Pelvic nerve injury following gynecologic surgery: a prospective cohort study

Justin C. Bohrer, MD; Mark D. Walters, MD; Amy Park, MD; David Polston, MD; Matthew D. Barber, MD, MHS

OBJECTIVE: The purpose of this study was to determine the incidence and time course of postoperative neuropathy resulting from gynecologic surgery.

STUDY DESIGN: A single cohort of 616 female patients undergoing elective gynecologic surgery for benign or malignant conditions at a tertiary care academic medical center underwent a postoperative neurologic evaluation to identify postoperative neuropathy of the lower extremities.

RESULTS: Fourteen peripheral nerve injuries were observed in 11 patients, making the overall incidence of postoperative neuropathy 1.8% (95% confidence interval, 1.0–3.2). Injury to the lateral femoral cutaneous (5), femoral (5), common fibular (1), ilioinguinal/iliohypogastric (1), saphenous (1), and genitofemoral (1) nerves were detected. Complete resolution of neuropathic symptoms occurred in all but 1 patient (91%). Median time to resolution of symptoms was 31.5 days (range, 1 day to 6 months).

CONCLUSION: The incidence of lower extremity neuropathy attributable to gynecologic operations is low, and these neuropathies resolve in the great majority of cases.

Key words: gynecologic surgery, nerve injury, neuropathy, postoperative complication


Iatrogenic neuropathy is a common but largely underrecognized cause of both short-term and persistent postoperative pain in patients undergoing major surgical procedures.1 Intraoperative nerve injury occurs through compression, stretch, entrapment, or transection of peripheral nerve fibers. Injury to the ilioinguinal, iliohypogastric, obturator, femoral, genitofemoral, lateral femoral cutaneous, pudendal, sciatic, and common fibular nerves have all been documented after gynecologic surgery.2-5

Previous prospective studies have focused on the risk of nerve injury associated with the use of self-retaining retractors and lithotomy positioning.3,6 Two retrospective studies have estimated the risk of nerve injury from major gynecologic procedures to be between 1.1% and 1.9%.7,8 Prospective studies evaluating the incidence and risk factors for postoperative nerve injury after routine gynecologic surgery are lacking. The objective of this study was to determine the overall incidence of pelvic nerve injury following both major and minor benign and oncologic gynecologic surgical procedures at a single academic medical center.

MATERIALS AND METHODS

Approval for this study was obtained from the Cleveland Clinic Institutional Review Board, and informed consent was obtained from all study participants. Female patients over 18 years of age undergoing an elective inpatient or outpatient gynecologic surgical procedure for oncologic and benign gynecologic conditions were eligible to participate. Patients with paraplegia, quadriplegia, progressive or recurrent neurologic condition (eg, multiple sclerosis), ASA class IV status, or patients undergoing emergent procedures were excluded.

On the assumption that the existing retrospective studies may have missed subtle or transient neurologic injury, we estimated a priori that the true incidence of pelvic nerve injury following gynecologic surgery is 3% for purposes of our sample size calculation. Assuming the incidence of nerve injury to be 3%, we needed 600 patients to determine the true incidence with a margin of error of ± 1.3% using a 95% confidence interval. To account for a predicted 10% rate of loss to follow-up and dropout, our enrollment goal was 660 patients over the time period of one year.

A comprehensive, standardized neurologic history and physical examination was performed preoperatively and again postoperatively within 24 hours of discontinuation of anesthesia by a single trained examiner (J.B.). The examiner was not blinded to the type of surgery, length of operation, or patient position. Motor strength was scored 0 to 5 according to the Medical Research Council rating scale, with 0 being absence of any resistance and 5 being full strength. Hip strength was tested in abduction, adduction, extension, flexion, and internal rotation. Knee strength was assessed in flexion and extension. Ankle strength was assessed in dorsiflexion, plantarflexion, inversion, and eversion. Sensation of the abdomen and lower extremities were assessed using light touch and pinprick. Patellar and ankle jerk reflexes were scored as present or absent. Subjects were questioned about the presence of pain, loss of sensation, and/or abnormal sensation (eg,
Data analysis was performed using JMP 6.0 (SAS Institute, Cary, NC). Incidence is reported as a percentage with 95% confidence interval. Means were compared using Student t test for continuous variables and proportions were compared using $\chi^2$ for nominal and ordinal data. Probability values less than .05 were used to demonstrate statistical significance.

**RESULTS**

Seven hundred sixty-two consecutive patients were approached for enrollment in this study between July 2007 and July 2008. Six hundred and sixty patients met enrollment criteria and consented to study participation. Details of participant enrollment and follow-up are found in the Figure. Six hundred and sixteen patients were screened for neuropathy postoperatively. The baseline characteristics of the cohort are listed in Table 1. At the preoperative neurologic evaluation, preexisting lower extremity neuropathies were observed in 12 (1.9%) participants prior to the surgery. These preoperative neuropathies included 1 femoral, 3 pudendal, 1 genitofemoral, and 7 lateral femoral cutaneous.

Surgical procedures performed are listed in Table 2. Overall, 22% were performed via laparotomy, 43% vaginally (including hysteroscopy), 26% laparoscopically, 14% other (including vulvar procedures and inguinal lymphadenectomy), and 5% by a combination of routes. Six percent were performed in the supine position without stirrups, 46% were performed in the low or high lithotomy position with support Boots (eg, Allen stirrups or yellow fin stirrups; Allen Medical Systems, Acton, MA) and 47% were performed in high lithotomy with candy cane stirrups.

Fourteen new peripheral nerve injuries were observed postoperatively in 11 patients, making the overall incidence of de novo postoperative neuropathy 1.8% (11/616; 95% confidence interval [CI], 1.0–3.2). Age, body mass index (BMI); Charlson Comorbidity index (CCI), history of smoking, history of peripheral vascular disease, history of neurologic disease, history of lumbar spine disease, and operative time were not significantly different between those who developed neuropathy and those who did not. Of the 21 patients not receiving preoperative evaluation per the protocol, none subsequently developed a postoperative neuropathy. None of the patients who underwent surgery in the supine position developed a postoperative neuropathy (0%; 95% CI, 0.06–9). Four subjects who underwent surgery in the dorsal lithotomy position with support boots developed a postoperative neuropathy (1.3%; 95% CI, 0.04–2.7) compared with 7 subjects (2.6%; 95% CI, 0.7–4.4) who underwent surgery in high lithotomy position with candy cane stirrups, ($P = .46$). In all, 5 lateral femoral cutaneous, 1 common fibular, 5 femoral, 1 ilioinguinal/iliohypogastric, 1 saphenous, and 1 genitofemoral neuropathies were detected (Table 3). Bilateral neuropathies of the femoral or lateral femoral cutaneous nerve were observed in 3 (27%) subjects. Complete resolution of neuropathic symptoms occurred in all but 1 subject (91%). One subject required physical therapy and another required a trigger point injection with local anesthetic to achieve symptomatic resolution; the remaining required no specific treatment. The median time to resolution of symptoms was 31.5 days (range, 1 day to 6 months).

Five lateral femoral cutaneous (LFCN) neuropathies were observed in 4 participants (Table 3). Three unilateral cases occurred in subjects undergoing vaginal surgery in candy cane stirrups, all of which were left-sided. One participant undergoing a laparoscopic procedure in boot stirrups suffered a bilateral LFCN neuropathy. All 4 subjects with LFCN neuropathies reported loss of sensation and paresthesias of the anterolateral thigh proximal to the knee. None reported neuropathic pain symptoms. Complete resolution was achieved in all 4 subjects with a range of 62 to 136 days.

Five femoral neuropathies were identified in 3 patients. A left-sided femoral neuropathy with involvement of the saphenous nerve was identified in a single subject undergoing vaginal surgery in candy cane stirrups. Motor strength and reflexes were intact. Two bilateral femo-
Assessed for eligibility (n = 762)

Excluded (n = 13)
Neurologic disease (n = 7), dementia (n = 3), age <18 (n = 1), emergent surgery (n = 1), non-english speaker (n = 1)

Consented (n = 660)

Refused to participate (n = 89)

Surgery cancelled (n = 18)

Preoperative examination (n = 611)

Voluntary withdrawals (n = 10)

Surgery (n = 632)\(^a\)

Lost to follow-up (n = 13)

Postoperative examination (n = 616)

Excluded (n = 3)
Critical status (n = 2)
Neurologic condition (n = 1)

\(^a\)21 subjects without preoperative examinations.

ral neuropathies were observed: 1 purely sensory and 1 with sensory and motor components. The purely sensory bilateral femoral neuropathy occurred in a participant undergoing a laparoscopic procedure in boot stirrups. Involvement of the saphenous branch of the femoral nerve was not observed. A bilateral femoral neuropathy with motor and sensory components was observed in a single subject undergoing vaginal surgery in candy cane stirrups. At the initial examination, knee extension was found to be 3 out of 5, and patellar reflexes were absent. This subject demonstrated involvement of the saphenous nerve including loss of sensation and paresthesias of the medial leg below the knee. Physical therapy was required for resolution of symptoms in this single participant. The time to resolution of the femoral neuropathies ranged from 112 to 298 days. One subject had loss of sensation and paresthesia over the anteromedial knee consistently with injury to a geniculate branch of the saphenous nerve. This participant had persistent symptoms at 8-month follow-up.

A single ilioinguinal/iliohypogastric neuropathy was identified in a subject undergoing a laparoscopic procedure. The participant presented postoperatively with 8 out of 10 burning left lower quadrant incisional pain at the trocar site that radiated to her proximal anteromedial thigh. A trigger-point injection with 10 mL of .25% Marcaine was performed in the office resulting in immediate pain relief. Complete pain relief was achieved 10 days following the injection.

A genitofemoral neuropathy was observed in a morbidly obese subject undergoing a rectovaginal fistula repair and placement of a trans-obturator mid-urethral sling in candy cane stirrups. The participant experienced loss of sensation and paresthesias over the left proximal anterior thigh at the femoral triangle. Symptoms were consistent with injury to the femoral branch of the genitofemoral nerve. The subject did not report labial or groin symptoms.

A common fibular neuropathy was observed in a subject undergoing laparoscopic surgery in boot stirrups. The participant experienced loss of sensation and paresthesia over the lateral dorsum.
of the right foot as well as foot drop. The subject’s symptoms completely resolved by the end of postoperative day 2.

**Comment**

The literature on nerve injury following gynecologic surgery is limited. We found the incidence of new postoperative neuropathy to be 1.8% in our prospective cohort, which is consistent with prior studies. Two separate retrospective cohort studies of patients undergoing major gynecologic oncology procedures at Tampa General Hospital have estimated the incidence of neuropathy to be between 1.1% and 1.9%. The studies are limited by their retrospective approach; they are restricted to major procedures and thus would not be able to capture nerve injury resulting from minor or laparoscopic procedures. Subtle nerve injuries may have escaped detection due to the absence of a careful prospective, comprehensive neurologic examination. In addition, the retrospective nature of these studies precluded the performance of preoperative exams to exclude the possibility of preexisting neurologic pathology. Preoperative nerve exams are crucial to detect existing neuropathies, which we found in 12 of 616 patients, so they are not confused with surgery-induced neuropathy.

A prospective study of 991 adult patients undergoing surgery in lithotomy position was performed at the Mayo Clinic and found the incidence of postoperative neuropathy to be 1.5%. That study differed from ours in that they included both male and female patients and only included those undergoing procedures in lithotomy positioning.

### Table 2

**Surgical procedures**

<table>
<thead>
<tr>
<th>Procedure type</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal or laparoscopic hysterectomy</td>
<td>127 (20.6)</td>
</tr>
<tr>
<td>Transvaginal hysterectomy</td>
<td>84 (13.6)</td>
</tr>
<tr>
<td>Radical hysterectomy</td>
<td>6 (0.9)</td>
</tr>
<tr>
<td>Open or laparoscopic prolapse surgery</td>
<td>68 (11.0)</td>
</tr>
<tr>
<td>Vaginal prolapse surgery</td>
<td>154 (25.0)</td>
</tr>
<tr>
<td>Mid-urethral sling</td>
<td>161 (26.1)</td>
</tr>
<tr>
<td>Tumor debulking</td>
<td>16 (2.6)</td>
</tr>
<tr>
<td>Pelvic and/or paraaortic lymphadenectomy</td>
<td>30 (4.9)</td>
</tr>
<tr>
<td>Oophorectomy</td>
<td>132 (21.4)</td>
</tr>
<tr>
<td>Open or laparoscopic myectomy</td>
<td>12 (1.9)</td>
</tr>
<tr>
<td>Hysteroscopy, diagnostic and operative</td>
<td>102 (16.6)</td>
</tr>
</tbody>
</table>


### Table 3

**Description of postoperative nerve injuries**

<table>
<thead>
<tr>
<th>No.</th>
<th>Nerve</th>
<th>Side</th>
<th>Motor loss</th>
<th>Sensory loss</th>
<th>Pain</th>
<th>Approach</th>
<th>Positioning</th>
<th>T&lt;sub&gt;procedure&lt;/sub&gt; (min)</th>
<th>T&lt;sub&gt;resolution&lt;/sub&gt; (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Iliolinguinal/iliohypogastric</td>
<td>L</td>
<td>n/a</td>
<td>no</td>
<td>yes</td>
<td>Laparoscopic</td>
<td>Boot</td>
<td>95</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>Saphenous</td>
<td>R</td>
<td>n/a</td>
<td>yes</td>
<td>no</td>
<td>Vaginal</td>
<td>Candy Cane</td>
<td>188</td>
<td>Persistent at 8-month follow-up</td>
</tr>
<tr>
<td>3</td>
<td>Genitofemoral</td>
<td>L</td>
<td>n/a</td>
<td>yes</td>
<td>no</td>
<td>Vaginal</td>
<td>Candy Cane</td>
<td>139</td>
<td>28</td>
</tr>
<tr>
<td>4</td>
<td>Common fibular</td>
<td>R</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>Laparoscopic</td>
<td>Boot</td>
<td>169</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Lateral femoral cutaneous</td>
<td>L</td>
<td>n/a</td>
<td>yes</td>
<td>no</td>
<td>Vaginal</td>
<td>Candy Cane</td>
<td>131</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Lateral femoral cutaneous</td>
<td>B</td>
<td>n/a</td>
<td>yes</td>
<td>no</td>
<td>Laparoscopic</td>
<td>Boot</td>
<td>136</td>
<td>180</td>
</tr>
<tr>
<td>7</td>
<td>Lateral femoral cutaneous</td>
<td>L</td>
<td>n/a</td>
<td>yes</td>
<td>no</td>
<td>Vaginal</td>
<td>Candy Cane</td>
<td>62</td>
<td>42</td>
</tr>
<tr>
<td>8</td>
<td>Lateral femoral cutaneous</td>
<td>L</td>
<td>n/a</td>
<td>yes</td>
<td>no</td>
<td>Vaginal</td>
<td>Candy Cane</td>
<td>95</td>
<td>120</td>
</tr>
<tr>
<td>9</td>
<td>Femoral</td>
<td>B</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>Vaginal</td>
<td>Candy Cane</td>
<td>298</td>
<td>150</td>
</tr>
<tr>
<td>10</td>
<td>Femoral</td>
<td>B</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>Laparoscopic</td>
<td>Boot</td>
<td>234</td>
<td>35</td>
</tr>
<tr>
<td>11</td>
<td>Femoral</td>
<td>L</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>Vaginal</td>
<td>Candy Cane</td>
<td>112</td>
<td>1</td>
</tr>
</tbody>
</table>

B: bilateral; Boot: Allen or yellowfin stirrups; Candy Cane, candy cane stirrups; L: left; n/a: nonapplicable; R: right; T: time.

Our prospective cohort included only female patients undergoing major or minor gynecologic procedures in both high and low lithotomy or supine positioning.

Two previous prospective studies estimated the incidence of femoral neuropathy following abdominal hysterectomy to be between 7.45% and 11.6%. This is much higher than the incidence that we observed in our cohort. The clinical features of femoral nerve palsy include weakness of the knee extensors, loss of the patellar reflex, and abnormal sensation of the anteromedial thigh and medial leg. Improper lithotomy positioning, self-retaining retractors, transverse abdominal incisions, and thin body habitus have been shown to be risk factors in previous studies. We surmise the mechanism of injury in our 3 patients with femoral neuropathy to be lithotomy positioning, as their surgeries did not involve placement of self-retaining retractors. Flexing, abducting, and externally rotating the thighs results in a sharp angulation of the femoral nerve beneath the inguinal ligament, which undoubtedly contributes to nerve injury. Two of the 3 patients experienced bilateral femoral neuropathy. This is not unusual as bilateral femoral neuropathies have been widely reported in the literature. It is possible that widespread education in proper lithotomy positioning has resulted in the low incidence of femoral neuropathy that we observed. Injury to the lateral femoral cutaneous nerve (LFCN) is characterized by alteration of sensation of the anterolateral thigh proximal to the knee. LFCN neuropathy is not uncommon in the general population as obesity and tight belts around the waist are risk factors, and we identified multiple patients with meralgia paresthetica prior to their operation. The most likely cause of LFCN neuropathy in gynecologic surgery is compression under the inguinal ligament in lithotomy positioning. Treatment of LFCN neuropathy is often conservative, and tricyclic antidepressants are a first-line medical treatment. In cases of intractable pain, surgical decompression/neurolysis may be attempted. Genitofemoral neuropathy has previously been reported in patients undergoing inguinal lymphadenectomy or procedures involving the pelvic sidewall. As with the femoral and lateral femoral cutaneous nerves the femoral branch of the genitofemoral nerve passes under the inguinal ligament. The normal anatomic course of the femoral branch is more medial along the inguinal ligament relative to these nerves and more deep, making it less susceptible to compression injury. However, external compression as a cause of injury to the femoral branch of the genitofemoral nerve at the level of the inguinal ligament has been implicated in at least 1 case report. Ilioinguinal/iliohypogastric neuropathy is most frequently a complication of procedures involving incision of the lower abdomen. Transsection of the nerve with neuroma formation, suture entrapment at fascial closure, and constriction of the nerve by scar formation are all postulated mechanisms of injury. In our patient with burning pain at the trocar site radiating to her groin in the immediate postoperative period, we suspect that suture entrapment was the most likely cause.

We observed a single common fibular neuropathy that we believe to be caused by compression by boot stirrups. Common fibular nerve palsy is characterized by foot drop and loss of sensation/paresthesias over the lateral surface of the leg and lateral dorsum of the foot. The precarious position of the common fibular nerve as it passes over the fibular head undoubtedly predisposes this nerve to injury by external compression in patients placed in candy cane or boot stirrups.

The strengths of this study include its prospective design and the use of standardized comprehensive neurologic evaluation both pre- and postoperatively. However, the inherent challenges of studying neurologic injury resulted in unavoidable weaknesses in our study design. Our history and physical examinations were limited to detecting “clinically significant” nerve injury. We may have missed patients with subclinical nerve injury that can only be detected by more sophisticated methods such as electrophysiology and nerve conduction studies. Ethical considerations prevent the routine use of EMG in a large cohort of patients with a low risk of nerve injury who would not be expected to benefit from this procedure. Moreover, nerve conduction studies of the proximal leg can be technically challenging and are frequently absent in normal subjects. Another potential weakness is that subjects were screened for neurologic injury in the first 24 hours after surgery. It is theoretically possible that subjects might not develop symptoms until after this time period; however, we feel this is unlikely because a prior study found that neurophyopathy patients were symptomatic within 4 hours of discontinuation of anesthesia. A third potential weakness of the study is because our incidence of neurologic injury was lower than what we expected, the study is likely underpowered to examine many of the potential risk factors for neurologic injury. For instance, although the incidence of neurologic injury in patients who underwent surgery in high lithotomy position with candy cane stirrups was almost twice as high as those undergoing surgery in lithotomy with support boots (2.6% vs 1.3%), no statistical difference was noted. A sample size of 3852 subjects would be required to obtain 80% power to detect the difference between stirrup types found in our study.

A number of conclusions can be reached from the current study. Preexisting lower extremity neuropathies occur at a low but not insignificant rate (1.9%) in women undergoing gynecologic surgery. As such, it is probable that retrospective studies will overestimate the true incidence of postoperative neurologic injury. Our study and others suggest the risk of new onset neurologic injury after gynecologic surgery is low (<2.0%) in women undergoing gynecologic surgery. Most nerve injuries are purely sensory and can be expected to resolve in weeks to months after surgery in as many as 90% of cases. Any future studies performed to evaluate this issue should be prospective, to allow inclusion of a preoperative examination, and should include a relatively large sample size to better study risk factors for neurophyopathy. Randomized controlled trials
are needed to further determine the role of certain operative variables in causing nerve injury. For example, a large study that randomly assigns patients to either candy cane or boot stirrups would be needed to establish a causative relationship between patient positioning and pelvic nerve injury.

REFERENCES