Lipohemartros: diagnosis by ultrasound

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Learning objectives

- Describe the benefits of musculoskeletal ultrasound.
- Review the technical realization of the ultrasound examination to assess effusion.
- Describe the sonographic findings of lipohemarthrosis.

Background

Synovial joints are those in which the bone surfaces are separated by a joint cavity which is delimited by a synovial membrane.

Under normal conditions, there is a small amount of fluid produced by the synovial membrane in the joint space. Its function is to nourish the cartilage and act as a lubricant to reduce friction and wear in the joint. When fluid accumulation is excessive, effusion occurs, causing pain and limited mobility.

Effusion is not a disease in and of itself, but rather a symptom that can have many causes. These causes are divided into 2 groups: traumatic and non-traumatic.

Effusions as a result of traumatic injury can be associated with one of the ligaments that stabilize the joint intra-articular fracture, patellar dislocation or a torn meniscus. Effusion may be the only sign of knee trauma. Non-traumatic effusion may be the result of osteoarthritis, rheumatoid arthritis, infectious diseases affecting the knee, gout and benign or malignant bone tumors.

Lipohemarthrosis, a type of joint effusion classified according to its composition, was first described in 1929 by Kling. It is the result of fat and bone marrow blood leaking into the joint space. Bloody synovial fluid contains blood droplets and bone marrow spicules. It is a reliable sign of intra-articular fracture, even though it is common to have fat in hemorrhages without there being a fracture, as for example in patients with significant cartilage or ligament injury. In the majority of cases this finding is seen in fractures of the knee or shoulder, but it is also seen in elbow and hip fractures. In the knees the source of the fat may be subtle fractures of the tibial plateau.
Imaging findings OR Procedure details

The diagnosis of lipohemarthrosis can be performed by MRI, CT or ultrasound. The advantages of ultrasound over other imaging modalities are that it is cost-effective, readily available, and does not emit ionizing radiation. In addition, ultrasound scanning in experienced hands is shorter than a MRI scan and provides immediate feedback. Moreover, ultrasound can guide arthrocentesis performing, particularly in hard to access joints such as the hip or when exploration by palpation is unproductive.

The technique requires the use of high frequency transducers (7-14 Mhz) in order to obtain good spatial resolution. For good acoustic transmission, completely filling the spaces between the ultrasound probe and the skin surface of the patient with gel is recommended.

Begin the exploration with the patient supine and with the knee fully extended. Behind the quadriceps tendon and above the patella is the suprapatellar bursa, inside which is a triangular echogenic structure that corresponds to the suprapatellar fat pad. The effusion is located between the suprapatellar and prefemoral fat pads (Fig. 1).

It is sometimes necessary to make movements of flexion-extension and compression in order to differentiate between echogenic fluid and synovial enlargement (not compressible in synovitis). Additionally, it is possible to look for posterior acoustic enhancement which are seen in effusions or use Doppler energy which may show an increase in flux in acute inflammatory processes.

By rotating the knee inward and outward, small amounts of intraarticular fluid that move because of gravity become more evident.

When the amount of joint fluid is small, an evaluation of the contralateral joint for asymmetry or unilaterality can be helpful.

The effusion may appear anechoic, hyperechoic (e.g., liquid with blood) or complex (detritus, with septa, with calcifications). Ultrasound, however, cannot differentiate between infected and non-infected fluid.

Because fat floats in the blood, layers are normally present in the ultrasound: a hyperechogenic one on the surface corresponding to the fat, and a deeper one which corresponds to the sedimentation of the blood cells, forming a fat-fluid layer (Figures 2 and 3).
When the immobilization period is greater, some cases may develop an intermediate layer may as a result of the serum, whose density is near that of water and greater than that of the fat, but is less than that of red blood cells which contain iron and hemoglobin, forming what is known as a double liquid-liquid level. (Figures 4 and 5). This latter finding is more specific to lipohemarthrosis.

The double liquid-liquid level can also be seen using CT and MRI (Figure 6).

Those cases where the fat component is not detected are hemarthroses, in which case one should consider other possibilities such as ligament damage, hemophilia or pigmented villonodular synovitis. In the case of hemophilia there may be no history of trauma since these patients experience spontaneous hemarthroses after certain carrying out actions such as walking or adopting certain positions, such as those during sleep. Repeated episodes will result in hemophilic arthropathy with synovial hypertrophy, destruction of the meniscus and free intra-articular foreign bodies.

In pigmented villonodular synovitis, ultrasound reveals joint effusion and hypoechoic synovial thickening with hairy nodular projections along with an increased vascularization when viewed with a color Doppler. Performing an MRI is required for its diagnosis, where one can see the intraarticular nodular thickening of low signal intensity on T1-weighted sequences, T2 and proton density, due to the presence of hemosiderin deposits.

Images for this section:
**Fig. 1:** Figure 1: Image of B mode ultrasound, sagittal section. White arrow: suprapatellar joint effusion. Red arrow: suprapatellar fat pad. Black Arrow: prefemoral fat pad. Blue Arrow: quadriceps tendon.

**Fig. 2:** Figure 2: This is a B-mode ultrasound, sagittal image where a suprapatellar effusion was observed in a 62 year-old patient with a lateral tibial plateau fracture. One can differentiate the hyperechoic surface layer, (black arrow) corresponding to the fatty component of the effusion and the hypoechoic deep layer (white arrow) corresponding to the heme component.

**Fig. 3:** Figure 3: This is the same patient as in figure 2 using a B-mode ultrasound, sagittal section image. One can differentiate the hyperechoic surface layer (white arrow) corresponding to the fatty component of the effusion and the deeper hypoechoic layer (red arrow) corresponding to the heme component. In the corresponding hyperechoic layer, it is possible to see serum bubbles (white asterisk) trapped among the fat.
**Fig. 4:** Figure 4: This is a B-mode ultrasound, sagittal image where a suprapatellar effusion was observed in a 52 year-old patient with a lateral tibial plateau fracture. One can differentiate a hyperechogenic surface layer (white arrow) corresponding to the fatty component of the effusion, a hyperechoic intermediate layer (red arrow) corresponding to the mixture of serum and synovial fluid, and a deep layer of intermediate echogenicity, compared to those of the two above, and which corresponds to that of the blood cells. In the hyperechoic layer, corresponding to the fat component, one can see serum bubbles trapped among the fat.

**Fig. 5:** Figure 5: This is a B-mode ultrasound, oblique sagittal image of the same patient as in figure 4. One can differentiate a hyperechogenic surface layer (white arrow) corresponding to the fatty component of the spill, an hypoechoic intermediate layer (red arrow) corresponding to the mixture of serum and synovial fluid, and a deep layer of intermediate echogenicity compared to those of the two above and which corresponds
to that of the blood cells. In the hyperechoic layer, corresponding to the fat component, one can see serum bubbles trapped among the fat.

Fig. 6: Figure 6 A and B: This is the same patient as in Figures 4 and 5. A: In an axial CT image, one can differentiate a hypodense surface layer (white arrow) corresponding to the fatty component of the effusion, an intermediate layer (red arrow) of intermediate density in comparison to the other two layers which correspond to the mixture of serum and synovial fluid and to the deep layer (purple arrow) which is that of the blood cells and of highest density when compared to the previous two. B: coronal CT image showing compression fracture of the external tibial plateau.
Conclusion

It is important to know the characteristic findings of lipohemarthrosis as their presence is a sign of intraarticular fracture. In turn, this finding is clinically relevant since the diagnosis and initiation of treatment as early as possible will significantly reduce the incidence of complications occurring in cases of hidden fractures.

References