Nerves sparing techniques using the LANN technique in gynecology

M. POSSOVER *
(Zürich, Switzerland)

INTRODUCTION

It is well known that radical pelvic surgery can be accompanied by postoperative morbidity: radical hysterectomy type III is often followed by dysfunction of the lower urinary tract such as loss of bladder/rectum sensation [1] and/or impairment of command to void urine or rectum spontaneously [1, 2]. This functional vesical and rectal morbidity varies, depending on the approach to the pelvis. With the perineal or perianal surgical approach, the functional morbidity presents more problems with bladder/rectum continence while the abdominal approach causes problems with hypercontinent bladder retention and/or chronic constipation. The differences must be found

* Hirslanden Clinic - Department of Surgical Gynaecology & Neuro-Pelveology - Witellikerstrasse 40 - CH- 8032 Zürich - Switzerland - www.neuro-pelveology.com

E-mail: marc.possover@hirslanden.ch

in the type of nerve destroyed during the surgical procedure: the perineal approach exposes the patient to lesions of the pudendal nerve and its branches while the abdominal approach carries the risk of destroying the parasympathetic nerves. For this reason « nerve-sparing » techniques were developed in the different speciality areas and mainly consist of identifying and respecting, as far as possible, the different bands of neural tissue which form the different neural plexuses [3-7]. Varying from this concept is the nerve-sparing technique developed by Hoeckel *et al.* in which the dissection not only focuses on the preservation of the parts of the « ligaments » which contain the nerves and plexus but tries to expose the autonomous pelvic nerves and plexuses using liposuction [8]. Based on the same principle of exposure of the splanchnic pelvic nerves, as well as on our functional studies of the pelvic autonomous nerves using electrostimulation of the nerves [9, 11] we reveal our experience with the laparoscopic para-sympathetic nerve-sparing techniques in gynecology.

Conflict of interest
None. No financial support was received for this study.

SURGICAL PROCEDURE

Since 2000, we have paid particular attention to sparing the parasympathetic pelvic nerves during transection of the cardinal ligament in all consecutive patients who underwent a LAVRH type 3 for a cervical cancer in stages IB1 to IIB proximal [12] or a laparo-scopic-assisted vaginal deep colorectal resection with a anterior colorectal anastomosis for a deep infiltrating endometriosis of the rectovaginal space with rectum stenosis [13]. For the inclusion of the patients for this study, not any exclusion-factor like prior surgery of adipositas where taken under consideration so that all consecutive patients sent to us where included. Before operation, all patients completed a standardized questionnaire including questions on bladder function, in particular on miction difficulties on the basis of the International Prostatic Symptom Score [14]. Additional measures

included sonographic residual urine volume measurement and assessment of the upper urinary tract.

The principle of this surgery is based on the primary identification of the anatomical pathway of the splanchnic pelvic nerves before transection of the parametria and consequently of a part of the inferior hypogastric plexus [9]: the dissection and exposure of the sacral roots S2, S3 and S4 is performed directly at their dorsal origin out of the sacral foramen where there is no risk of lesion of the pelvic parasympathetic nerves. The functional identification of the different sacral roots is performed using the LANN technique - Laparaoscopic Neuro-Navigation [10]: we use a mono- or bipolar laparoscopic forceps for electrostimulation and a current with a square-wave pulse duration of 250 ms, a pulse frequency of 35 Hz, and a electric potential of 12 V. A microtip rectal probe and an 8F dual sensor microtip transurethral catheter with filling channel are used for intraoperative urodynamik testing. The sensor at the tip of the rectal probe is placed 7 cm proximal to the anal sphincter while the transurethral catheter is inserted in such a manner that the urethral and the intravesical pressure can be measured concomittantly but separately. The bladder capacity during neurostimulation was 150 to 200 cc Ringer's solution.

Stimulation of S3 nerves is visually confirmed by a deepening and flattening of the buttock groove as well as a plantar flexion of the large toe and to a lesser extent of the smaller toes while stimulation of S2 produces an outward rotation of the leg and plantar flexion of the foot as well as a clamp-like squeeze of the anal sphincter from anterior/posterior. By ventrally following both sacral roots, the pelvic splanchnic nerves involved in the miction and defecation are exposed and their different anatomical pathways into the pararectal space from the pelvic wall to the inferior hypogastric plexus can be exposed [15]: the « rectal splanchnic nerves » are the more dorsal nerves, which show with laparoscopic vision a horizontal or tangential direction, are perforing the sacral hypogastric fascia dorsally in the pelvis and finally anastomose to the homolateral inferior hypogastric plexus in latero-dorsal position to the level of the rectum. Their electrostimulation produces an isolated rise in intrarectal pressure of about 20 cm of water without any change in intravesical or intraurethral pressure. The « vesical splanchnic nerves » sprout out of the sacral roots from their middle portion to their fusion in the sciatic nerve, with laparoscopic vision they adopt a more vertical direction, remain lateral of the sacral hypogastric fascia and finally anastomose with the homolateral inferior hypogastric plexus at the level of the vagina or more ventral, directly lateral of the homolateral bladder pillar and caudal of the ureter and

its junction into the bladder. Elective electrostimualtion of the vesical splanchnic nerves produces an isolated rise in intravesical pressure of 40 to 80 cm of water without any change in intrarectal or intraurethral pressure. After exposure of the splanchnic pelvic nerves from their origin to their anastomosis in the homolateral inferior hypogastric plexus, depending on the radicality required for the procedure, resection of the parametria is performed radically in such a matter that the parasympathetic nerves are respected at the level of the neural part of the cardinal ligament or more ventrally at the level of the rectovaginal ligament (vesical + rectal fibers) or finally at the level of the bladder pillar (vesical fibers).

At the end of the procedure, no suprapubic catheter is required and the transurethral catheter is removed the morning of the first or second postoperative day. On the 4th-5th postoperative day, an estimation of the postmictional resturine is performed by vaginal sonography. If the resturine is estimated to be more than 50 ml, postmictional catheterisation of the bladder is carried out and when the resturine is confirmed to be more than 70 ml, a suprapubic catheter is placed in order to begin bladder training. When rectum resection is performed with deep anterior colorectal anastomosis less than 6 cm from the linea dentata, a suprapubic catheter is placed at the end of the procedure for two reasons:

- firstly, to avoid filling of the bladder before spontaneous defecation, this could disturb the healing process of the deep anterior colorectal anastomosis,
- secondly, because dissection of the nerve, even by gentle dissection, can produce a neurapraxy for a few days and consequently cause a temporary bladder atony.

In order to make the postoperative follow-up as safe as possible, we drain the bladder for the first 6 postoperative days where the risk of anastomosis leakage is highest [16] and bladder training begins after spontaneous defecation generally between the 6th and the 8th postoperative day. The suprapubic catheter is removed when the postmictional resturine is measured to be constantly less than 70 ml. The duration of this bladder training is documented and particular attention is paid to whether the patient voids her bladder spontaneously and continuously or uses contraction of the abdominal muscle.

The trial was performed in accordance with the 1975 Declaration of Helsinki. To use laparoscopic neurostimulation, we obtained ethics approval from the medical ethics committee at every institution and every patient provided written informed consent.

CONCLUSION

Due to the magnification effect and the possibility of bloodfree dissection even in the depth of the pelvis, laparoscopic surgery in the retroperitoneum is becoming one of the most useful and important instruments for learning the pelvic retroperitoneal anatomy. The combination of a good knowledge of pelvic neuroanatomy and the technique of laparoscopic dissection in the retroperitoneum aided by the magnification of the endoscope allows a very gentle dissection of the splanchnic pelvic nerves. To gain intraoperative information in regard to the motoric function of the exposed nerves, we developed a new concept of laparoscopic neuro-navigation: the LANN technique: by using simple electrostimulation of the nerves, the surgeon is able to gain direct information on the functionality of all exposed nerves and to make individual functional cartography of the pelvic autonomous neurosystem in each patient. Finally, elective dissection of the « vesical and the rectal splanchnic pelvic nerves » and consequently, the development of a « parasympathetic nerve sparing technique » is now technically feasible in a shorter operative time than with the conventional technique and permits a significant reduction in postoperative functional morbidity in comparison to the classical technique of radical vaginal hysterectomy with different radicalities [17-19]. However our « parasympathetic nerve-sparing technique » for cervical cancer must be differentiated from the nerve-sparing techniques which propose the preservation of all the autonomic nerves of the inferior hypogastric plexus [20]. In our technique, we do not want to preserve the sympathetic nerves contained in the upper part of the inferior hypogastric plexus as this part of the parametria is close to the cervix and unfortunately contains lymph and blood vessels coming directly from the cervix.

The laparoscopic assisted vaginal nerve-sparing resection of the rectum with deep anterior colorectal anastomosis in extended endometriosis is based exactly on the same principles of primary identification of the parasympathetic pelvic nerves. **Extended resection of the infiltrated plexus is mandatory and makes selective sparing of the parasympathetic nerves during the resection of the ligaments technically not feasable**. The only chance of identifying and preservation of the pelvic parasympathetic nerves is to do it not during resection of the nodule, but on the contralateral side, on **the « non-involved side »** where the anatomy is still normal and where the nerves can be preserved [23]. Preservation of the pelvic splanchnic nerves on

one side is enough for normal bladder functions. Therefore « nerves-sparing technique » in deeply infiltrating parametric endometriosis is started on the non- or less-involved side while on the involved side, the nerves are resected en bloc with the lesion. The elective sparing of the vesical splanchnic nerves significantly reduces the rate of postoperative bladder dysfunction even more than by the nerve-sparing mesorectal excision technique [21, 22].

The revealing of the pelvic splanchnic nerves is the world of laparoscopic surgery, as this technique requires special taking into account of some rules of neuro-microsurgery:

- optimal access to the nerves lying in the depth of the pelvis and dorsal of the rectum,
- boodless dissection techniques for permanent optimal vision, avoid haematomas and ensure a complication-free postoperative course,
- sufficient magnification effect for optimal identification of the nerves,
- atraumatic technique with atraumatic instruments,
- intraoperative electrostimulation of the revealed motoric nerves.

These requirements are fulfilled by laparoscopy with suitable instruments, mircrosurgical techniques and the 10-15 times magnification effect. Optimal access to the relevant pelvic area and in the depth of the peritoneum is guaranteed. Furthermore, the laparoscopy facilitates the deliberate endoscopic neurostimulation for the intraoperative control of the motoric function of the revealed nerves. In comparison, access to the pelvic parasympathetic nerves by laparotomy causes a problem. Optimal access to the anatomic region is not possible without complicated and traumatic dissection. This is especially difficult in women because of the uterus. The long instruments are not suitable for microsurgical operative techniques and the necessary magnification effect can only be achieved with impractical optics.

The « parasympathetic nerve-sparing techniques » have to change the surgeons' surgical philosophy and oblige us to change our surgical technique from « macrosurgery » with clamp/section to the technique of minute and bloodfree dissection. This new knowledge about the functional pelvic neuroanatomy is, not only changing our surgical concept, but also the classical anatomical nomenclature of « cardinal ligament » and « sacrouterine ligament » which are no longer acceptable as these structures do not exist as ligaments: the classical concept of pelvic support by ligaments has to be reviewed.

Bibliographie

[1] Low JA, Mauger GM, Carmichael JA. The effect of Wertheim hysterectomy upon bladder and urethral function. Am J Obstet Gynecol 1981;139:826-834.

[2] Barnes W, Waggoner S, Delgado G, Maher K, Potkul R, Barter J, Benjamin S. Manometric characterization of rectal dysfunction following radical hysterectomy. Gynecol Oncol 1998;42:116-119.

[3] Heald RJ. Sphincter and nerve preserving total mesorectal excision. Acta Chir Iugosl 2002;49:7-8.

[4] Hautmann RE, de Petriconi R. Nerve-sparing cystectomy technique in the women. Urologe 1995;34:221-24.

[5] Montorsi F, Briganti A, Salonia A, Rigatti P, Burnett AL. Current and future strategies for preventing nad managing erectile dysfunction following radical prostatectomy. Eur Urol 2004;45:123-33.

[6] Yabuki Y, Asamoto A, Hoshiba T, Nishimoto H, Stou N. A new proposal for radical hysterectomy. Gynecol Oncol 1996;62:370-78.

[7] Possover M, Stöber S, Plaul K, Schneider A. Identification and preservation of the motoric innervation of the bladder in radical hysterctomy type III or IV. Gyneco Onco 2000;79:154-57.

[8] Köckel M, Horn LC, Hentschel B, Hockel S, Naumann G. Total mesometrial resection: high resolution nerve-sparing radical hysterectomy based on developmentally defined surgical anatomy. Int J Gynecol Cancer 2003; 13:791-803.

[9] Possover M. Laparoscopic exposure and electrostimulation of the somatic and autonomous pelvic nerves: a new method for implantation of neuroprothesis in paralysed patients? Journal Gynecological Surgery - Endoscopy, Imaging, and Allied Techniques 2004;1:87-90.

[10] M. Possover, Rhiem K, Chiantera V. The « Laparoscopic Neuro-Navigation » - LANN: from a functionnal cartography of the pelvic autonomous neurosystem to a new field of laparoscopic surgery. Min Invas Ther & Allied Technol 2004;13:362-367

[11] Kneist W, Heintz A, Junginger T. Intraoperative identification and neuro-physiologic parameters to verifiy pelvic autonomic nerve function during total mesorectal excision for rectal cancer. J Am Coll Surg 2004;198:59-66.

[12] Possover M, Krause N, Kühne-Heid R, Schneider A. Laparoscopic assistance for extended radicallity of vaginal radical hysterectomy: description of a technique. Gynecol Obstet 1998;70:94-99.

[13] Possover M, Diebolder H, Plaul C, Schneider A. Laparoscopic assisted vaginal resection of rectovaginal endometriosis. Obstet Gynecol 2000;96:304-307.

[14] Mebust W, Roizo R, Schroeder F, Villers A. Correlation between pathology, clinical symptoms and course of the disease. In: Cocket AT, Aso V, Chatelain C *et al.*, eds. Proceedings of the International Consultation on Begnin Prostatic Hyperplasia. Geneva, Switzerland: WHO 1991:51-62.

[15] Possover M, Chiantera V, Baekelandt J. Anatomy of the sacral roots and the pelvic splanchnic nerves in women using the LANN technique. Surg Laparosc Endosc Percutan Tech 2007 Dec;17(6):508-10.

[16] Zirngibl H, Schmidt J. Konzept zur Erkennung und Sicherung von Anastomoseinsuffizienzen des Gastrointestinaltraktes. Zentralbl Chir 1997;12:20-24.

[17] Crisp WE. The Schauta operation. Obstet Gynecol 1969;33:453-60.

[18] Pescetto G, De Cecco L, Mansani FE. Curent status of the Schauta-Amreich method of radical colpohysterectomy. Ann Obstet Ginecol Med Perinat 1970;92:61-9.

[19] Seski JC, Dioknu AC. Bladder dysfunction after radical abdominal hysterectomy. Am J Obstet Gynecol 1977;128:643-51.

[20] Raspagliesi F, Ditto A, Fontanelli R, Solima E, Hanozet F, Zanaboni F, Kusamura S. Nerve-sparing radical hysterectomy: a surgical technique for preserving the autonomic hypogastric nerve. Gynecol Oncol 2004;93:307-14.

[21] Junginger T, Kneist W, Heintz A. Influence of identification and preservation of pelvic autonomic nerves in rectal cancer surgery on bladder dysfunction after total mesorectal excision. Dis Colon Rectum 2003; 46: 621-8.

[22] Kneist W, Heintz A, Wolf HK, Junginger T. Identification of pelvic autonomic nerves during partial and total mesorectal excision - influence parameters and significance for neurogenic bladder. Chirurg 2004;75:276-83.

[23] Possover M, Quakernack J, Chiantera V. The LANN technique to reduce postoperative functional morbidity in laparoscopic radical pelvic surgery. J Am Coll Surg 2005 Dec;201(6):913-7.