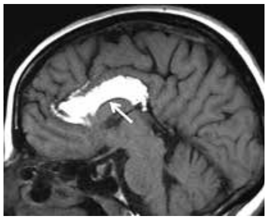

# LIPOMAS: FROM HEAD TO TOE

## Lipomas: De la cabeza a los pies

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## Summary

*Introduction:* In daily practice, and in most cases incidentally, we often find lipomatous lesions of different origin which require proper characterization. *Objective*: Our goal is to review and describe the most frequently found benign lipomatous lesions, describing their origin and their characteristics in different imaging techniques such as ultrasound (US), Computed tomography (CT) and Magnetic resonance (MR), and their involvement in disease. *Methods*: We perform a bibliographic research in lipomatous lesions from head to toe and a retrospective review of cases from our institution. *Results*: Lipomatous lesions are benign tumors usually diagnosed incidentally. It is important to know its features in the different imaging methods for an accurate diagnosis.

## Resumen

*Introducción:* En la práctica diaria, y la mayoría de veces de manera incidental, es frecuente encontrar lesiones lipomatosas de diferente origen que requieren una caracterización adecuada. *Objetivo:* Revisar y describir las lesiones lipomatosas benignas más frecuentes; analizar su origen, sus características en los diferentes métodos de imagen —como ultrasonido (US), tomografía computarizada (TC) y resonancia magnética (RM)— y su implicación en procesos de enfermedad. *Métodos:* Revisión bibliográfica de las lesiones lipomatosas de la cabeza a los pies con una revisión retrospectiva de casos de nuestra institución. *Resultados:* Los lipomas son tumores benignos usualmente diagnosticados de manera incidental. Es importante conocer sus características en imágenes para acercarse al diagnóstico apropiado.

### Introduction

Lipoma is the most common tumour of mesenchymal origin. In our experience we have found little interest in this subject in the literature (1).

The majority of lipomatous lesions are benign and they are characterized by slow growth; they are composed of mature adipose tissue organized into lobes, which is, in turn, surrounded by fibrous capsules (1).

They occur most often in the 5th to 6th decade of life (2) and are usually sporadic. However, they may be associated with syndromes such as hereditary multiple lipomatosis, Gardner syndrome and Madelung's disease, among others (1).

The term lipomatosis refers to multiple lipomatous lesions regardless of their location (1).

By having a composition of mature adipose tissue, lipomas have a classic look in imaging studies. In computed tomography (CT) they are low-density lesions, whose fat density varies between -65 to -120 Hounsfield units and resembles subcutaneous fat tissue (3). These lesions do not enhance with intravenous contrast medium (4).

In magnetic resonance (MR) they are characterized by high signal lesions on T1 and T2 weighted sequences, which decrease the signal in the fat sequences for which they are seen with low signal and, as in CT, do not enhance with intravenous contrast medium (4,5). Sequences may be used "in phase" and "out of phase" for better characterization of the fat content (5).

### Lipomatous lesions of the head, neck and column

#### *Intracraneal lipomas*

30 to 50% of lipomas are located in the head and neck (2) and correspond to less than 1% of intracranial tumours (4,6-8). One must keep in mind that up to 55% of intracranial lipomas are associated with congenital malformations of varying seriousness and compromise, usually from the midline, such as agenesis or dysgenesis of the corpus callosum (4,6). Its biological behaviour can simulate a malformation (9). Less frequently associated with other malformations, such as cavum septi pellucidi, bifida skull, spina bifida, encephalocele, myelomeningocele, vermis hypoplasia and cortical malformation (4). These isolated lipomas are usually asymptomatic, and are found as an incidental finding in imaging studies requested for different reasons (4). In patients without other findings, these lipomas can become a cause of epileptic disorders (4).

The majority of lipomas occur in the midline, especially in the pericallosal cistern (figures 1 and 2), in some cases extending to the lateral ventricles and choroid plexus (4). The other locations are cuadrigeminal cistern (Figure 3) or superior cerebellar cistern (25%), interpeduncular or suprasellar cistern (14%), pontocerebellous angle cistern (9%) and Sylvian cistern (5%) (4).

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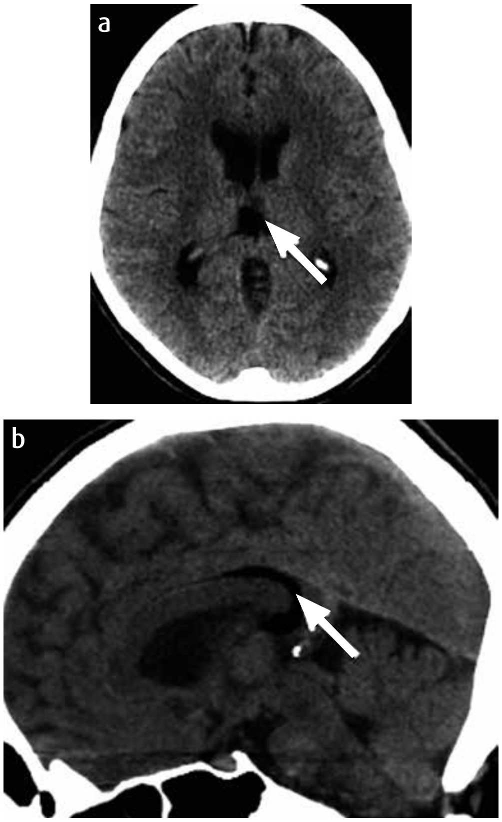

Figure 1. CT. a) Axial slice and b) sagital reconstruction. Low density image, third of fat, localized in the splenium and posterior part of the corpus callosum compatible with lipoma (arrow).

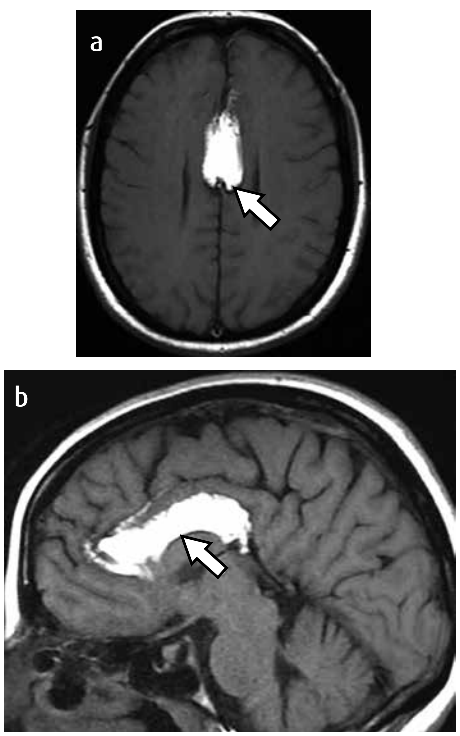

Figure 2. MRI T1-weighted sequence. a) Axial, b) sagittal. High signal image (arrow), localized in the pericallosum sulci towards the anterior region of the corpus callosum compatible with lipoma. It is associated to disgenesia of the corpus callosum.

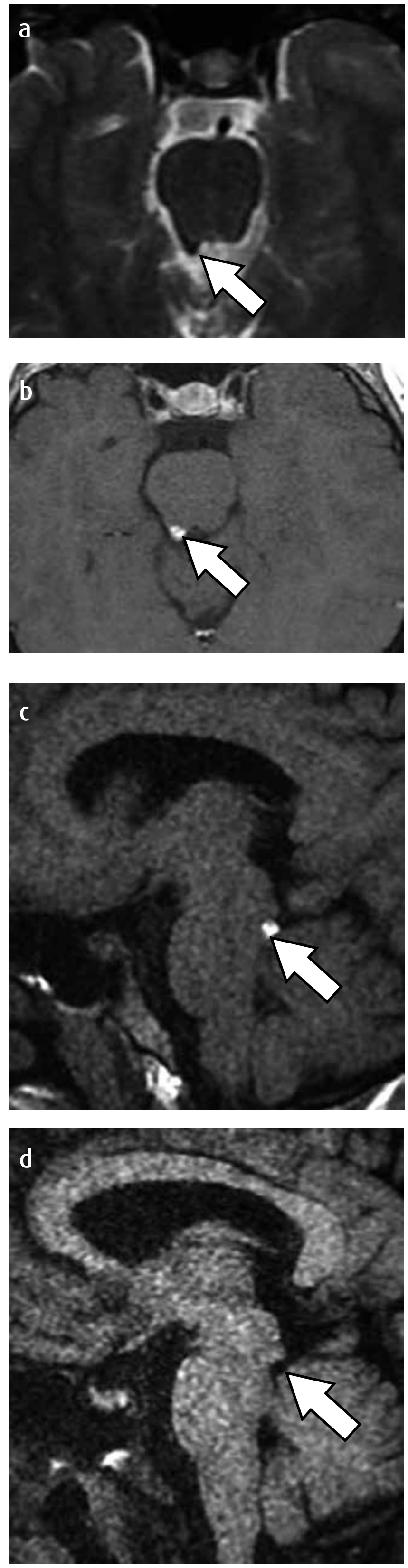

Figure 3. a) Axial MR potentiated in T2. b) Axial MR potentiated in T1, c) Sagittal T1 weighted MR, d) Sagital MR T1 weighted sequence with fat saturation. Localized in the cuadrigeminal cistern it can be appreciated a low signal image in T2 (arrow), high signal in T1, which can be seen in the fat saturation sequence (d) that corresponds to lipoma.

The image features are key to making the diagnosis. In CT one can observe low-density lesions from -50 to -100 UH, well defined, which do not enhance with contrast medium administration (4). These lesions may have calcifications, especially when it is inter-hemispheric lipoma (4).

In MRI lesions they are characterized by high signal sequences T1 and T2, which do not enhance with intravenous contrast medium (4).

Among the differential diagnoses, the dermoid cyst should be considered. It is an ectopic ectodermal inclusion cyst, of benign aetiology, that corresponds to 0.3% of intracranial lesions (10). Its MRI appearance is classic, high signal on the T1 weighted sequences, variable signal intensity on T2-weighted sequences and without further enhancement to contrast medium (10).

### *Lipoma of the corpus callosum*

The lipoma of the corpus callosum occurs in the 0.004 to 0.008% of the population and generally corresponds to 30 to 50% of intracranial lipomas (9-11). Like other lipomas, this is composed of mature fat cells, is clearly separated from adjacent structures and those of large size are surrounded by a thick capsule (9). The most common localization is pericallosal, especially towards the dorsal surface (9-11). Their morphology is ovoid, linear and thin or organized as two parallel lines having a central separation space (9). At the same time, it can be tubule-nodular or curvilinear (8,10), with variable size and in some cases surrounds or envelops the anterior cerebral artery and its branches (9). There have been four possible theories postulated about the formation of this lipoma; the first one is related to a failure in the ectodermal tissue disjunction of adjacent mesoderm during neural tube formation. The second is the hypertrophy of pre-existing meningeal fatty tissue. The third is metaplasia of the meningeal connective tissue. The last involves an abnormal persistence of the primitive meninges with dedifferentiation in lipomatous elements (8).

It is presented in association with calcification areas in the fibrous capsule of the lipoma or the adjacent cerebral parenchyma (9).

As mentioned above, like intracranial lipomas, lipoma of the corpus callosum is associated with partial or complete agenesis of the corpus callosum in up to 48% of cases, in which the lipoma replaces the area normally occupied by the corpus callosum (4,6,9-11) and presents a tubulo-nodular morphology (10).

In CT it is identified by the low density that surrounds the dorsal surface of the corpus callosum, showing in some cases a linear calcification (Figure 1) (9).

MRI clearly shows the lipoma and its relationships with neighbouring structures (9). In T1-weighted images one can find a high signal (Similar to the orbital fat), curvilinear in the dorsal aspect of the corpus callosum, without mass effect; sequences in T2-weighted present a high curvaceous signal (less than T1) that can be associated or not to a linear focus of low signal in the anterior aspect, corresponding to a calcification or to pericallous branches of the anterior cerebral artery (Figure 2) (9).

### *Lipoma of the phylum terminale*

Phylum terminale lipomas are characterized in MR by being lines of high signal in T1 weighted sequences that are associated with thickening of the phylum terminale (Figure 4) (12). They are considered an anatomical variant when not associated with spinal pathologies (12).

### *Lipoma of the neck*

90% of these lipomas are located in the soft tissues (2). They are fat density masses characterized as being compressible, having well-defined margins, its common form is in ellipse and are organized parallel to the cutaneous surface (Figure 5) (2). Its diameter ranges from 10 to 40 mm (2).


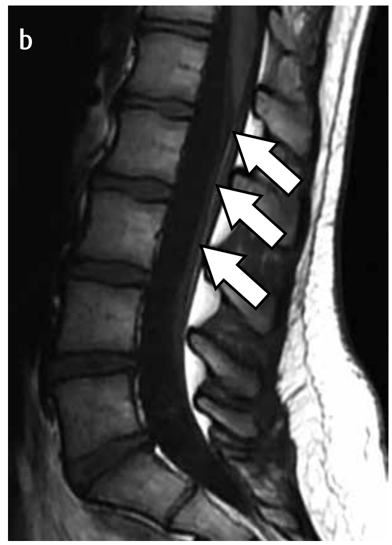


Figure 4. a) MR a) axial T1 weighted sequence T1: one can appreciate the high signal image, rounded, well defined, posterior intradural, corresponding to lipoma of the phylum terminale (arrow). b) Sagittal T1 weighted sequence: one can appreciate a high signal linear image, well-defined, intradural, without alterations of the medullary cone, corresponding to lipoma of the phylum terminale (arrows).

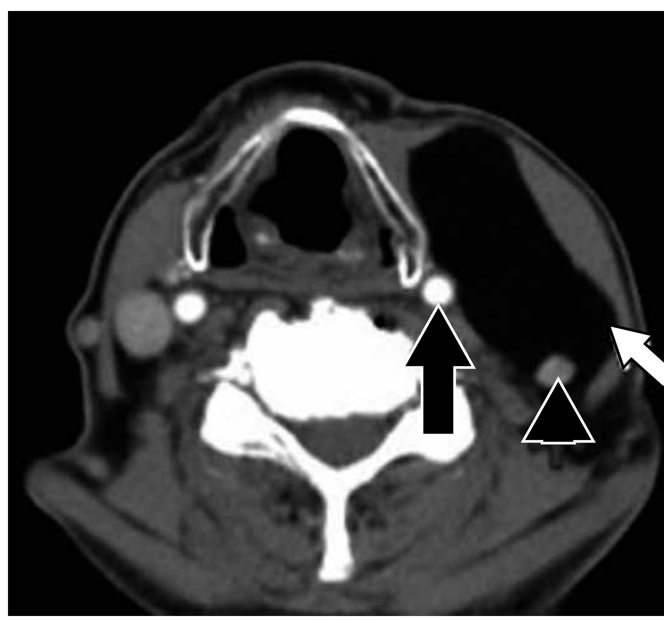

Figure 5. a) Axial cut CT: Low fat density image, localized in the carotid space, which moves adjacent structures and separates the carotid (black arrow) from the jugular vein (arrow head) compatible with lipoma (white arrow).

One of the most important factors is to know the differential diagnoses for neck lipomas; among the injuries to be considered are: epidermoid cyst, cysts on the gill slits, thyroglossal conduct cyst, haemangiomas, lymphadenopathy, prominence of muscle tissue and pathology of the muscle planes, among others (2). One must take into account that there are neck lipomas disposed between the muscle fibres and as they grow they separate these fibres with a distribution of the infiltrative type (1).

Lipomas have also been described of the para-pharyngeal space corresponding <1 to 2% by mass of this space, in which liposarcoma predominates over lipoma (13).

## Lipomatous lesions of the respiratory and cardiovascular system

Las lesiones de contenido graso del tórax son hallazgos incidentales en Lesions of fat content of the thorax are incidental findings in CT and MRI (14); they can be found in the lung parenchyma, mediastinum and airway (14).

### *Endobronchial lipoma*

It is a rare lesion that constitutes 0.1% of lung tumors and the 3.2 to 9.5% of endobronchial benign tumors (14,15). It originates in the submucosa of the interstitial adipose tissue, and is well defined (14). This lesion is located predominantly in the source bronchi and usually has a pedicled disposition (14). In CT it is revealed as a pedunculated lesion, with fat density, homogeneous, which may or may not lead to obstructive changes (14).

### *Pulmonar (parenchymatous) lipoma*

The presence of lipomas in the lung is rare (14). Like the other lipomas, they are benign mesenchymal tumours that are located in the periphery and are surrounded by normal lung tissue (14). They have slow growth and therefore may go unnoticed until they found as incidental lesions on chest radiography (14). In conventional radiology they are opacities with soft tissue density that can be confused as a consolidation while in CT they can be seen as low density lesions, with fat attenuation surrounded by lung parenchyma, corresponding to lipoma (14).

### *Mediastinal lipoma*

This mass with fat content has a predilection for the anterior mediastinum (14). It corresponds to 1.6-2.3% of primary mediastinal tumours (14, 16). Like lung lipomas, its development is insidious until they reach sufficient size to appear as an opacity on the chest radiograph (14). Depending on their location and extent, they can be classified as: (a) mediastinal, located in the cardio-diaphragmatic angle; (B) cervico-mediastinal extending to the neck; (C) transmural if they penetrate the thoracic wall usually in the anterior and superior mediastinum (14, 17). They have fat attenuation and are usually homogeneous in CT (14). MRI helps to delineate the extent and to confirm the nature of the fat lesion (14).

The term mediastinal lipomatosis refers to the excessive deposition of infiltrative fatty tissue, unencapsulated in the mediastinum, usually associated with obesity and intake of corticosteroids (14).

### *Cardiac lipoma*

Heart and pericardium lipomas constitute between 8 to 12% of primary tumours (14, 16). Most are extra-myocardial, however, they can also be subendocardial or sub-pericardial (14). Symptomatology is dependent on the size, location and mobility of the lesion (14). CT shows lesions with low density, generally oval, not pedunculated and encapsulated between the parietal and visceral pericardium (Figure 6) (14). MRI allows defining the extent of lipoma and its relationship to adjacent structures (14).

### *Pleural lipoma*

It is a benign neoplasm originated in the sub-mesothelial layer of the parietal pleura. It extends into the sub-pleural, pleural or extra-pleural space (14).

This lipoma appears encapsulated and is characterized by slow growth (14). It is a lesion with homogeneous fat attenuation and well defined (Figure 7) (14). If adjacent to the diaphragm, differential diagnosis includes hernias and incisional hernias with fat content (14).

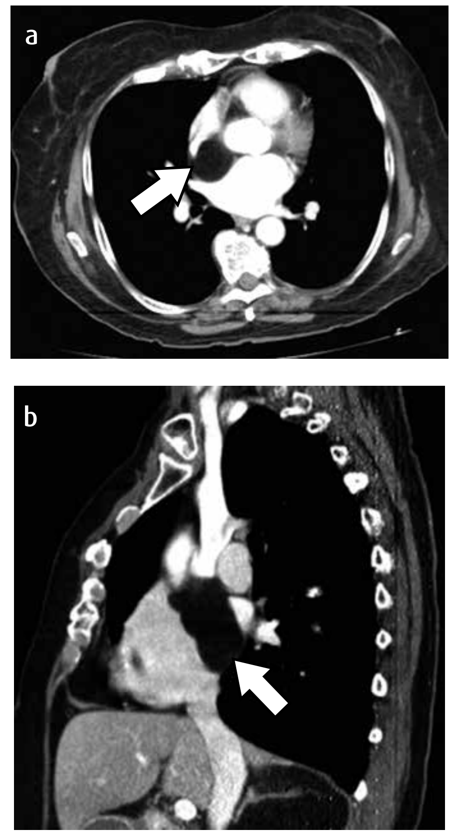


Figure 6. a) Axial CT, b) Sagital reconstruction. Low fat density image, localized in the middle mediastinum that corresponds to lipoma (arrows).

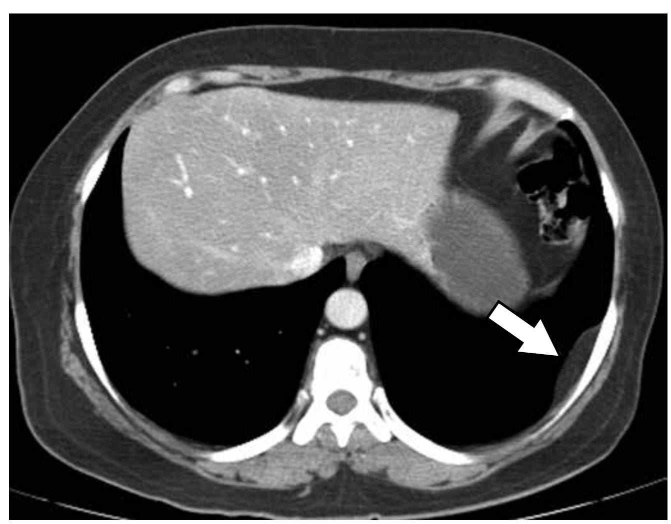

Figure 7. a) Axial cut CT: Low fat density image, localized in the left superficial pleura corresponding to lipoma (arrow).

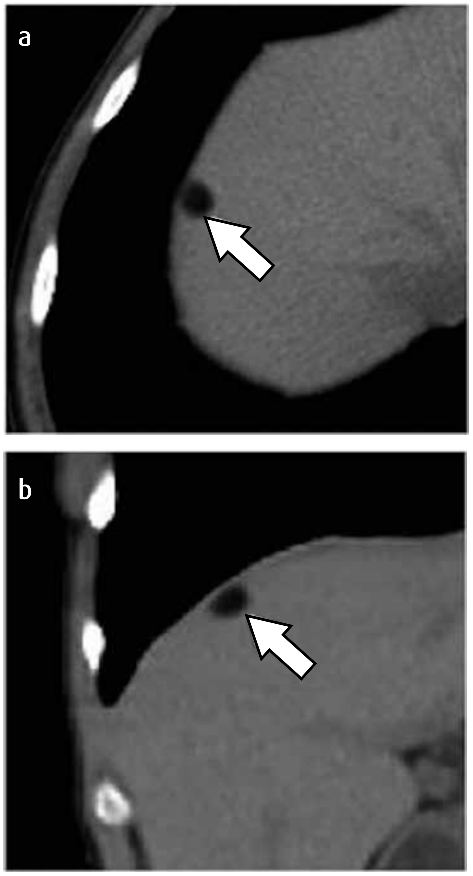


Figure 8. a) Axial cut, b) coronal resconstruction. Image with low fat denstity, localized in the VIII hepatic segment corresponding to lipoma (white arrows).

## Lipomatous lesions of the gastrointestinal and genitourinary system

### *Hepatic lipoma*

This lipoma is rare (18). It is composed of mature adipose tissue (18). It is a well-defined, homogeneous lesion with characteristically uniform content with sizes ranging from a few millimeters to 13 cm (18,19). Its appearance in the different imaging methods is classic, shown as homogeneous lesions, hyper-echoic in ultrasonography, low density in CT and high signal in both T1 and T2-weighted MRI sequences (Figure 8) (18,19).

Hepatic adenomas are masses of low density, well defined, that can be confused with lipomas (19). However, adenomas tend to appear with haemorrhage so its density is heterogeneous and this is the key factor for its proper diagnosis, both in CT and MRI (19).

### *Pancreatic lipoma*

Pancreatic lipoma is a rare, benign lesion, rarely described in the literature, appearing in asymptomatic patients for which it is discovered incidentally (20-22).

It is characterized by being well circumscribed, with fat attenuation, surrounded by a thin collagen capsule, which may present some isolated septa and vessels in its interior. It is located around the pancreas, especially towards the head of the pancreas (Figure 9) (20,22,23). It is seen as separated from the pancreatic parenchyma and peripancreatic fat (22). Its size varies from 1.4 to 5.3 cm (21). The management of these lesions are usually conservative, especially when there is no dilation of the main pancreatic duct (21).

### *Suprarenal lipoma*

As technology advances, incidental lesion findings increases, however, suprarenal lipoma remains a low frequency lesion (Figure 10) (24). It is usually unilateral, benign, encapsulated, with diameters between 1 and 5 cm (24). A discrete predominance in the right side has been reported (25). Calcification excludes the diagnosis of lipoma and some kind of intervention should be considered, since it may correspond to a primary suprarenal cortical carcinoma (24).

This lipoma must be differentiated from myelolipoma, which is a neoplasia of mature adipose cells and hematopoietic tissue (5). Myelolipoma is seen in CT as a mass with negative Hounsfield densities, however, given the presence of haemorrhage or calcification, these units are higher than those found in lipomas (5). In MRI it often shows high signal on T1 weighted sequences and variable signal intensity on T2 sequences (5).

### *Kidney lipoma*

It is considered a benign tumor, extremely rare, with few cases reported in the literature (26). The origin of this lipoma is controversial and unknown since the renal capsule contains no fat (26). The first theory considers that there may be a proliferation of mesenchymal cells that change to adipose cells by the aggregation of fat inside the cells (26,27), and the second, considers that they arise from perivascular connective tissue that makes a metamorphosis into adipose tissue (26,28).

This lipoma predominates in middle-aged women without laterality preference and is characterized by being confined to the renal capsule (26). It can be confused with perirenal lipoma that grows beyond the renal capsule, while the true renal lipoma is located between the capsule and the renal parenchyma (Figure 11) (26). Some authors have reported the malignant potential and even recurrence of these lesions (26,27,29).

The renal lipoma must be differentiated from renal angiomyolipoma. This last one is a hamartomatous benign lesion containing varying degrees of fat and is prone to bleeding (5). These lesions are associated with sclerosis tuberosa (5). Although they usually contain fat, it is not always possible to view it in CT because of the predominance of blood vessels, muscle or other tissues that produce a heterogeneous appearance with soft tissue density (5).

### *Retroperitoneum lipoma*

It is a rare lesion of the retroperitoneum whose diagnosis should be made carefully, because in most cases it is a well-differentiated liposarcoma, more than a lipoma (30). The deeper and more central the lesion, the greater the possibility that it is malignant (30). The image features are similar to those of the other lipomas of the body, the density and signal intensity is fat and it contains few or any septi (30). It does not enhance with contrast medium or presents areas with soft tissue density (30).

## Gastrointestinal lipomas

Gastrointestinal lipomas represent 4% of gastrointestinal benign tumours (31). These lesions can be located in any part of the gastrointestinal tract, from the pharynx to the rectum (32). Like most lipomatous abdominal lesions, they are rare (33).

Gastrointestinal lipomas are slow growing and its peak incidence is between the fifth and sixth decades of life (33). They are located mainly in the submucosa (90 to 95%) and a small part in subserosa (5 to 10%) (33). They are asymptomatic lesions, found incidentally (31), however, it has been found that lesions greater than 2 cm produce abdominal pain, intussusception, diarrhea, constipation and gastrointestinal bleeding (31-33).

Figure 9. CT. Axial cut: Image with fat density, located in the head of the pancreas that corresponds to lipoma (arrow).

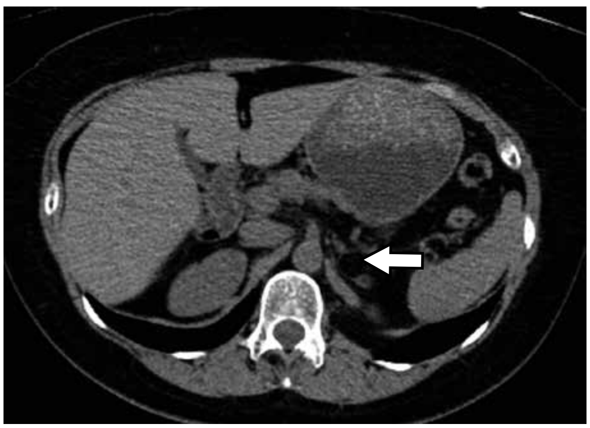

Figure 10. CT. Axial cut: Image with low fat density, well defined, homogeneous located in the left suprarenal gland (arrow) corresponds to lipoma.

Figure 11. CT. Axial cut arterial phase: Image with low fat density, located in the left kidney cortex that corresponds to lipoma (arrow).

Figure 12. CT. Axial cut: Image with fat density, located in the wall of the gastric antrum that corresponds to lipoma (arrow).

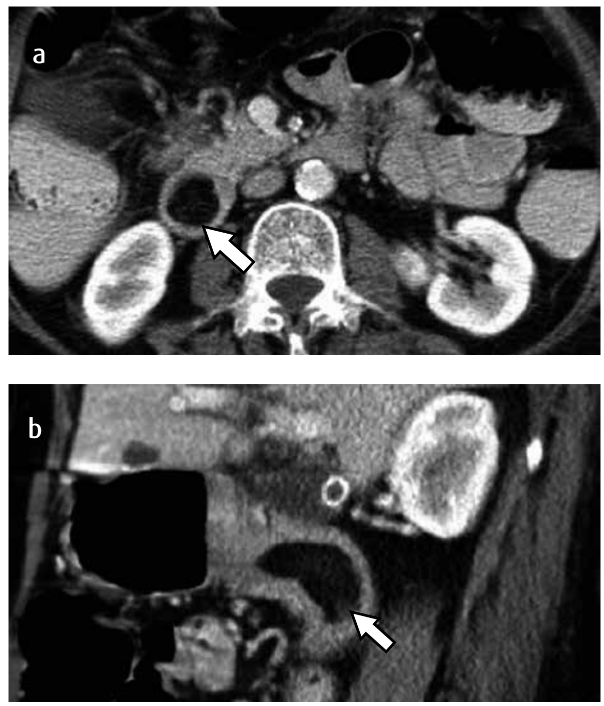


Figure 13. a) Axial cut, b) sagital resconstruction. Image with fat density, located in the duodenal wall that corresponds to lipoma (arrow).

Figure 14. CT. Axial cut: Image with fat density, located in the wall of the jejunum that corresponds to lipoma (arrow).

### Pharyngeal and esophageal lipoma

These are the areas of the gastrointestinal tract where lipomas are least often found (33).

In the pharynx they may originate from the aryteno-epiglottic folds or of adjacent structures to the piriform sinus (33,34). They can be, additionally, pedunculated polypoid lesions, however, it is more common that they are fibrolipomas than pure lipomas (33,35). Symptoms are usually related to blockage of the digestive tract with dysphagia, foreign body sensation and voice changes (33). In some cases the polypoid lesions can prolapse into the esophagus and be confused with injuries originating in the same (33).

In the esophagus, lipomas are the third mass, preceded by the leiomyoma and fibro vascular polyp, respectively (33,35). They represent 3% of gastrointestinal lipomas (31,33). Usually they originate in the upper third of the oesophagus, near the cricoid cartilage (33,35).

### Gastric lipoma

It corresponds to 5% of gastrointestinal tract lipomatous masses and 3% of benign gastric masses (33,36). Most are located in the gastric antrum and therefore have the possibility of prolapse towards the pylorus (Figure 12) (33). They can also generate a complete obstruction (33). They are usually single lesions, however, they may also be multiple (33).

### Small intestine lipoma

It is the second most common location for lipomas of the gastrointestinal tract, it represents 20 to 25% of lipomas in this area (Figure 13) (38). Usually they are found in the ileum, second in the jejunum (Figure 14) (26%) and the duodenum (4%) (32,33,37,38). It is the second most common benign tumour preceded by leiomyoma (22,27).

### Colon lipoma

El colon es la zona del tracto gastrointestinal donde más se encuentran lipomas, con una frecuencia del 65 al 75 % (33,37). El lipoma es el segundo tumor benigno precedido de los pólipos adenomatosos (33,38,39). Es más usual encontrarlos en el ciego, en segundo lugar por el colon sigmoide (figura 15) (33). La mayoría de los lipomas son solitarios, pero, ocasionalmente, múltiples y en este caso debe diferenciarse de la lipomatosis colónica, una condición rara donde hay múltiples depósitos de grasa (33,40).

### Lipomatous tumours of the uterus

Lipomatous uterine tumours are a type of rare benign neoplasm (41,42), where the spectrum of lipomas (50 to 60%) is included, lipoleiomyomas, fibromyolipomas (41,43).

They correspond from 0.03 to 0.2% of benign tumors of the uterus (42-44). The average age of onset varies between 50 and 70 years (43). Symptoms are similar to leiomyomas and even 50% of cases have been associated with abnormal uterine bleeding (43,44). These lesions may appear in conjunction with leiomyomas (43). They are shown as pedunculated or exophytic lesions (41,43). 88% appear on the anterior or posterior wall of the body of the uterus (Figure 16) (43). Most are intramural (60%) and the remaining percentage is localizedin the submucosal and subserosa (42-44). Their size varies between 5 and 10 cm, however, there have been found cases of uterine lipomas up to 32 cm (42-44).

## Lipomatous lesions of the musculo-skeletal system

### Intraosseous lipoma

It corresponds to 0.1% of primary bone tumours (45). Although it can occur at any age, it occurs predominantly in patients between the 4th and 5th decade of life (45). It is a relatively low frequency benign bone tumour (46-48). Although the presence of adipose tissue in the bone marrow is normal, the proliferation of this is not the most frequent (46,49). It is localized in the metadiaphysis of long bones, most often in the intertrochanteric and subtrochanteric regions, less frequently in the calcaneus, ilium, proximal tibia, fibula, humerus, ribs, craniofacial bones, pelvis and spine (45). Approximately 10% of intraosseous lipomas occur in the calcaneus (46). The radiological characteristics between simple bone cyst and lipoma of the calcaneus are very similar, which has led to think they are interrelated (46,50); it could be the same entity in two different stages or two separate entities (46).

In histology there are three recognized stages: the first, consisting of fat cells organized into lobes simulating mature adipose tissue; the second stage presents these same cells associated with fat necrosis and calcifications; and the third stage is the involution of the lipoma with border sclerosis (45).

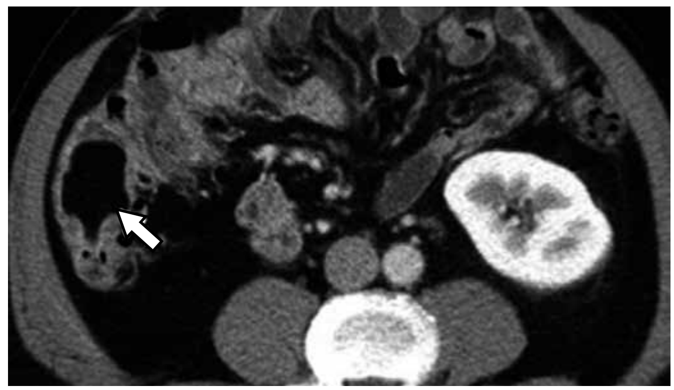

Figure 15. CT. Axial cut: Low density image, located in the wall of the colon that corresponds to lipoma (arrow).


Figure 16. a) Transvaginal ultrasound. Hyper-echoic image, rounded, well defined, intramural located in the anterior wall that corresponds to lipoma. b) CT axial cut. Well-defined low density image, intramural, located in the uterine bottom (arrow) that corresponds to a lipoleiomyoma.

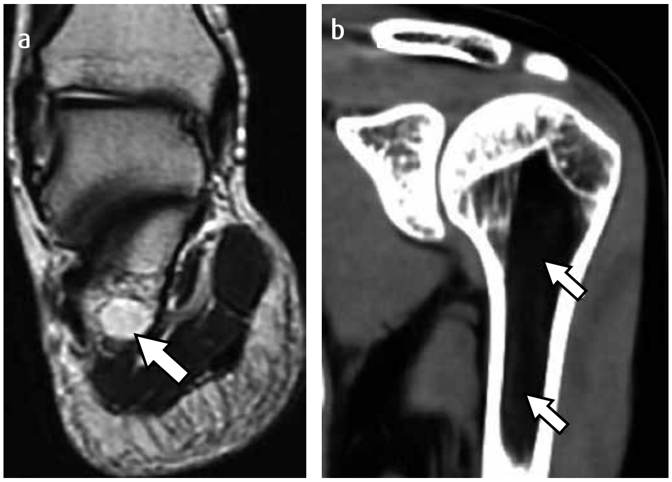


Figure 17. a) T1-weighted sagittal MRI sequence: high signal lesion, rounded, well defined, located in the bone marrow of the lateral portion of the calcaneum that due to its behaviour corresponds to intraosseous lipoma (arrow). b) CT with coronal reconstruction. One can identify a fat density lesion that is located in the proximal metaphysio-diaphysiary osseous marrow of the humerus, of defined contours, without periostic reaction, corresponding to intraosseous lipoma (arrows).

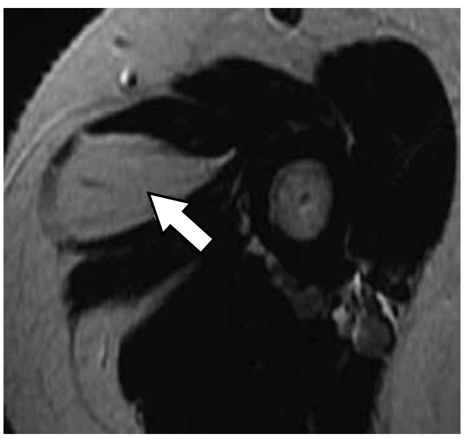

Figure 18. MRI. T1-weighted axial sequence. a well defined lesion, located in the soft tissues of the right arm with extension towards the deltoid muscles, with high T1 signal and loss of signal in the fat saturation sequence, corresponding to lipoma (arrow).

Figure 19. MRI. T1-weighted coronal sequence. a well defined lesion, located in the soft tissues adjacent to the cubital aspect of the third finger proximal phalange, with a high signal in T1 and loss of signal in the fat saturation sequence, corresponding to lipoma (arrow).

In radiography they are identified as well circumscribed radiolucent lesions, located in the bone marrow predominantly toward the end of a long bone, not eroding the cortex or produce periosteal reaction (46,51). They may have calcification or central ossification (51). In CT they appear as a bone lesion, with low density, well defined with fat density (Figure 17) (46). As in conventional radiography, they do not present cortical erosion or periosteal reaction (46). MRI shows a lesion of high signal on T1 and T2-weighted sequences, with signal intensity similar to the subcutaneous fatty tissue (46). There is no soft tissue mass associated (45).

### *Muscular lipomas*

They are soft tissue masses derived from primitive mesenchymal tissue (52). They appear in patients of any age, however, they predominate in adults aged between 50 and 60 years (52). There's a slight predominance in males (52). They are classified according to their location, superficial or deep (52,53), of which, superficial are the most common and well defined (52). Deep lipomas occur most commonly in the retroperitoneum, the thoracic wall and hands and feet. They often contain other mesenchymal tissue intermingled with connective tissue that form the septa (52). These muscle lipomas originate in muscle fibres (intramuscular) or between muscle fibres (intermuscular) (52). Intramuscular compromise both muscle as well as intermuscular fat (Figures 18 and 19) (52). Intramuscular lipoma fat can infiltrate and separate the muscle fibres giving it a striated appearance (52), therefore, in histology, they can be divided into two types: those well defined and those infiltrative (53,54). Besides fat tissue, these intramuscular lipomas may contain blood vessels, fibrous septa, necrotic areas and inflammation (55). There have been found cases of cortical thickening in paraosteal lipomas (52).

## Conclusion

Lipomas are benign tumours that can develop in any part in the body, usually diagnosed incidentally and their imaginological features are classic. Although most of these lipomas are asymptomatic, in some specific locations they can be a cause of symptoms in patients with no other findings. It is important to recognize the fat content of neoplasms to adjust the differential diagnoses and thus make a proper approach to diagnosis.

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