Lesions of the Femoral Nerve

Lesions of peripheral nerves cause motoric malfunctions, reflex disturbances, sensory disturbances, vegetative malfunctions, disturbances of trophism, pain-and irritation syndromes and much more. The following article presents an overview about the femoral nerve, the causes for lesions, their diagnosis and treatment as well as the possible differential diagnoses and appropriate therapies that have to be considered.

Definition

Definition of the femoral nerve
The femoral nerve is a peripheral nerve originating from the spinal cord segments L1 to L4 and containing motor- and sensory nerve fibers. The motor nerve fibers are responsible for muscle contractions and control body movements. The motor fibers of the femoral nerve supply the m. iliopsoas as well as the extensors of the knee joint. Sensible and sensory fibers transfer the signals from the periphery to the CNS. The sensible fibers supply the skin at the ventral surface of the thigh, the medial surface of the lower leg as well as the tarsal.

As the strongest nerve originating from the plexus lumbalis, its course proceeds between m. psoas major and m. iliacus. It passes through the lacuna musculorum and proceeds laterally of the vasa femoralia into the fossa iliopectinea where it divides in a fan-shaped pattern into:

1. **Musculares**
   - The muscular branches proceed retriperitoneal to the m. psoas major and the m. iliacus and below the inguinal ligament to the m. quadriceps femoris and the m. sartorius.
   - Together with the n. obturatorius, they supply the m. pectineus.

2. **Cutanei anteriores**
   - The muscular branches of the cutanei anteriores supply the anterior medial skin of the thigh and the skin of the knee.

3. **Saphenus**
   - The saphenous nerve is the only branch of the lower leg, which is solely of sensible nature and proceeds from the a. femoralis to the medial area of the knee joint and accompanied by the v. saphena until the medial margin of the foot.

**Etiology**

**Causes for lesions of the femoral nerve**

The causes leading to damages of the femoral nerve are distinguished into:
- Traumatic reasons
- Postoperative reasons
- Hematoma
- Other reasons

Traumatic reasons

Paresis of the femoral nerve, which is mostly reversible, can be caused by direct lesions in the inguinal region as well as by blunt trauma or severe compressions from outside. Lesions caused by sudden, uncontrolled hyperextension of the hip joint in an accident and strain-paralysis of the femoral nerve caused by sportive activity are rare cases.

Postoperative reasons

Damages of the femoral nerve in connection with abdominal rectopexy can also result from retrocecal (behind the colon) operations of the appendix or kidney transplants. Furthermore, femoral paresis that does not always recede can be observed after implanting a total prosthesis of the hip joint. In the case of interventions in vascular surgery, lesions of the aorta abdominalis and the iliac vessels caused by ischemia are also possible.

Hematoma

The femoral nerve is a preferred body region for blood clotting disorders. Hematoma can form and show in the groin due to bleedings into the fascia. In such cases, the nerve stem at the inguinal ligament is particularly sensible to pressure pain. The disappearance of the psoas edge on the paretic side caused by the hematoma can be a hint to the cause of the paralysis. In many cases the hematoma recede by themselves and there is no necessity for a surgery.

Other reasons

Besides the previously mentioned reasons, medical conditions have also been noticed in cases of retroperitoneal malignant lymphomas, prolonged coma, abdominal aortic aneurysms or psoas abscesses. Additionally, diabetes is known to be a significant cause for femoral neuropathy as a result of variations in blood pressure and blood sugar. This occurrence may be attributed to the findings by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) which cites that diabetes is a common reason for peripheral neuropathy in patients who have been diagnosed with diabetes for not less than 25 years.

Symptoms and Clinical Signs

Symptoms of lesions of the femoral nerve

Characteristic symptoms of lesions of the femoral nerve are:
- Paresis of the muscles supplied by the femoral nerve.
- Sensibility disorders of the innervated skin areas.

The m. iliopsoas is the most important and strongest flexor of the hip joint. Without it, we would not be able to lift the leg or bend the trunk forward. Especially sitting up from a
supine position would be impossible. Further flexors of the hip joint are the m. sartorius as well as the m. rectus femoris. In case of lesions of the femoral nerve, the depicted movements cannot be executed anymore.

The musculus quadriceps femoris is solely an extensor of the knee joint. In case of lesions of the femoral nerve, said muscle cannot be stretched actively anymore, since the extensors fail to carry out their function.

Sensibility disorders can also be seen in case of lesions of the femoral nerve. This leads to damage of all skin areas that are innervated by the femoral nerve that can be found on the ventral surface of the thigh, along the medial surface of the lower leg until the medial margin of the foot. A stripe of skin above the medial surface of the tibia is also stated as skin area, especially in cases of damage to the region of the spinal cord segment L4.

The general symptomologies that are indicative of femoral neuropathy may include dull aching pain in the genital area, numbness in any part of the leg, lower extremity muscle weakness, feeling like the knee or leg is going to buckle and difficulties in extending the knee as a result of weakness in the quadriceps.

Diagnosis

Diagnosis of femoral nerve lesions

A diagnosis of femoral nerve lesions can be made with clinical functionality tests. Thereby, the examiner can check the function of the m. iliopsoas, the m. sartorius and the m. rectus femoris.

The muscle test of the m. iliopsoas starts with the patient being in supine position, the leg rotated outwards in a flexion and abduction of about 45°. The examiner places one hand firmly on the contralateral side of the pelvis for stabilizing the patient and prevents the patient from rolling over to the side of the tested muscle. With the other hand, the examiner reaches for the distal thigh. The test is done in direction of extension and slight abduction. The patient pushes in direction of flexion and adduction. Alternatively, the muscle test can be done while standing or sitting.

The most suitable position for testing the m. sartorius is again the supine position. However, it is possible to perform the test while seated.

Taking the example of the left leg, the examiner holds the knee from the outside with his right hand and the distal lower leg on the medial side, directly above the ankle joint with the left hand. Then, the patient’s leg is positioned in approx. 30° – 45° abduction with maximal external rotation, slight flexion of the hip joint and simultaneous flexion in the hip joint. The patient takes a position similar to the “Indian style sitting”. Afterwards, the examiner starts with the test pressure and the patient tenses against the pressure with maximal resistance.

For checking the flexors of the knee joint, the m. rectus femoris and the m. sartorius are optimally innervated. The test can also be performed in supine position. However, it has to be assured that the patient is letting his legs hang down freely. During the test, the patient tenses these muscles and resists the temptation to inflect the lower leg at the knee.

In addition to muscle tests, the function of the femoral nerve can also be controlled with
the patellar reflex. In case of lesions of the femoral nerve, the patellar reflex is weakened or not present at all.

Additional tests which help in diagnosis of femoral neuropathy include the nerve conduction test which checks the speed of electrical impulses of the nerve. This implies that a slow time for the transmission of electrical impulses through the nerves would imply damage to the nerve. The electromyography (EMG) test is performed as a follow-up test to the nerve conduction test and it measures how well the muscle and nerves are working. In essence, EMG is suitable to assess whether the muscles would respond appropriately during stimulation.

![Schematic representation of patellar tendon reflex (knee jerk) pathway (red and green arrows). The reciprocal innervation via an inhibitory neuron (blue) to the antagonist hamstring muscle is also shown.](image)

Differential Diagnosis

Similar disease patterns to femoral nerve lesions

As already mentioned, the femoral nerve is a peripheral nerve that originates from the spinal cord segments L1 to L4. Root lesions of L3/4 can cause lumbar disc herniation, paresis of the quadriceps, weakened patellar reflex and sensible disturbances at the flexor side of the thigh. Functional disorders of the adductors can be seen in root lesions in the areas L2 to L3. L4-lesions usually affect the m. tibialis.

Pareses of the plexus lumbalis are usually easy to detect due to the extended attack of muscles in the hip area. In the course of dystrophin-associated myopathies show an isolated attack of the m. quadriceps and a slowly progressing development that does not show any sensibility disorders.

Therapy
Treatment of the femoral nerve

In practice, treatment of the femoral nerve is dependent on the etiology of the lesions. Surgical interventions are usually no alternatives for lesions of the femoral nerve. Diagnostic imaging of the nerve inside and outside the pelvis has to be done. As soon as the continuity of the nerve is interrupted, grafts have to be used in almost all cases. Empirically, surgical treatments have a very good prognosis. Additionally, physical therapy has emerged as a conservative treatment intervention. Other approaches may include avoidance of external rotation and excessive hip abduction and the use of a knee brace which prevents the buckling of the knee. Equally important is the fact that neuropathic pain medications may be recommended in cases of painful femoral neuropathy.

Review Questions

The answer key can be found below the references.

1. Which 3 muscles are crucial for the diagnostic muscle function test of a femoral nerve lesion?
   A. M. ileopsoas, hamstrings and m. rectus femoris
   B. M. tibialis anterior, m. sartorius and m. rectus femoris
   C. M. tibialis anterior, m. sartorius and hamstrings
   D. M. ileopsoas, m. Sartorius and m. rectus femoris
   E. M. ileopsoas, tibialis anterior and hamstrings

2. Which is a “rare cause” of lesions of the ischiadic nerve?
   A. After implantation of a hip prosthesis
   B. Infections
   C. Caused by external pressure
   D. Circulatory disorders
   E. Injection damages

3. Which beginning disease may look like a paresis of the ischiadic nerve on the surface?
   A. Polymyositis
   B. Myatrophic lateral sclerosis
   C. Multiple sclerosis
   D. Parkinson
   E. Myasthenia gravis

References

G.J. Tortora und B.H. Derrickson, Anatomie und Physiologie, Wiley-VCH Verlag

Mumenthaler, M. Stöhr, H. Müller- Vahl, Läsionen peripherer Nerven und radikuläre Syndrome, Georg Thieme Verlag

Mumenthaler, M. Stöhr, H. Müller- Vahl, Kompendium der Läsionen des peripheren Nervensystems, Georg Thieme Verlag

Schiebler, Schmidt, Zilles, Anatomie 8. Auflage, Springer