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Femoral Nerve Paralysis Following Open Inguinal Hernia Repair

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Abstract Open inguinal hernia repair remains the gold standard to treat inguinal hernias and is associated with a low recurrence and complication rate [1,2,3,4]. The majority of inguinal hernia repairs are completed on an outpatient basis. Local, spinal, epidural, and general endotracheal anesthesia are used depending on patient comorbidities and surgeon preference. Overall, patient recovery is relatively quick and patients return to their normal activities in approximately four weeks. Complications may include hematoma, seroma, chronic groin pain, surgical site infection, and injury to adjacent organs. Femoral nerve injury may occur but is an exceedingly rare event following an open inguinal hernia repair. This manuscript details a patient with a transient sensorimotor paralysis of the femoral nerve following an open inguinal hernia repair. Various etiologies are discussed along with a review of the literature.

Keywords: *inguinal hernia repair, femoral nerve paralysis, inguinal hernia complications, local anesthetic complications*

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1. Introduction

Inguinal hernia repair is the most common procedure performed in general surgery worldwide, with close to 800,000 operations annually in the United States alone [5]. Bassini introduced the first successful surgical repair for inguinal hernias in 1884 [6]. Since that time, more than 70 types of tissue repair have been described, including modifications of the Bassini technique such as the McVay and Shouldice repairs [7,8]. All three of these techniques are currently practiced, with the Shouldice repair reporting the lowest recurrence rates and no differences in rates of adverse events [1,4,9].

Immediate postoperative adverse events associated with open inguinal hernia repair include hematoma (6.4%), urinary retention (3.8%), drainable seroma (1.2%), wound infection (0.9%), and testicular atrophy (0.8%). Inguinal paresthesias (5%) are not an uncommon complication [10]. Inadvertent injury to one of the nerves proximal or within the inguinal canal may cause sensory deficits in the medial part of the thigh or perineal area. The nerves most susceptible to injury include the ilioinguinal, iliohypogastric and genital branch of the genitofemoral nerve. Injury of the femoral nerve is extremely rare during inguinal hernia repair. Symptoms may range from mild cutaneous sensory deficits to paralysis of the quadriceps femoris with inability to extend the knee [11].

This article discusses a transient femoral nerve paralysis following a sutured inguinal hernia repair. Mechanisms are discussed for this type of adverse event and the literature is reviewed for femoral nerve injury following open inguinal hernia repairs.

2. Case Report

A 40-year-old healthy male presented with a one year history of a symptomatic right inguinal hernia. He had no past medical or surgical history and was not taking any medications. On exam, he was a thin, exceedingly fit male with a body mass index of 24.5 kg/m^2. He had a non-tender, reducible right inguinal hernia. Subsequently, he was scheduled for an open inguinal hernia repair.

He underwent general endotracheal anesthesia without paralytic agents. Two mg of midazolam and 100 mcg of fentanyl were administered during the procedure. Intraoperatively, a 4.5 cm incision was made in the right groin and an indirect defect was identified. The ilioinguinal nerve was identified and retracted laterally during the procedure. A hernia sac was dissected from the spermatic cord and opened. No enteric contents were identified and there was no evidence of a femoral hernia with palpation. The sac was ligated with two 2-0 silk sutures. A concurrent direct defect was present and the course of the iliohypogastric nerve was identified. The inguinal floor was repaired with two running 2-0 Prolene sutures. The first suture approximated the iliopubic tract to the conjoint tendon and the second suture imbricated the first suture line. There was no impingement of the iliohypogastric nerve during the repair. The external

oblique was closed with a 3-0 Vicryl running suture with no impingement of the ilioinguinal nerve. Subsequently, 30 cc of 0.25% bupivacaine were injected into the subcutaneous tissue. The skin was closed and the patient was extubated. The patient remained hemodynamically stable throughout the procedure with normal blood pressures and heart rates.

In the recovery room, the patient experienced multiple vasovagal syncopal episodes with a blood pressure of approximately 80/40 mmHg and a heart rate of 56. He also reported a loss of sensation along the anterior aspect of his right leg. Upon standing, the patient's right leg buckled and he was unable to ambulate. On physical exam, his abdomen was non-distended with a dry gauze dressing in place. His abdomen was soft and minimally tender over the inguinal incision. There was no evidence of ecchymosis. His flank and thigh was soft and non-tender. He could dorsiflex and extend his right foot, however was unable to extend his knee or hip. He had decreased sensation over the anterior medial aspect of his thigh. He also had a slightly decreased patellar tendon reflex. While in the recovery room, two liters of intravenous normal saline were administered with a slight increase of his systolic blood pressure and pulse.

He underwent a complete blood count (CBC) and a computed tomogram (CT) of the abdomen and pelvis. The CT showed a small amount of air below the inguinal incision. There was no evidence of a hematoma or fluid collection within the inguinal region (Figure 1). There were no abnormalities of the lumbar spine. The postoperative CBC showed an unchanged hemoglobin. At this point, he was admitted to the hospital. Twelve hours following the operation, the patient's motor and sensory symptoms spontaneously resolved. The patient's neurologic exam showed no persistent weakness or sensory deficits on postoperative day one and the patient was discharged. At fourweeks follow-up, he had a normal gait and a grossly intact neurologic exam. He had returned to his normal activities including jogging. At six months follow-up, he again had a normal exam and no evidence of a recurrent hernia.

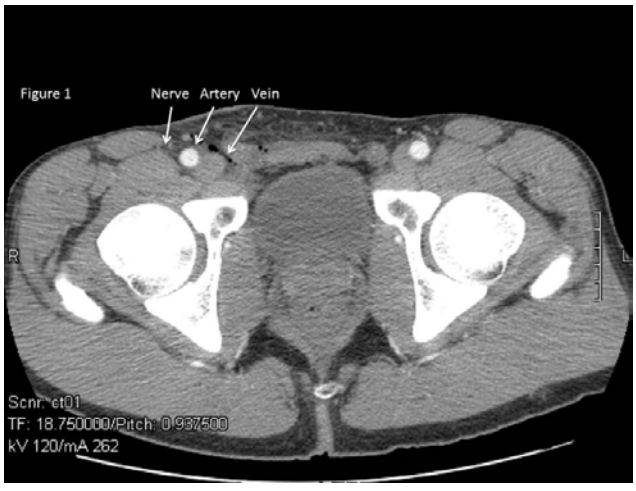

Figure 1. the relationship of the femoral nerve, femoral artery, and femoral vein. Air is noted in the tissue planes due to the recent hernia repair (Demonstrates no hematoma or fluid collection)

3. Discussion

Seromas and hematomas are the most common adverse events after an open inguinal hernia repair. The majority of these collections spontaneously resolve within 6-8 weeks. Other adverse events after inguinal hernia surgery include neuralgias in the distribution of the ilioinguinal, iliohypogastric, genitofemoral and lateral femoral cutaneous nerves. Presently, there are few reports of femoral nerve sensorimotor paralysis following open inguinal hernia repair.

The femoral nerve is formed from contributions from the L2, L3, and L4 nerve roots that coalesce behind the psoas muscle. The nerve emanates between the psoas and iliacus muscle lateral and deep to the iliac artery. The nerve exits the abdomen deep to the iliacus fascia and lateral to the femoral artery as it passes posterior to the inguinal ligament and enters the anterior compartment of the thigh (Figure 2 and Figure 3). The nerve is particularly vulnerable to iatrogenic injury at the iliopsoas groove, and at the inguinal ligament [12]. Since dissection during an open inguinal hernia repair is no deeper than the transversalis fascia, the preperitoneal fat and the iliacus fascia should serve as barriers between the surgeon and femoral nerve. The femoral sheath is a funnel shaped sleeve of fascia with the wide opening facing superiorly. It is continuous with the transversalis fascia superiorly and inferiorly fuses with the fascial investment of the femoral vessels.

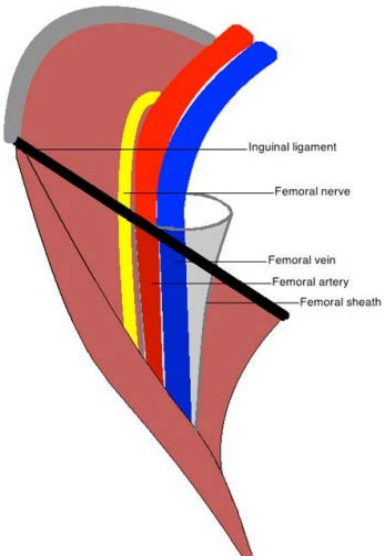

Figure 2. a schematic demonstrating a coronal view of normal inguinal anatomy (Schematic showing the relationship of the artery, vein, and nerve)

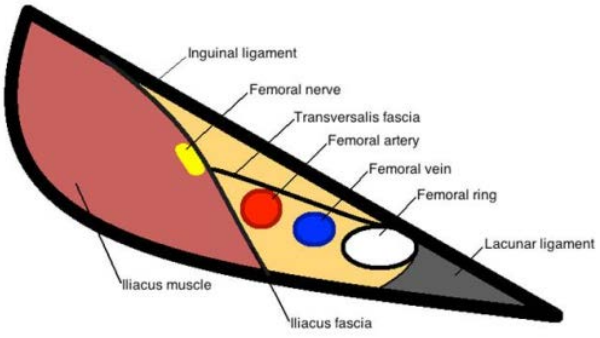

Figure 3. a schematic demonstrating a transverse view of normal inguinal anatomy (Schematic showing the transverse plane)

Iatrogenic femoral nerve injury is a known complication of certain pelvic and abdominal surgeries including colorectal, gynecologic, orthopedic (total hip arthroplasties), and arterial bypass procedures [13,14]. A small number of cases have been reported of femoral nerve paralysis following extra peritoneal laparoscopic inguinal hernia repairs [15,16]. There have been multiple reports of inadvertent femoral nerve paralysis during anesthetic blocks for hernia repair where the deficit showed marked improvement within 2.5 hours [17]. Transient femoral nerve paralysis following ilioinguinal nerve block is well documented [18]. One small study documented as many as 5% of patients undergoing this intervention experienced some disruption of sensory or motor nerve function [19]. There have also been cases of spontaneous femoral nerve paralysis following procedures performed in the lithotomy position due to anatomic entrapment [13].

The mechanism of femoral nerve injury may vary with different procedures and techniques. The nerve may be injured directly by trauma (clipping, incision, puncture, or thermal injury), indirectly by ischemia (stretch or poor perfusion), or by a combination of both (compression or excessive retraction) [11]. Prompt identification of the injury is important in order to initiate treatment. Treatments vary depending on the mechanism of injury. In general, hematomas or fluid collections may require surgical or radiologic drainage if symptomatic. Retraction injuries are usually associated with inflammation and may resemble a shear injury of the neural axon. Operative intervention is unusual for this type of injury as there is no mechanical source that may be rectified [14]. Physiotherapy may be necessary to prevent muscle atrophy and if there is no improvement surgical exploration may be considered.

In the aforementioned case, direct compression of the femoral nerve by a hematoma was excluded with physical exam and a CT scan. A retraction injury was unlikely as the patient was in the supine position and the transversalis fascia was not violated. The local anesthetic may have been injected below the iliacus fascia and infiltrated around the femoral nerve. This is likely the cause of the transient paralysis of the nerve and its sensory innervation. The thin body habitus of this patient and tight fascial planes contributed to this scenario. It is possible that some of the anesthetic may have actually been injected directly into the femoral nerve. The sensorimotor signs and symptoms resolved approximately 14 hours after injecting the anesthetic. Bupivacaine reaches its maximum concentration in the blood approximately thirty minutes following administration and the effects of bupivacaine may last up to 16 hours [20]. This patient's hospital course certainly supports an anesthetic related event. Interestingly, the autonomic changes in terms of blood pressure may have been secondary to proximal extension of the anesthetic. Alternatively, the autonomic response may have been an entirely different pathophysiologic event that was not associated with the local anesthetic.

Based on this event, we now infiltrate the superior aspect of the inguinal incision with bupivacaine liberally. With regards to the lower aspect of the incision, the needle for the local anesthetic is inserted only a few millimeters to hopefully avoid this situation in the future. Also, the amount of local anesthetic on the lower half of the incision is limited to approximately 5-10 cc.

Statement of Competing Interests

None of the authors have any competing interests.

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