



Laparoscopic identification of pelvic nerves in patients with deep infiltrating endometriosis

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Abstract

Background: Nerve sparing is suggested for cancer surgery, but no experience is available for deep endometriosis. The aim of this study was to laparoscopically identify the pelvic nerves in the posterior pelvis.

Methods: A total of 24 patients operated for deep endometriosis were considered. During surgery and on videotapes of the procedures, we evaluated single- or double-sided resection of the uterosacral ligaments and other structure's visualization of the inferior hypogastric and the splanchnic nerves. The most important objective criteria for resection of the nerves was urinary retention after surgery, which was compared to surgical resection on the videotapes.

Results: Visualization of the inferior hypogastric nerves was possible in 20 of 22 patients (90.1%). Eight of the 24 patients had at least one inferior hypogastric nerve resected (33.3%). In seven patients (29.2%) resection of the uterosacral ligaments was bilateral, and in three of these the nerves were resected. Postoperatively, the median residual urine volume after the first spontaneous voiding was 40 ml (range, 20–400). Seven of eight patients (29.2%) with resection of the nerves had urinary retention and self-catheterization at discharge. The difference in urinary residuum after first voiding between patients undergoing self-catheterization and patients released without the catheter was significant ($p < 0.01$). The median time to resume the voiding function in patients with self-catheterization was 18 days (range, 9–45).

Conclusions: Nerve visualization is possible by means of laparoscopic surgery for deep endometriosis in a high rate of patients. Careful technique is necessary, but the laparoscopic approach may help. Even single-sided radical dissection can induce important urinary retention.

Key words: Nerve sparing — Deep endometriosis — Laparoscopic surgery

Nerve sparing surgery has been suggested to decrease the side effects of the radical treatment of cervical cancer [8, 14–16, 19–22]. Although the anatomy of the autonomic and sensitive nerves is not fully described, most authors suggest that there are different pathways for sensory, autonomous sympathetic, and parasympathetic nerves [10, 15].

Frequently, deep infiltrating endometriosis is found at the level of the rectovaginal septum and the uterosacral ligaments in the posterior pelvis, and the pain related to the disease is probably also due to neural infiltration [1]. Laparoscopy has gained acceptance as a treatment for cystic and deep infiltrating endometriosis [4, 6, 7, 13, 17, 18]. Furthermore, laparoscopy allows better visualization of the retroperitoneal structures due to enlargement of the structures and carbon dioxide pressure. Little attention has been paid to the anatomic distribution of the nerves in the uterosacral ligament, where most of this surgery is performed. Also, in the literature on presacral neurectomy, there is no detailed anatomical description of the hypogastric plexus in its distal aspect [11, 12].

The inferior hypogastric nerves cross the uterosacral ligament from medial to lateral, converging with the ureter coming from the promontory. They lie approximately 2 cm from the ureter in the lateral part of the uterosacral ligament at their origin from the uterus entering the lateral parametrium. The inferior hypogastric nerves carry the sensitive fibers and the sympathetic fibers responsible for the relaxation of the bladder detrusor muscle and contraction of the urethral sphincter.

The pelvic splanchnic nerves run from the S2–S4 roots of the sacral plexus and join in the inferior hypogastric plexus with the inferior hypogastric nerves at the lateral part of the uterosacral ligaments, laterally

to the rectum. The inferior hypogastric plexus forms a "triangularly shaped plexus, placed in a sagittal plane" [10] approximately 4 cm long, 3 cm wide, and 0.5 cm thick; however, when it is observed at the sacral root, it is much larger. The pelvic splanchnic nerves carry the parasympathetic fibers, which are responsible for the voiding function of the detrusor of the bladder.

A quantitative description of the content of nerves in the uterine ligaments was provided by Butler-Manuel et al. [2, 3]. They observed a significant difference with regard to the presence of parasympathetic versus sympathetic and sensory nerves, respectively in the parametrium versus the uterosacral ligament, mostly in the area where they are divided during radical hysterectomy.

Based on the experience of radical and laparoscopic surgery, we performed this study to evaluate if the inferior hypogastric nerves and the pelvic splanchnic nerves are identifiable and sparable when performing laparoscopy for deep infiltrating endometriosis of the uterosacral ligaments and the rectovaginal septum.

Materials and methods

A total of 24 patients who underwent surgery for deep infiltrating endometriosis between February 2002 and October 2002 were selected for this study. In these patients we wanted to identify at least one of the inferior hypogastric nerves and tried to visualize the hypogastric splanchnic nerves.

The videotape recordings of the surgical procedures were evaluated independently by two authors (E.V. and A.F.). A quantification of the extent of surgery was performed according to the extent of dissection of the uterosacral ligament (laterally and posteriorly) and to the resection of the vagina. For every procedure, the authors noted single- or double-sided resection of the uterosacral ligaments and other structures, visualization and side of the inferior hypogastric nerves, and visualization of some of the pelvic splanchnic nerves. For every patient, age, type of procedure, body mass index, duration of surgery, time of stay in hospital, urinary retention, and return to normal urinary voiding function were recorded. The urinary catheter was removed on the second day after surgery and the urine residuum was tested immediately after first voiding. Urinary retention and return to normal voiding function were considered the most important objective evidence of conservation or resection of the nerves.

Analysis of the data was performed using the EPI Info 2000 package [5] after an ad hoc database was created.

The technique for dissection of the nerves was as follows: the uterosacral ligament was isolated, forming the pararectal space. The ureter was identified and dissected to the intersection with the uterine artery. To visualize the inferior hypogastric nerves, anterior mobilization of the uterus with a forceps is needed. Moving the posterior aspect of the uterus at the level of the isthmus toward the bladder allows visualization of a solid line running from the promontorium parallel to the ureter in the uterosacral ligament, more easily identified on the right side. The overlying peritoneum is then progressively dissected from the lateral to the medial aspect of the nerve, leaving the peritoneum unresected, to visualize the complete course of the inferior hypogastric nerve. In the case of very deep infiltration, we freed the distal part of the sigmoid and the rectum in its lateral and posterior aspect to mobilize and separate it from the medial part of the uterosacral ligament. After the inferior hypogastric nerve is visualized, the medial fibrotic part of the uterosacral ligament is dissected bluntly from the neural part of the ligament, according to the technique described by Trimbois et al. [20]. The formation of this space and of the pararectal space identifies the inferior hypogastric plexus in relation to the vaginal wall. After the inferior hypogastric nerve and plexus are identified, radical excision of endometriotic tissue can be performed, attempting to spare as many nerves as possible, even though a certain amount may be lost because the disease infiltrates them.

Table 1. Procedures performed in the 24 patients with deep infiltrating endometriosis

Procedure	No.
Resection of less than 2 cm of vaginal wall	6
Resection of more than 2 cm of vaginal wall	12
Resection of more than half of the uterosacral ligament	18
Resection of less than half of the uterosacral ligament	11
Posterior dissection to the pelvic wall	7
Lateral dissection to the pelvic wall and parametrectomy	1
Anterior resection of the rectosigmoid	1
Bladder resection	1
Ureteral stenting	1

Results

The median age of the patients was 31.5 years (range, 23–42). The median Quetelet index was 21.48 (range, 17.26–28.04). Two patients had previously undergone surgery for endometriosis at our institution, but the procedure was considered insufficient.

The surgical procedure in all but two patients consisted of deep dissection of the retroperitoneal space in the pararectal space with preparation and resection of the uterosacral ligament. One of the patients refused bowel resection before surgery and the procedure was aborted, and in the second patient the endometriotic lesion was central and no dissection of the pararectal space was performed. These two patients were not considered in the evaluation of the videotapes. In one of the patients, resection of the rectosigmoid and the left uterosacral ligament was performed. In another patient, the dissection was performed to the great vessels, and parametrectomy at the pelvic side wall and ureteral stenting were necessary. One resection of the bladder wall was performed. Cystic endometriosis was diagnosed and treated in nine (37.9%) patients.

Resection of vaginal lesions was performed in 18 of 24 (66.7%) patients. Only a few patients had laparoscopic suture, whereas normally the vagina was closed transvaginally. The median time for the procedure was 110 min (range, 50–230).

No laparotomy was performed. Two complications were observed: one patient had a retrocervical abscess with opening of the vaginal suture, and one patient had hemorrhage from the cervical branch of the uterine artery 15 days after the procedure. Vaginal hemostasis was performed.

The median time of stay in the hospital was 3 days (range, 1–9). Table 1 shows the surgical procedures of the 24 patients. For some patients, more than one procedure was performed.

When analyzing the tapes of the procedures, the two authors (E.V. and A.E.) recorded that visualization of the inferior hypogastric nerves was possible in 20 of 22 (90.1%) patients. The nerve fibers coming from the sacral roots could be identified deeper at the base of the uterosacral ligaments, but with more difficulty. There was no statistical difference in body mass index between patients in whom the nerves were identified and those in whom they were not. In seven patients (29.2%), dissec-

Table 2. Relation between self-catheterization and preservation of the hypogastric plexus^a

	Preservation		Total
	Yes	No	
Self-catheterization			
Yes	0	7	7 (29.2%)
No	16	1	17 (70.8%)
Total	16 (66.7%)	8 (33.3%)	24 (100%)

^a $p < 0.001$ (Chi-square test)

tion of the uterosacral ligaments was bilateral. In eight patients (33.3%), we resected the hypogastric nerve and the upper part of the hypogastric plexus at least on one side. Three of the eight patients (37.5%) had bilateral resection of the nerves. Postoperatively, the median residual urine volume after the first spontaneous voiding was 40 ml (range, 20–400). Seven of eight patients (87.5%) with resection of the nerves had urinary retention at discharge and had self-catheterization. The difference in urinary residuum after first voiding between patients undergoing self-catheterization and patients released without the catheter was significant (Kruskal–Wallis for nonhomogeneous groups, $p < 0.01$). The median time to resume the voiding function in patients with self-catheterization was 18 days (range, 9–45). Table 2 shows the relationship between self-catheterization and conservation of the nerves in this group of patients. The difference is statistically significant (Chi-square, $p < 0.01$). Self-catheterization was necessary in five patients (71.4%) who had monolateral resection Figure 1 shows the hypogastric nerve and plexus after removal of the left uterosacral ligament.

Discussion

This is the first report on the feasibility of nerve sparing surgery by laparoscopy in deep infiltrating endometriosis. We believe that preservation of the nerves in the patients affected by a benign condition is much more important than in cancer surgery. Possover et al. [13, 15] described the technique of nerve identification in radical hysterectomy by laparoscopy and in bowel resection for endometriosis.

In our experience, a high percentage (29.2%) of patients undergoing radical surgery for deep infiltrating endometriosis of the uterosacral ligaments can develop some kind of urinary retention, and this may be underreported in the literature [4, 6, 9, 17, 18]. We attempted to visualize the nerves to prevent damage to them. In fact, procedures including the lateral part of the uterosacral ligaments and large resection of the vaginal wall were performed, and this explains the high rate of urinary complications observed. Removal or damage of only the inferior hypogastric nerve result in changes in the feeling for bladder filling, whereas damage of the plexus in a deeper area leads to urinary retention.

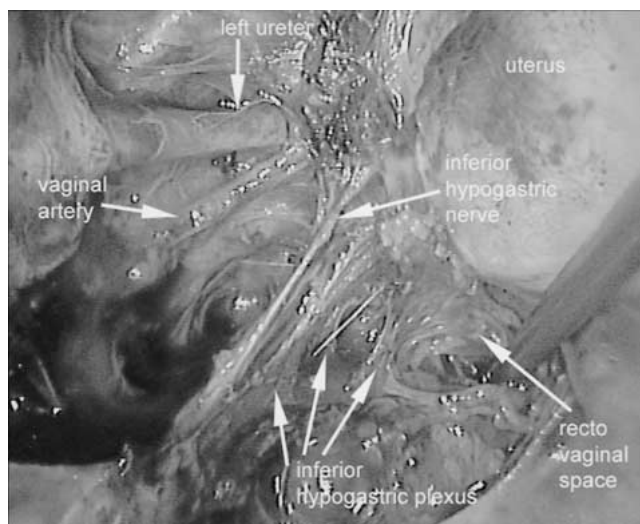


Fig. 1. The left inferior hypogastric nerve in relation to the vagina after removal of the uterosacral ligament and opening of the recto-vaginal septum.

The types of procedures in our patients varied greatly, but in all cases of deep infiltrating endometriosis the operator must be aware of the range of problems due to infiltration of the retroperitoneal space.

Although preoperative residual urine was not measured routinely, none of the patients had a positive history of urinary retention. We are currently evaluating the preoperative residuum of urine to compare it with the one after surgery.

In our experience, the pelvic innervation was visible in approximately 90% of patients. We believe that some experience is needed to visualize the nerves, but the knowledge of their presence is the most important factor for their preservation. Technically, the infiltration of the uterosacral ligaments may make it easier to visualize the inferior hypogastric nerves since retraction and infiltration are characteristic of the disease. When the uterus is moved upwards, the nerves can be directly visualized mostly on the right side, where the mesosigmoid is absent. On the leftside, the physiological adhesions of the bowel should be removed to visualize the uterosacral ligaments. CO₂ pressure helps in visualizing the nerves since the peritoneum is stretched on the retroperitoneal structures. Strangely, we could not identify a cause for not being able to visualize the nerves in two patients. Body mass index in these patients was not statistically different. We think that this may have been due to a lack in experience or the nerves in these cases were not in a single bundle but, rather, in many different small fibers that were not identified as the inferior hypogastric nerve. The presence of different nerve bundles may also be the explanation for the absence of urinary retention after resection in one patient fibers. We may have severed some of the more superficial fibers but left some other fibers passing deeper. We think that enlargement of the laparoscopic view is important for visualizing the single fibers of the inferior hypogastric plexus.

We believe that radicality is the aim of oncologic surgery and in several patients this is in contrast with

nerve sparing [8, 15], while most of the endometriotic tissue is found in the uterosacral ligaments only monolaterally and these are the areas in which it is important to identify the nerves. Our results are consistent with the findings of Butler-Manuel et al. [3], who showed that the uterosacral ligament contains more nerve fibers than the cardinal ligament. These are predominantly sensory and motosensory nerves, so radical dissection of only these ligaments can lead to dysfunction of the target organs. Early release of patients is not always feasible. We removed the catheter on the first or second day postoperatively and urinary retention was tested immediately. Patients were released when the residual urine was less than 50 ml or when they were able to self-catheterize. In the experience of Possover et al. [15] on radical surgery, bladder training was started on day 6 and subrapubic drainage was removed on day 21 in the non-nerve sparing patients. This result is very similar to ours in the seven patients in whom the nerves were not spared. This is the first report to show that even monolateral nerve resection can induce urinary retention since in radical oncologic surgery bilateral severing of the uterosacral ligaments and parametria is necessary. This result was completely unexpected since we believed that monolateral conservation of the nerves was sufficient for normal bladder function. In our experience, five patients with monolateral resection needed self-catheterization. We hypothesize that innervation of the detrusor is not distributed contralaterally and so the detrusor is not efficient for contraction. Some patients also had some kind of constipation [14] and altered feeling of bladder filling after the procedure, but our data are not sufficient for an accurate analysis of the topic.

In conclusion, visualization of the autonomic nerves in the pelvis is feasible. Preservation of the nerves is not always feasible, but a procedure sparing the nerves is advisable since radical surgery in endometriosis can leave some long-term sequelae and urinary retention.

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