

Lower Extremity Neuropathies Associated with Lithotomy Positions

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Background: **The goal of this project was to study the frequency and natural history of perioperative lower extremity neuropathies.**

Methods: **A prospective evaluation of lower extremity neuropathies in 991 adult patients undergoing general anesthetics and surgical procedures while positioned in lithotomy was performed. Patients were assessed with use of a standard questionnaire and neurologic examination before surgery, daily during hospital stay in the first week after surgery, and by phone if discharged before 1 postoperative week. Patients in whom lower extremity neuropathies developed were observed for 6 months.**

Results: **Lower extremity neuropathies developed in 15 patients (1.5%; 95% confidence interval, 0.8–2.5%). Unilateral or bilateral nerves were affected in patients as follows: obturator (five patients), lateral femoral cutaneous (four patients), sciatic (three patients), and peroneal (three patients). Paresthesia occurred in 14 of 15 patients, and 4 patients had burning or aching pain. No patient had weakness. Symptoms were noted within 4 h of completion of the anesthetic in all 15 patients. These symptoms resolved within 6 months in 14 of 15 patients. Prolonged positioning in a lithotomy position, especially for more than 2 h, was a major risk factor for this complication (P = 0.006).**

Conclusions: **In this surgical population, lower extremity neuropathies were infrequent complications that were noted very soon after surgery and anesthesia. None resulted in prolonged disability. The longer patients were positioned in lithotomy positions, the greater the chance of development of a neuropathy. These findings suggest that a reduction of duration of time in lithotomy positions may reduce the risk of lower extremity neuropathies. (Key words: Anesthesia; complications; positioning.**

ANESTHETIZED patients who undergo surgical procedures while placed in a lithotomy position may show development of lower extremity neuropathies.[1–12] These neuropathies often are mild and resolve spontaneously, but they can be severe and associated with prolonged or permanent disability. One retrospective study of patients undergoing procedures performed while they were in lithotomy positions showed a frequency of severe motor disability from lower extremity neuropathy of 1:3,608.[1] The frequency, natural history, and outcomes of less disabling lower extremity neuropathies after these procedures are unknown.

A number of patient characteristics (*e.g.*, thin body habitus[1,8]; history of smoking,[1] diabetes,[13–15] familial neuropathies,[16] alcoholism[2]; and the presence of subclinical neuropathies[17] or anatomic anomalies[9,10,18]), surgical factors (*e.g.*, duration in lithotomy position,[1,2,] use of intrapelvic self-retaining retractors,[19–21] or positioning of extremities beyond the comfortable range of motion when the patient is awake[6–8,12,13]), and anesthetic techniques (*e.g.*, central-axis needle placement[3]) have been identified as possible risk factors for perioperative lower extremity neuropathies. The mechanism of neuropathy in this perioperative setting often is unclear, although improper positioning or padding of the lower extremities during surgery in patients in lithotomy positions often is implicated.[22] There is, however, little direct evidence to support this hypothesis. Why? Perioperative lower extremity neuropathies occur infrequently, and extensive anatomic and sensorimotor nerve testing of a large surgical population would be needed to accurately determine the timing of onset, the precise location, and the potential causes of these neuropathies.

The current study was performed to prospectively study a large cohort of surgical patients who were to undergo procedures while in lithotomy positions to determine the frequency and natural history of symptoms of lower extremity neuropathies after surgery.

Methods

Patient Selection

The Mayo Institutional Review Board approved the study. Patients 18 yr of age and older undergoing general anesthetics during elective ambulatory or inpatient surgeries likely to involve lithotomy positioning at the two Mayo hospitals in Rochester, Minnesota, from June through August, 1997 and 1998 were asked to participate. All major specialties in which surgical procedures are routinely performed on patients positioned in lithotomy positions were available at these two hospitals. A total of 991 patients were enrolled during the 6-month study period. Patients with preexisting lower extremity neuropathies were excluded. Neuropathies were defined as symptoms of paresthesia or dysesthesia (burning) with or without aching pain in the distribution of a lower extremity nerve or weakness of any lower extremity muscle, or both.

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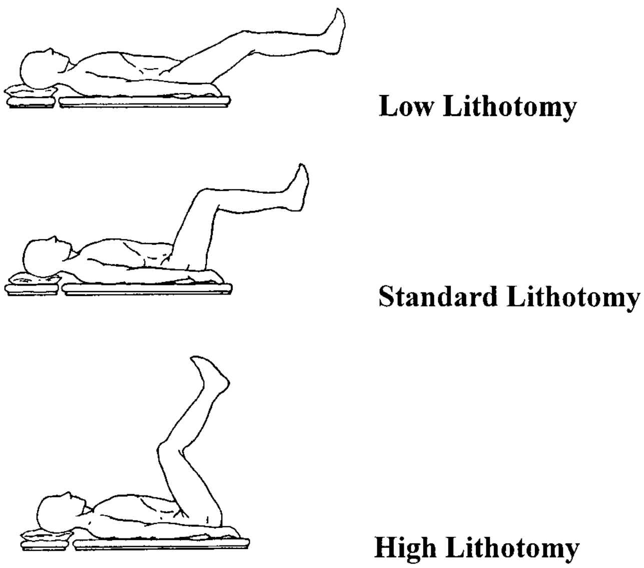

Fig. 1. Variations of lithotomy positions used in this study. Reproduced with permission.[23]

Study Procedure

Potential study participants were identified on the day of their surgery and enrolled after informed consent was given. All participants answered a short, standardized questionnaire designed to detect preexisting lower extremity neuropathy before surgery and to identify potential risk factors for the development of lower extremity neuropathy associated with surgery. Specifically, patients were asked about preexisting weakness or paresthesia of their lower limbs; previous back pain; lumbar spine problems; the presence of diabetes for which they took insulin or oral hypoglycemic medication; the presence of peripheral vascular disease of the lower extremities; their smoking history; and any family history of peripheral nerve problems. A standardized baseline neurologic examination of the lower extremities was performed. This screening examination included assessment of strength in all major muscle groups of the lower limbs. Research assistants, who were instructed in neurologic examination of the lower extremities by the study neurologist, performed the clinical examinations.

Information regarding potential intraoperative risk factors for lower extremity neuropathies was collected for each patient. This information included surgical procedure and duration, anesthetic type and duration, lithotomy type[23] (*i.e.*, low, standard, or high; fig. 1) and duration, leg-holder type (*i.e.*, candy cane, knee crutch, or boot support; fig. 2), and use of leg wrappings (*i.e.*, pneumatic compressive devices, elastic wrappings, or stockings) for each patient. All parts of the lower extremities that might contact hard surfaces were padded with either foam or gel pads. After surgery, each participant was assessed in the postoperative recovery room and then daily until they were discharged or for as long as 7 days after surgery with use of a standardized questionnaire and a screening neurologic examination designed to detect manifestations of lower extremity nerve dysfunction. Those who were discharged before 7 days were interviewed by telephone 7–9 days after surgery with use of a standardized questionnaire designed to screen for possible lower extremity nerve dysfunction.

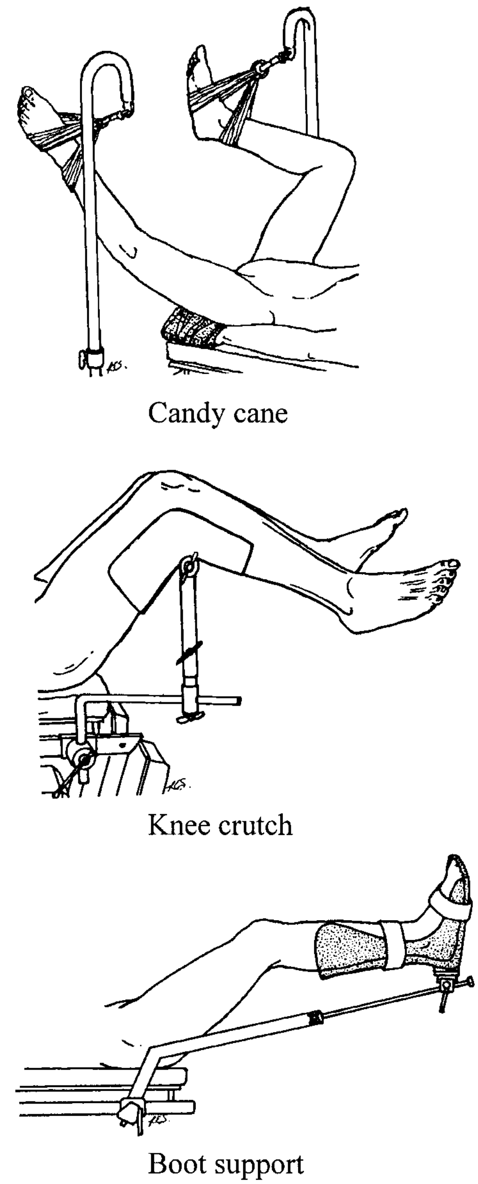

Fig. 2. Types of leg holder used in this study. Modified and reproduced with permission from Martyn TT: Compartment syndromes: Concepts and perspectives for the anesthesiologist. Anesth Analg 1992; 75:275.

One neurologist evaluated all patients who were identified with signs or symptoms suggestive of lower extremity neuropathy. Nerve conduction studies and needle electromyography were used at the discretion of the neurologist to confirm the diagnosis. Patients with lower extremity neuropathies were contacted at various postoperative intervals, and specifically 6 months after surgery, to determine their long-term outcomes and disabilities.

Statistical Methods

Based on a previous prospective study of ulnar neuropathy[24] and a pilot study of 20 women who underwent hysterectomy and 20 men who underwent transurethral resection of their prostates while positioned in lithotomy positions, we anticipated the frequency of neuropathy to be 2.5% in this surgical population. Based on this assumption, we determined that a sample size of 1,000 patients would be necessary to estimate the true frequency of neuropathy, with a margin of error (*i.e.*, half the width of the 95% confidence interval) of ± 1 percentage point.

Patient and procedure characteristics of participants in whom lower extremity neuropathies developed were compared with those of patients without neuropathy using the rank sum test or the Fisher exact test for continuous and discrete variables, respectively. When appropriate, exact 95% confidence intervals were calculated for the frequency of lower extremity neuropathies. In all cases, two-tailed tests with P values ≤ 0.05 were used to denote significance. All calculated measures are reported as mean values ± SD.

Results

Complete data are available for all 991 enrolled patients. Table 1 shows patient and perioperative characteristics. Patients were 58 ± 16 yr of age, and 65% were women. The mean body mass index was 27 ± 6 kg/m^2. The durations of anesthesia and lithotomy positioning were 101 ± 65 and 79 ± 57 min, respectively. Twelve percent of the patients underwent outpatient procedures. The remaining patients were admitted to the hospital for 2 days or less (23%), 3–7 days (58%), or more than 7 days (7%). The most commonly performed surgical procedures included operations on the urinary tract (38% of all cases), reproductive organs (32%), and gastrointestinal tract (19%).

In 15 patients (1.5%; exact 95% confidence interval, 0.8–2.5%), at least one lower extremity neuropathy developed during the first 7 days after surgery. Table 2 provides specific information for each of these patients. All 15 patients with neuropathies were symptomatic at the time of their first postoperative examination, performed within 4 h of discontinuation of administration of anesthetics. The neuropathies were bilateral in six patients but always affected the same nerve in both lower extremities. The obturator nerve was affected in five patients, the lateral femoral cutaneous nerve in four patients, and the peroneal and sciatic nerves in three patients. Nearly all of these patients reported paresthesia as the initial symptoms. Four patients also reported dysesthesia within the sensory distribution of the affected nerve. During the initial assessment, only these four patients, and two patients who had paresthesia but not pain, spontaneously reported a sensory disturbance. The remaining nine patients noted the presence of paresthesia only after specific inquiry. Objective weakness re-

Table 1. Patient and Perioperative Characteristics

	N	% Neuropathy	*P* Value*
Overall	991	1.5	
Patient characteristics			
Gender			0.999
Male	345	1.4	
Female	646	1.6	
Age (yr)			0.182
< 40	170	1.2	
40–54	233	2.6	
55–69	303	2.0	
70–84	267	0.4	
85+	18	0.0	
BMI			0.240
< 20	55	1.8	
20–24	379	1.1	
25–29	346	1.4	
30–34	127	2.4	
35+	84	2.4	
Able to walk normally			0.999
No	31	0.0	
Yes	460	1.6	
Weakness in one/both legs			0.708
No	855	1.6	
Yes	136	0.7	
Tingling or loss of feeling			0.655
No	891	1.5	
Yes	99	2.0	
Diabetes			0.999
No	963	1.6	
Yes	28	0.0	
Smoking status			0.534
Never	540	1.7	
Former	316	1.0	
Current	135	2.2	
Problems with blood vessels/circulation			0.999
No	908	1.5	
Yes	83	1.2	
Perioperative characteristics			
Lithotomy position	246	2.0	0.416
Low	696	1.3	
Standard	49	2.0	
High			
Legs wrapped in lithotomy position			0.143
No	545	0.9	
Yes	444	2.2	
Anesthesia duration (min.)			0.008
< 60	243	0.0	
60–89	263	1.5	
90–119	182	1.6	
120–149	146	2.7	
150+	157	2.6	
Duration in lithotomy position (min.)			0.006
< 30	125	0.0	
30–59	301	0.7	
60–89	221	2.3	
90–119	156	1.3	
120+	188	3.2	

* Fisher exact test for discrete variables; rank sum test for continuous variables.
BMI = body mass index.

Table 2. Clinical Characteristics of Patients in Whom a Lower Extremity Neuropathy Developed

Patient	Gender (M/F)	Age (yr)	Procedure	Anesthesia Time (min)	Lithotomy Position	Leg Holder Type	Affected Nerve(s)	Side
1	F	41	Hysterectomy	90	Standard	Candy Cane	LFC	Left
2	F	74	Bladder biopsy	71	Low	Knee Crutch	LFC	Right
3	F	59	Hysterectomy	135	Standard	Candy Cane	Sciatic	Right
4	F	65	Vulvar cancer excision	75	Standard	Candy Cane	Obturator	Bilateral
5	F	51	Hysterectomy	93	Standard	Candy Cane	Sciatic	Bilateral
6	F	48	Hysterectomy	146	Low	Knee Crutch	Obturator	Left
7	M	69	Cystectomy	85	Low	Boot Support	Sciatic	Left
8	F	53	Hysterectomy	265	Standard	Candy Cane	Obturator	Bilateral
9	F	30	D&C, cervical biopsy	105	Standard	Candy Cane	Obturator	Left
10	F	40	Hysterectomy	110	Standard	Candy Cane	Peroneal	Right
11	F	42	Hysterectomy	137	Standard	Candy Cane	LFC	Left
12	M	36	Pelvic node dissection	245	Standard	Boot Support	Peroneal	Bilateral
13	M	57	TURP	145	Low	Knee Crutch	LFC	Left
14	M	66	TURP	25	Low	Knee Crutch	Obturator	Bilateral
15	F	62	Hysterectomy	165	Standard	Candy Cane	Peroneal	Bilateral

D&C = dilation and curettage of the cervix; LFC = lateral femoral cutaneous; TURP = transurethral resection of the prostate.

lated to a neuropathy developed in none of the patients during the 7 days after surgery.

Five of 15 patients had complete resolution of symptoms within 4 weeks of the procedures (table 2). Six more recovered in the next 4 weeks, and three patients required 4 months for resolution of symptoms. Only one patient, a 42-yr-old woman (patient 11) who underwent a vaginal hysterectomy and in whom paresthesia developed without pain in the distribution of the lateral femoral cutaneous nerve, had symptoms longer than 4 months. Paresthesia still were present 18 months after surgery. Interestingly, early resolution of symptoms did not occur in the four patients in whom pain was an initial symptom; all required 6 weeks to 4 months for complete resolution. None, however, required specific treatment for the pain.

The mean duration of anesthesia and time spent in lithotomy positions were longer in patients with neuropathies than in those without neuropathies (table 1). Clearly, duration of anesthesia and duration of time in lithotomy positions probably are related; however, the sample size of only 15 symptomatic patients precludes multivariate analysis that would confirm this relation. Overall, the frequency of this complication increased markedly after 2 h of lithotomy positioning. No other patient or procedure characteristics were identified as significantly different in the two groups.

Discussion

Lower extremity neuropathies may be related to surgical trauma,[19–22] central-axis anesthetic techniques,[3] or patient positioning.[12] Compressive wraps also may cause perioperative lower extremity neuropathies.[25] However, in many instances, it is difficult to determine a specific mechanism of nerve injury. This study shows that multiple lower extremity nerves are affected and with similar frequency. Because of the marked difference in the anatomy, size, and function of the major lower extremity nerves, this finding is not surprising. Multiple mechanisms probably are involved.

We were surprised (and pleased) that motor dysfunction did not develop in the patients. We would not expect motor dysfunction with lateral femoral cutaneous neuropathies, and the obturator and sciatic nerves have many sensory components. However, we were surprised to find three patients with peroneal neuropathies who did not have motor impairment. Nearly all cases of perioperative peroneal palsy report motor dysfunction of the deep peroneal nerve.[2,7,12] The common peroneal nerve (named the common fibular nerve since 1988 by the Federative Committee on Anatomical Terminology[26]) wraps superficially around the neck of the fibula before dividing into the superficial peroneal (sensory only) and deep peroneal (primarily motor) nerves within the peroneal longus muscle.[27] Previous reports have speculated that many perioperative peroneal palsies are associated with pressure at the fibular head on the common peroneal nerve from contact with a hard surface (*e.g.*, a leg support). If true, sensory and motor peroneal nerve function should be impaired.[2,12] Our patients with peroneal neuropathies only had sensory loss over the lateral aspect of their legs and dorsa of the feet, suggesting isolated involvement of the superficial peroneal nerves. We speculate that only the superficial peroneal nerves were either compressed distal to the head of the fibula (*e.g.*, by compressive wraps or straps) or stretched (*e.g.*, by plantar flexion of the foot).

Our findings support previous reports in which increased duration in a lithotomy position was associated with increased risk of lower extremity neuropathy.[1,2,7] The neuropathies we observed occurred in a select group of patients in whom there were no preexisting neuropathies, and all patients were carefully moved into well-padded lithotomy positions. Therefore, it is unlikely that additional preventive measures, except for decreasing the duration of time in lithotomy position, will significantly reduce the frequency of these neuropathies until specific mechanisms are identified. We found that the frequency of neuropathy increased markedly after 2 h of lithotomy positioning.

Our simple neurologic screening tests and survey tools clearly are insufficient to provide accurate data for either the timing of onset or the specific nerve location for these neuropathies. Nonetheless, they provide information regarding the frequency and general natural history of these neuropathies. Interestingly, we found all perioperative lower extremity neuropathies to be symptomatic within several hours of discontinuation of anesthesia. This finding contrasts sharply with our previous findings with use of similar neurologic evaluation techniques for perioperative ulnar neuropathy.[24] In that study, patients did not comment about their symptoms during daily assessments until 2–7 days after surgery. Although those patients may have not noticed or mentioned postoperative paresthesia for a variety of reasons (*e.g.*, persistent sedation or concomitant administration of narcotics), the patients in the current study readily noticed paresthesia soon after surgery. This finding further strengthens our previous speculation that perioperative ulnar neuropathy may be primarily a postoperative phenomenon.

In conclusion, signs or symptoms of lower extremity neuropathies developed within 7 days of procedures in 1 of every 66 patients who underwent general anesthesia and surgery while in lithotomy positions. All neuropathies were sensory only, and nearly all resolved within 4 months. Prolonged duration of time in lithotomy positions, especially for more than 2 h, was strongly associated with these neuropathies. This association suggests that surgeons and anesthesiologists should develop alternatives to prolonged use of lithotomy positions, when possible, to decrease the frequency of these neuropathies.

References

1. Warner MA, Martin JT, Schroeder DR, Offord KP, Chute CG: Lower-extremity motor neuropathy associated with surgery performed on patients in a lithotomy position. ANESTHESIOLOGY 1994; 81:6–12
2. Parks BJ: Postoperative peripheral neuropathies. Surgery 1973; 74:348–57
3. Kroll DA, Caplan RA, Posner K, Ward RJ, Cheney FW: Nerve injury associated with anesthesia. ANESTHESIOLOGY 1990; 73:202–7
4. Hakim MA, Katirji MB: Femoral mononeuropathy induced by the lithotomy position: A report of 5 cases with a review of literature. Muscle Nerve 1993; 16:891–5
5. Tondare AS, Nadkarni AV, Sathe CH, Dave VB: Femoral neuropathy: A complication of lithotomy position under spinal anaesthesia: Report of three cases. Can Anaesth Soc J 1983; 30:84–6
6. Roblee MA: Femoral neruopathy from the lithotomy position: Case report and new leg holder for prevention. Am J Obstet Gynecol 1967; 97:871–3
7. Herrera-Ornelas L, Tolls RM, Petrelli NJ, Piver S, Mittelman A: Common peroneal nerve palsy associated with pelvic surgery for cancer: An analysis of 11 cases. Dis Colon Rectum 1986; 29:392–7
8. McQuarrie HG, Harris JW, Ellsworth HS, Stone RA, Anderson AE III: Sciatic neuropathy complicating vaginal hysterectomy. Am J Obstet Gynecol 1972; 113:223–32
9. Romfh JH, Currier RD: Sciatic neuropathy induced by lithotomy position. Arch Neurol 1983; 40:127
10. Reinstein L, Eckholdt JW: Sciatic nerve compression by preexisting heterotopic ossification during general anesthesia in the dorsal lithotomy position. Arch Phys Med Rehabil 1983; 64:65–8
11. Loffer RD, Pent D, Goodkin R: Sciatic nerve injury in a patient undergoing laparoscopy. J Reprod Med 1978; 21:371–2
12. Britt BA, Gordon RA: Peripheral nerve injuries associated with anaesthesia. Can Anaes Soc J 1964; 11:514–36
13. Dawson DM, Krarup C: Perioperative nerve lesions. Arch Neurol 1989; 46:1355–60
14. Massey EW, Pleet AB: Compression injury of the sciatic nerve during a prolonged surgical procedure in a diabetic patient. J Am Geriatr Soc 1980; 28:188–9
15. Goodman JI: Femoral neuropathy in relation to diabetes mellitus: Report of 17 cases. Diabetes 1954; 3:266–73
16. Hirota N, Kaji R, Yoshikawa H, Nishimura T, Ikeda T, Yanagihara T, Kimura J: Hereditary neuropathy with liability to pressure palsies: Distinguishing clinical and electrophysiological features among patients with multiple entrapment neuropathy. J Neurol Sci 1996; 139:187–9
17. Alvine FG, Schurrer ME: Postoperative ulnar-nerve palsy: Are there predisposing factors? J Bone Joint Surg 1987; 69:255–9
18. Khella L: Femoral nerve palsy: Compression by lymph glands in the inguinal region. Arch Phys Med Rehabil 1979; 60:325–6
19. Rosenblum J, Schwarz GA, Bendler E: Femoral neuropathy—A neurological complication of hysterectomy. JAMA 1966; 195:409–14
20. Kvist-Poulsen H, Borel J: Iatrogenic femoral neuropathy subsequent to abdominal hysterectomy: Incidence and prevention. Obstet Gynecol 1982; 60: 516–20
21. Ruston FG, Politi VL: Femoral nerve injury from abdominal retractors. Can Anaes Soc J 1958; 5:428–37
22. Dornette WHL: Compression neuropathies: Medical aspects and legal implications. Int Anesthesiol Clin 1986; 24:201–29
23. Martin JT: Lithotomy positions, Positioning in Anesthesia and Surgery, 3rd edition. Edited by Martin JT, Warner MA. Philadelphia, WB Saunders, 1997, pp 47–70
24. Warner MA, Warner DO, Matsumoto JY, Harper CM, Schroeder DR, Maxson PM: Ulnar neuropathy in surgical patients. ANESTHESIOLOGY 1999; 90:54–9
25. Horlocker TT, Cabanela ME, Wedel DJ: Does postoperative epidural analgesia increase the risk of peroneal nerve palsy after total knee arthroplasty? Anesth Analg 1994; 79:495–500
26. Federative Committee on Anatomical Terminology: Terminologia Anatomica. Stuttgart, Georg Thieme Verlag, 1988
27. Peri G: The "critical zones" of entrapment of the nerves of the lower limb. Surg Radiol Anag 1991; 13:139–43