more significant in younger or even infants (congenitally), while others in more middle aged. These masses originating from lipomas tend to expand from physiological adipose tissue.

Summary

The thesis introduces a classification system for canine lipoma, which has not been introduced in veterinary pathology, yet. As there are currently limited/ no literature concerning canine lipoma classification, literature from human medicine has used to establish histological and anatomical criteria for the classification. The classification based on anatomy and histology criteria would be useful for diagnosis with this system. More and more journal articles are being published about canine lipoma cases, which are generally not subcutaneous cases; these are the cases that were researched the most about. Cases which could be life threatening and significant are now categorized. These cases may have previously be thought of as benign and disregarded.

Most cases of canine lipoma are removed successfully, and do not recur. However, some cases do have a long history of inconclusive symptoms and some do actually reoccur. Although this thesis focus on canine lipomas from a more pathological point of view, many clinical cases were discussed, hence it may be used as a clinical reference, for the diagnosis of types of lipoma and for its prognosis and treatment.

Összefoglalás

A szakdolgozat a kutyák lipómájának szisztematikus osztalyozását vezeti be, mivel eddig a rendszerezés módszere az állatorvosi patológiában még nem lett kidolgozva.
Pillanatnyilag alig, vagy nem is található a kutyák lipómájának osztályozására vonatkozó publikálás az irodalomban, ezért az embergyógyászatban használt osztályozási rendszer képezte az alapját a szövettani es anatómiai kritériumokra épülő osztalyozásnak.
Az anatómiai és szövettani kritériumokon alapuló osztályozás fontos eszköz lehet a diagnosztikában is. A szaklapokban egyre több publikació jelenik meg a kutyák lipómájának kutatásáról, amik általában nem a szubkután lipómával foglalkoznak, hanem a többi lipóma típussal.

A legtöbb esetben a kutyáknál a lipóma sikeresen eltávolítható és nem tér vissza. Néhány esetben azonban hosszú ideig tartó, nem specifikus tüneteket észlelhetünk és más esetekben a

lipóma ki is újulhat.

A szakdolgozat elsősorban patológiai szempontból dolgozza fel a kutyák zsírdaganatainak típusait, sok klinikai esetet is ismertet, ezért jól lehet használni klinikai esetekben a lipóma típusának meghatározásában, a gyógykezelés megtervezésénél és a prognózishoz.

Acknowledgement

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