

SHORT COMMUNICATION

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Femoral nerve injury in gynecologic surgery: medico-legal issues for best surgical practices

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Abstract

Background: Femoral nerve injury following gynecologic surgery may be a postoperative complication, leading to medical malpractice claims and litigation.

Methods and results: A retrospective analysis was performed on data collected from 973 medico-legal reports of suspected malpractice in gynecologic surgery, filed with the Italian Court between 2000 and 2010. Twelve cases were selected for proven negligence, after a blinded investigation conducted by a gynecologist and a medico-legal expert. Surgical data included type of procedure (hysterectomy, salpingectomy, cesarean section, endometriosis excision), duration of procedure, patient position, and use of retractors. For each case, the observed neuropathy, degree of severity, and recovery time after physical therapy were described. Neuropathies were classified into three categories: neuropraxia (three cases), axonotmesis (six cases), and neurotmesis (three cases) with high sensory and motor deficits. Many particular conditions and pre-existing comorbidity were observed. Two neuropraxia cases were associated with the lithotomy position; axonotmesis cases were related to the incorrect use of self-retaining retractors and an inadequate lithotomy position.

Conclusions: To avoid potential malpractice lawsuits, care must be taken to accurately collect data linked to individual factors and the possible complications of a surgical procedure. A detailed description is required of the patient's position on the surgical table, the self-retaining retractors selected, length of time they were in use, maximum tractive force exerted, and their inspection or repositioning during the operation.

Keywords: Femoral nerve injury, Gynecologic surgery, Hysterectomy, Salpingectomy, Malpractice, Medico-legal issues

Background

The femoral nerve, the largest branch of the lumbar plexus, is derived from nerve roots L2-L4. It descends behind the psoas major and emerges from its lateral border, passing through the groove between the psoas and iliac muscles and underneath the inguinal ligament to run down the thigh lateral to the femoral sheath and its vessels.

The motor branches innervate the sartorius, quadriceps femoris, and articularis genus, while the sensory branches supply the anterior and medial side of the thigh.

Many abdomino-pelvic operations [1, 2] may generate intraoperative femoral nerve injury, but this neuropathy is especially associated with gynecologic procedures with an incidence of 1.1–1.9% [3].

In the majority of cases, femoral iatrogenic lesion is transient, but some patients sustain long-term disability. In these cases, the unexpected nerve injury may have

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medical malpractice implications and the surgeon may face the risk of a medical malpractice claim.

The purpose of this study is to examine the mechanism of iatrogenic femoral nerve injury in observed cases, with best practice suggestions for limiting the risks and evaluating the surgeon’s activity.

Methods

A retrospective analysis was performed on data collected from 973 medico-legal reports, related to the authors’ professional activity, and filed with the Italian Court between 2000 and 2010 for suspected malpractice. Femoral nerve injury resulting from gynecologic surgery was established in 28 cases.

The selected cases were reviewed and investigated in a blinded study by two specialists (a gynecologist and a medico-legal expert) to investigate evidence of medical liability.

Both specialists identified and agreed on 12 certain cases of incorrect surgical procedure. We excluded neuropathies related to spinal anesthesia and the pre-existing ones.

We describe the 12 cases, and for each one, we report the patient’s age, body mass index (BMI), pre-existing comorbidities, risk factors, and gynecological pathology.

Surgical data included the type of procedure, duration of procedure, patient position, and use of retractors. In addition, we describe the observed neuropathy, degree of severity according to the Medical Research Council (MRC) scale [4], and recovery time after physical therapy.

Results

The results of the survey are set out in the tables below. We describe the observed patient’s characteristics (Table 1), surgical procedure (Table 2), and type of nerve injury (Table 3).

Discussion

Our investigation highlights that the femoral nerve, especially the left femoral nerve, may be damaged in gynecologic surgery. Anatomical studies suggest that in approximately 30% of people, the left femoral nerve divides before leaving the pelvis, and its branches run through the psoas and iliac muscles [5]. Although this may provide possible protection against surgical injury, it has been observed that the left femoral nerve is more susceptible to ischemia because it is penetrated by fewer branches of the deep circumflex iliac artery [6]. In our series, on the basis of our assessments, in pelvic surgery, retractor blades are frequently placed laterally to the iliopsoas to better explore the recto-sigmoid colon, thus increasing the risk of damage to the left femoral nerve. In any case, in our investigation, the right femoral nerve was damaged in only three cases.

Maneschi et al. [7], however, reported 12 cases of right femoral nerve injury after surgery for gynecologic cancer and suggested that this neuropathy occurs on the side of the major pelvic procedure. The literature has also reported bilateral femoral injury [8] in subjects undergoing vaginal surgery in “candy cane” stirrups.

In our study, we observed an ilioinguinal left nerve injury in cesarean section because the surgeon extended the Pfannenstiel incision beyond the lateral margin of the rectus muscle, resulting in nerve compression after the closure of the abdominal wall [9]. In the other three

Table 1 Patient’s characteristics (age, BMI, risk factors, comorbidity, pathology)

| Case | Age (years) | BMI | Risk factors | Comorbidity | Pathology |
|------|-------------|-----|----------------------|---------------------------|--|
| 1 | 62 | 24 | Smoking, diabetes | _____ | Uterine myoma |
| 2 | 67 | 26 | _____ | Mild renal failure | Giant uterine myoma |
| 3 | 65 | 21 | Lumbar spine disease | _____ | Uterine myoma |
| 4 | 57 | 25 | Diabetes | Vascular disease | Uterine myoma |
| 5 | 68 | 20 | Smoking | Heart disease | Uterine myoma |
| 6 | 27 | 26 | _____ | Previous cesarean section | Labor dystocia |
| 7 | 45 | 28 | Smoking | _____ | Uterine myoma |
| 8 | 51 | 23 | Diabetes | Previous myomectomy | Uterine myoma |
| 9 | 49 | 22 | Narrow pelvis | Previous myomectomy | Uterine myoma |
| 10 | 54 | 27 | _____ | Previous cesarean section | Uterine myoma Ovarian cysts |
| 11 | 53 | 18 | Smoking | Previous appendectomy | Right ovarian cyst Uterine myoma |
| 12 | 46 | 18 | Smoking | Endometriosis | Bilateral ovarian cysts Uterine myoma |

Table 2 Type of surgical procedure, patient position, surgical incision, procedure duration (in minutes), and use of sanitary retractors

| Case | Procedure | Patient position | Surgical incision | Duration (min) | Retractors |
|------|---|------------------|--|----------------|------------|
| 1 | Hysterectomy Bilateral salpingectomy | High lithotomy | Pfannenstiël incision | 145 | Yes |
| 2 | Hysterectomy Left salpingectomy | Supine position | Pfannenstiël incision | 120 | Yes |
| 3 | Hysterectomy Bilateral salpingectomy | High lithotomy | Laparoscopic surgery | 135 | No |
| 4 | Hysterectomy Bilateral salpingectomy | High lithotomy | Xipho-pubic incision | 140 | Yes |
| 5 | Hysterectomy | Lithotomy | Pfannenstiël incision | 162 | Yes |
| 6 | Cesarean section | Supine position | Pfannenstiël incision | 35 | No |
| 7 | Hysterectomy | Low lithotomy | Pfannenstiël incision | 130 | Yes |
| 8 | Hysterectomy | Supine position | Xipho-pubic incision | 146 | Yes |
| 9 | Hysterectomy Bilateral salpingectomy | Lithotomy | Transversal laparotomy (Kustner technique) | 140 | Yes |
| 10 | Hysterectomy Bilateral salpingectomy | High lithotomy | Pfannenstiël incision | 142 | Yes |
| 11 | Hysterectomy Bilateral salpingectomy | High lithotomy | Pfannenstiël incision | 132 | Yes |
| 12 | Hysterectomy Bilateral salpingectomy Endometriosis excision | High lithotomy | Laparoscopic surgery | 148 | No |

cases, femoral nerve lesions were associated with injuries of the pudendal, femoral cutaneous, and obturator nerves. The lateral femoral cutaneous nerve was damaged instead of the femoral nerve during cesarean section. Finally, the obturator nerve was observed to have been damaged following endometriosis excision during a hysterectomy and bilateral salpingectomy.

The observed neuropathies were classified into categories: neuropraxia (three cases), axonotmesis (six

cases), and neurotmesis (three cases) with high sensory and motor deficits. In order to assess the extent of nerve injury, with reference to the MRC scale, one or more electromyography-electroneurography (EMG-ENG) exams were performed, the last of which was conducted no less than 1 year after the initiating surgery. Only the examinations performed at the same hospital operating unit were taken into consideration.

Table 3 Nerve injury, degree of severity, motor loss, sensory loss, and regression evaluated after EMG-ENG

| Case | Nerve injury | Degree of severity (0–5) ^a | Motor loss | Sensory loss | Regression |
|------|---|---------------------------------------|------------|--------------|--|
| 1 | Femoral (left) | Axonotmesis (3) | Yes | Yes | < 8 months |
| 2 | Femoral (left) | Neuropraxia (1) | - | Yes | < 6 months |
| 3 | Femoral (right) | Neuropraxia (2) | Yes | Yes | < 6 months |
| 4 | Femoral (right) Pudendal (right) | Axonotmesis (3) | Yes | Yes | < 10 months (femoral nerve) Persistence (right pudendal nerve) ^b |
| 5 | Femoral (left) | Neurotmesis (5) | Yes | Yes | Persistence |
| 6 | Ilioinguinal (left) | Axonotmesis (3) | Yes | Yes | < 8 months |
| 7 | Femoral (left) | Axonotmesis (3) | Yes | Yes | < 8 months |
| 8 | Femoral (left) | Axonotmesis (5) | Yes | Yes | Persistence |
| 9 | Femoral (right) | Axonotmesis (3) | Yes | Yes | < 8 months |
| 10 | Femoral (left) | Axonotmesis (2) | Yes | Yes | < 6 months |
| 11 | Femoral (left) Lateral femoral cutaneous | Neurotmesis (4) | Yes | Yes | Persistence |
| 12 | Femoral (left) Obturator | Axonotmesis (3) | Yes | Yes | < 8 months |

^aAccording to the MRC criteria [4]

^bThe femoral neuropathy regressed after 6 months but suffering in the right pudendal nerve persisted

Paresthesia, pain, and motor deficits generally regressed within 6–10 months after medical and physical therapy because the degree of neurological severity was light-medium, a prompt diagnosis had been proposed, and an aggressive physiotherapy program was completed.

Neuropraxia and painful sensations fully resolved in two cases, but in other cases, sensory and motor deficits only regressed and did not disappear. In three cases characterized by neurotmesis, due to persistent neurological deficits, the patients were addressed to the neurosurgeon for nerve repair, after making EMG and a neurological consultation. In the majority of surgical procedures, the patient was placed in the lithotomy position and several times in the high lithotomy position, but in three cases, the supine position was favored. The lithotomy position, especially the high lithotomy with “candy cane” stirrups, requires the excessive flexion of the thigh with abduction and external rotation of the hip. This position can strain the femoral nerve trapped below the inguinal ligament [10].

The neuropathies under study arose after a hysterectomy or hysterectomy with bilateral salpingectomy in subjects with giant uterine myomas and bilateral ovarian cysts. Surgery time for laparoscopic surgery was between 135 and 148 min. The laparotomic approach required 120–168 min. It has been reported that, in general, when surgical time exceeds 2 h, prolonged compression of the femoral nerve in the lithotomy position can be particularly dangerous for the nerve fibers [11].

In two cases, a laparoscopy was performed, while in the other ten cases, a laparotomic approach was chosen with a Pfannenstiel incision (seven times), xiphopubic incision (twice), or the transversal Kustner technique.

We observed that in laparotomic surgery, retractors and self-retaining retractors (Balfour or Bookwalter) were used. In the literature, nerve injuries are associated with the use of these devices because retractor blades, if not properly applied, may compress the femoral nerve, retracting the psoas muscle laterally or impinging on the nerve against the pelvic sidewall [12]. In fact, previous studies have found that femoral neuropathies decrease significantly after modified application of retractors, when their use and duration of maximum traction are reduced [7].

In this analysis, the age of operated patients varied between 27 and 68 years and the BMI was between 18 and 28. Narrow pelvis, smoking, low BMI, and pre-existing comorbidity (previous myomectomy, cesarean section, endometriosis, vascular disease, diabetes, and mild renal failure) were also observed.

In some studies, pre-existing pathologies or conditions, especially old age and a low BMI (< 20), have been found to increase the risk of femoral nerve injury due to

thin subcutaneous fat cover and poorly developed rectus muscles; thus, retractor blades were more likely to impinge on the femoral nerve. However, other authors [7] have not reported BMI and old age as variables influencing the development of neuropathies.

Medico-legal issues

Iatrogenic nerve injury, as the literature reports, represents an unexpected and undesired outcome of some major surgical procedures. Such lesions may bring about both short-term and persistent neurological deficits and frequently lead to litigation between the patient and surgeon with considerable medico-legal and financial implications for the doctor and a country's national healthcare system.

In incident cases, medico-legal investigation is necessary to identify and fully assess the causes of injury, but it is very difficult to carry out a retrospective survey because various factors are not always reported in clinical records [13]. Besides, nerve injuries are frequently caused by several factors and the literature does not offer a global consensus on risk assessment.

However, several studies offer clinically relevant warnings. For example, in a prospective cohort study, Bohrer et al. [14] attributed three cases of femoral neuropathy to the lithotomy position, two of which were bilateral. Abdalmageed et al. [10] reported that the high lithotomy position with extreme flexion at the hip in the Trendelenburg position can contribute to perioperative peripheral nerve injuries. Maneschi et al. [7] highlighted, above all, the significantly higher frequency of femoral nerve injury when the Bookwalter retractor is used in surgery for gynecologic cancer.

As mentioned previously, some authors have observed that patients with a low BMI and those who are aged 60 and over are more susceptible to nerve injuries because the peripheral nerves in these patients seem to be less protected and more sensitive to pressure [12] (although femoral neuropathies are also reported in obese patients [15]).

Also, surgical time is regarded differently by various authors: Abdalmageed et al. [10] reported that surgical time exceeding 2 h in the lithotomy position is enough to bring on femoral neuropathies. On the other hand, Kuponyi et al. [16], Warner et al. [11], and Chan and Manetta [12] associated femoral lesions with the same position only in operations lasting more than 4 h. According to Irvin et al. [17], the predisposing factors in neurologic injury during gynecologic surgery are as follows:

- Improper placement of retractors (fixed or self-retaining)

- Improper positioning of patients in the lithotomy position
- Radical surgical dissection

In addition, Kuponiyi et al. [16] drew attention to hematoma formation and direct nerve entrapment or transection as primary causative factors in postoperative nerve injury.

In our series, based on the cases examined in the present study, nerve injuries in gynecologic procedures are more related to the surgeon’s activity and surgical procedures than the patient’s characteristics, as reported in Table 4.

In fact, in three cases distinguished by neurotmesis following a hysterectomy or hysterosalpingectomy and in one case characterized by axonotmesis after cesarean section, the surgical activity was found to be inappropriate. Two cases of neuropraxia were related to the lithotomy position; in six cases, axonotmesis was brought on by the incorrect use of self-retaining retractors and an inadequate lithotomy position.

To pick out all possible factors contributing to the genesis of nerve injuries, it could be helpful to report surgical time (accounting for each stage and the timing of each step), as well as position of the patient, BMI, and age, as these are recognized risk factors. In particular, in the case of a prolonged intervention, it is very important to describe the possible presence of adhesions. In fact, the need for adhesiolysis increases surgery time, thus extending the duration of nerve compression. Moreover, tissue traction for adhesiolysis can itself cause nerve lesion [18].

Since patient positioning, in particular the lithotomy position, could be an important factor related to femoral nerve lesion, a standardized approach is needed [18]. Indeed, ensuring the correct position is essential for the primary prevention of nerve lesions. For example, using footrest brackets allows the surgeon to obtain the right balance of weight between the legs and feet, to avoid flexion of the knees and hip above 90°, and to position hips with minimal abduction and external rotation [19]. However, the risk of nerve complications related to

patient position must not condition the surgical approach in gynecologic surgery.

In the future, to warrant further studies aimed to understand the genesis of nerve lesion, the precise description of each stage of the surgical procedure is very useful not only for understanding the genesis of nerve lesion, but also for finding correlations with other risk factors and the patient’s individual characteristics. It is also necessary to register any repositioning of the patient during an operation and to avoid prolonged dorsolithotomic position in patients with risk factors such as diabetes and obesity. In fact, patients without risk factors are also exposed to nerve lesion if the duration of the intervention is prolonged or if the lithotomy position is held too long [20].

The surgical team must be vigilant in investigating the patient’s characteristics, choosing the best surgical planning software and performing the surgical procedure as well as possible. It should be kept in mind that patients at increased risk need more attention to avoid more predictable complications.

Conclusions

A thorough medico-legal investigation should reveal all the possible factors related to postoperative neuropathy, taking into account and verifying the patient’s characteristics, surgical procedure, and the surgeon’s activity in every specific case.

Furthermore, it seems appropriate that clinical records should give an accurate report of the preoperative visit, risk factors, possible complications of the surgical procedure, and the patient’s informed consent. Finally, it is imperative to describe the patient’s position on the surgical table, the self-retaining retractors selected, their duration of use, the maximal traction exerted, and their inspection or repositioning during the operation.

Thus, femoral nerve injury in gynecologic surgery can be investigated in a clinically significant way, and the medico-legal report can be accurately established, freeing the surgeon from any possible claims.

Table 4 Factors related to nerve injury during gynecologic surgery (patient’s characteristics, surgical procedure, surgeon’s activity)

| Patient’s characteristics | Surgical procedure | Surgeon’s activity |
|----------------------------|--|---|
| Age > 60 years BMI < 20 | Major surgical procedure (hysterectomy, radical hysterectomy, hysterectomy with bilateral salpingectomy, etc.) | Side of surgical incision |
| Narrow pelvis | Kind of procedure (laparoscopic/laparotomic surgery) | Type, placement, time, and maximal traction of retractors |
| Smoking/alcohol | Patient position on the surgical table | Intraoperative bleedings |
| Diabetes | Time of procedure (> 120 min) | Surgical dissection and operative procedure |
| Endometriosis | | Abdominal wall and fascial wound closure |
| Pre-existing neuropathies | Use of retractors or self-retaining retractors | |

Abbreviations

BMI: Body mass index; MRC: Medical research council; EMG-ENG: Electromyography-electroneurography

Acknowledgements

Thanks to Jemma Dunnill for proofreading the manuscript.

Authors' contributions

PF conceived the key points of the work. MG, PG, and AD acquired the data. LLM and GV reviewed and investigated the selected cases. RS contributed to the conception of the work and verified the structure of the manuscript. GV also supervised the findings of this work and verified the analytical method. All authors read and approved the final manuscript.

Funding

Not applicable.

Availability of data and materials

The datasets generated during the current study are not publicly available due the authors' professional activity and filed with the Italian Court, but they are available from the corresponding author on reasonable request.

Declarations**Ethics approval and consent to participate**

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Received: 20 December 2020 Accepted: 23 April 2021

Published online: 30 April 2021

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