Surgical Tutorial 3:
Anatomy with Nerve Sparing

PROGRAM CHAIR
Robert M. Rogers, MD

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Professional Education Information

Target Audience
This educational activity is developed to meet the needs of residents, fellows and new minimally invasive specialists in the field of gynecology.

Accreditation
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Surgical Tutorial 3: Anatomy with Nerve Sparing

Robert M. Rogers, Chair

Faculty: Sven Becker, Nucelio Lemos, Benoit Rabischong

This session provides participants with practical instruction on the anatomic location of the visceral nerves in the female pelvis, their importance to the patient and the clinician, and surgical dissection techniques for exposing these fine nerves. Presentations and discussions will include the clinical opinions of what to do with these visceral nerves during procedures for treatment of endometriosis, chronic pelvic pain and gynecologic cancers.

Learning Objectives: At the conclusion of this course, the clinician will be able to: 1) Explain the anatomic location of the visceral nerves in the pelvic sidewall and demonstrate the surgical dissection techniques needed to expose these fine nerves.

Course Outline

2:15 Welcome, Introductions and Course Overview R.M. Rogers
2:20 Visceral Innervation from the Promontory to the Vesicouterine Ligament with Clinical Perspectives B. Rabischong
2:35 The Function and Purpose of the Visceral Nerves N. Lemos
2:50 The End of Nerve-Sparing Radical Hysterectomy? S. Becker
3:05 Questions & Answers All Faculty
3:15 Adjourn
PLANNER DISCLOSURE
The following members of AAGL have been involved in the educational planning of this workshop and have no conflict of interest to disclose (in alphabetical order by last name).
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Other: Researcher Initiated Support: Laborie Inc., Medtronic
Benoit Rabischong*
Robert M. Rogers*

Asterisk (*) denotes no financial relationships to disclose.
Objective

- Discuss Visceral Innervation from Promontory to Vesicouterine Ligaments

Anatomy of Pelvic Visceral Innervation

1st part: Autonomic Nerves
- Hypogastric,
- Splanchnic,
- Inferior Hypogastric Plexus,
- Visceral branches...

2nd part: Clinical applications and Perspectives...

Topographic Anatomy

Retroperitoneum: Focus of modern pelvic surgery

- Complex architecture based on connective tissue of different degrees of density
- Remarkable Interconnection of connective tissue
Pelvic Innervation

Autonomic Nerves, Pararectal Fossa

Pararectal Space
described by Japanese authors in radical hysterectomy

Could be divided in three spaces:

- Latzko space (B)
- Okabayashi space (C)
- Yabuki or the Fourth space (D)
  « Paravaginal and pararectal space »

Pararectal Fossa (B,C,D)

Latzko space, right side

Pelvic Autonomic Innervation

Pararectal fossa, visceral ligaments

- Sympathetic system
  - Superior hypogastric plexus
  - Hypogastric nerves

- Parasympathetic system
  - Pelvic splanchnic nerves

- Inferior hypogastric plexus

- Visceral nerve branches

Pararectal fossa

right hypogastric nerve(s) by Latzko space

Pay Attention to Operative Peritoneum!!!

Hypogastric Nerve, right side

Yabuki et al. Gynecol Oncol 2000

Yamaguchi K. Clin Anat 2011
Operative Peritoneum
Hypogastric Nerve, Right Side

Identification of Autonomic Innervation
Hypogastric Nerve

Identification of Autonomic Innervation
Hypogastric Nerve, Right Side

Identification of Autonomic Innervation
Hypogastric Nerve, Left Side

Hypogastric Nerve
Promontory

Splanchnic Nerves
right pararectal fossa (Latzko)
**Inferior Hypogastric Plexus**
- Form of triangular blade (3 edges, 3 angles)
- Constitution:
  - Hypogastric nerve, cranially
  - Sacral sympathetic nerves, posteriorly
  - Pelvic splanchnic nerves, caudally
- Sagittal direction
- Relationships, Location:
  - Ureter, cranially
  - Pelvic floor, caudally
  - Rectum, medially
  - Paracervix, Ligament laterale du rectum
  - Landmark of Deep Uterine Vein


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**The Vesicouterine Ligament**
*Anatomically very fashionable now...

Could be divided from a surgical point of view in 2 parts

1st part: Superficial layer or Anterior leaf
- Anterior and medial to the ureter
- The « daily pillar of the bladder »

2nd part: Deep layer or Posterior leaf
- Posterior and lateral to the ureter
- Contains autonomic innervation / bladder
- The focus of « distal » nerve sparing

In radical surgery, the surgeon should deal with: ureteral and pelvic nerves anatomy...

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**Yabuki Space**
The fourth space, right side

- Bladder
- Vagina
- Uterine artery
- Paracervix

---

**VUL**
Radical Hysterectomy

- Right Paravesical Space
- Uterine, Artery
- Right Ureter

---

**Yabuki Space, Pelvic ureter**

- Right Ureter
- U1
- U2
- U3
- Uterus
- Vagina
- Uterine Artery
- Umbilical and Superior Vesical Arteries
- Right Side
- Left Side
Bladder

Vagina

Uterine Artery

Autonomic Innervation for Bladder

Radical Hysterectomy
Right Side

Inferior Hypogastric Plexus

3 groups of visceral branches (fiber bundle or trunk)
• Two Anteriors
  - Vaginal (vesical nerve)
  - Utero-vaginal (satellite of uterine artery), Superior Rectal Nerve
• Medial and inferior, inferior edge of IHP
  - Inferior rectal plexus in nerve

Rectal efferences (anterior and inferior)
• Superior rectal nerve / Recto-vaginal space/ Superior part and anterior wall of rectum
• Inferior rectal plexus / inferior part of rectum and IAS
• +/- Branches satellite of middle rectal artery


Pelvic Autonomic Innervation

Bladder and sexual functions

✓ Sympathetic system / Adrenergic
  • Compliance and storage
  • Stimulation of urethral smooth sphincter
  • Inhibition of detrusor muscle

✓ Parasympathetic system / Cholinergic
  • Voiding
  • Stimulation of detrusor
  • Inhibition of urethral smooth sphincter
  • Vaginal lubrication and genital swelling

Yoshimura et al. Korean J Urol 2014

What happens if I cut?
Bladder and sexual functions

✓ Superior hypogastric plexus and hypogastric nerves
  • Urinary incontinence
  • Urgency

✓ Pelvic splanchnic nerves
  • Bladder atonia
  • Disorders of bladder sensitivity
  • Decreasing blood flow to vagina, lubrication

✓ IHP and visceral branches
  • Various dysfunctions according to the level of injury

✓ The chance of the surgeon:
  • Consequences seem to be more limited if unilateral injury

But is it always so simple in the real life? Probably No...

Rectovaginal Septum

Posterior Mesh, Genital Prolapse

Superior rectal plexus
Inferior rectal plexus

Inferior Hypogastric Plexus

Superior rectal plexus
Inferior rectal plexus

Rectovaginal Septum
NO because...

Coexistence of adrenergic and cholinergic fibers in sympathetic and parasympathetic

» Computer assisted dissection » (CADD)
3D reconstruction with immunochemical techniques

Descriptive and functional anatomical study

Alsaid B et al. J Anat 2009

No because... Anatomical variations

Men-Women Differences, Hypogastric nerves

Yamaguchi K et al. Clin Anat 2011

No because... Anatomical variations

Men-Women Differences, Hypogastric nerves

Yamaguchi K et al. Clin Anat 2011

Clinical Applications, « Nerve Sparing », from Dr. Okabayashi until now... Evolution in the concept

Old Japanese Concept
Objective: decrease urinary morbidity with same radicality

Kobayashi 1961, Tokyo method (laparotomy)
Sakamoto 1980 (laparotomy)
Hoeckel 1998 (laparotomy)
Possover 1999 (laparoscopy)
Maas, Trimbos 2000 (laparotomy)
Kuwabara 2000 (laparotomy)
Kato, Murakami, Yabuki 2000-2003 (laparoscopy)
Uration 2001 (laparotomy)
Leval (University of Paris)
Kaplan 2004 (laparoscopy)
Sakuragi 2005 (laparotomy)
Possover 2005, LANN technique
Fujii 2008 (laparotomy)
………..

Sakuragi N. Int J Gynecol Cancer 2005

Parametrium, paracervix, ureter, Deep uterine vein

« Nerve Sparing » from Okabayashi until now...
Radical Hysterectomy, paracervix resection

Technical principles of lymphadenectomy
Excision of parametrium and paracervix left side

Obturator nerve
Pectineus ligament
Vaginal vessels
Obturator muscle
Ilio-coccygeus

Nerve Sparing in Endometriosis...
Left Hypogastric Nerve

Hypogastric Nerve
Ureter
Nodule

Nerve Sparing in Endometriosis...
Left Hypogastric Nerve, final view

Endometriosis Negra Method

Functional Results in DIE
Is it effective? prospective study

Perspectives

- « Computer assisted dissection » (CADD)
- 3D reconstruction with immunohistochemical techniques
- Descriptive and functional anatomical study

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Group A (n = 65)</th>
<th>Group B (n = 61)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear motion within 3 months</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Linear motion between 3 and 6 months</td>
<td>NS</td>
<td>&lt;0.05</td>
<td></td>
</tr>
<tr>
<td>Linear motion between 6 and 12 months</td>
<td>NS</td>
<td>&lt;0.05</td>
<td></td>
</tr>
<tr>
<td>Urinary incontinence within 1 month</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Urinary incontinence between 1 and 6 months</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Urinary incontinence between 6 and 12 months</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Days of self catheterization</td>
<td>123.1 (57.1)</td>
<td>39.4 (29.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Severe urinary pelvic dysfunctions</td>
<td>26 (39.2%)</td>
<td>1 (1.6%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cauterization to reimplantation</td>
<td>30 (45.4%)</td>
<td>1 (1.6%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Posterior</td>
<td>4 (6.2%)</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>Cauterization between 6 and 12 months</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

Perspectives
Peroperative Neurostimulation
- Katahira A et al. Gynecol Oncol 2005

For the Future
Laparoscopic implantation of neural electrodes
- Restoring of motor or autonomic functions
- Functional electrostimulation
  - Clinical perspectives ++: Paraplegic, bladder and rectal dysfunction, pelvic chronic pain

Clinical Application
New strategies of pelvic nerves stimulation for recovery of pelvic visceral functions and locomotion in paraplegics
M. Possower et al. Neurourol Urodyn 2010
- Three patients with spinal cord injuries (Th5, Th7, Th10)
- Bilateral laparoscopic implantation of:
  - Octipolar electrodes on sciatic and pudendal nerves
  - Brindley-Finetech extradural double electrode on S3 and S4 roots
  - Brindley-Finetech single electrodes on femoral nerves

Results
- Control of spasticity of lower extremities and of reflex incontinence by stimulation of sciatic and pudendal nerves
- Bladder emptying by sacral roots stimulation +/- interruption of pudendal stimulation +/- pudendal nerve inhibition with high-frequency current
- Standing and pendular walking by femoral stimulation in 2 patients

Perspectives
Beyond Nerve Sparing...
- Rabischong B et al. Surg Endosc 2011

Conclusions
- We are still far from knowing everything...
  - Architectural and functional complexity of pelvic nervous system
  - Minimum theoretical knowledge is now essential
  - "Anatomical" advantage of laparoscopic approach satisfying the requirements of the modern pelvic surgery
  - Optimization of nerve preservation by new techniques of electrostimulation or virtual imaging or augmented reality
- Beyond nerve sparing... fascinating clinical perspectives...Neuropelveology
Thank You Very Much

For Your Attention!

http://theison.org/
The Function and Purpose of the Visceral Nerves

NUCELIO LEMOS

FEDERAL UNIVERSITY OF SÃO PAULO
DEPARTMENT OF GYNECOLOGY
PELVIC NEURODYSFUNCTION CLINIC

OBJECTIVES

- Review the main anatomical aspects of pelvic floor neuro-physiology
- Discuss the neural pathways behind pelvic floor function

Continenence

Petros & Ulmsten, 1993

LUT Function

Petros & Ulmsten

Micturition

Petros & Ulmsten, 1993

DISCLOSURE

- Speakers Bureau: Medtronic
- Other: Travel Grants: Medtronic
- Other: Researcher: Initiated Support: Laborie Inc., Medtronic

Continence

Post = Ant
R = 0

"Hammock"

Continence

Post > Ant
R > 0

"Hammock"

Continence

Post = Ant
R = 0

"Hammock"

Continence

Post > Ant
R > 0

"Hammock"
Anal Continence

Bowel Emptying

Petros & Swash, 2000

Autonomic Nerves

Hypogastric Nerves

Pelvic Splanchnic Nerves

Inf. Hypogastric Plexus

The Sacral Nerve Roots

Autonomic Nerves

Hypogastric Nerves

Pelvic Splanchnic Nerves

Inf. Hypogastric Plexus

Image from www.sorelpleasing.com
Neurophysiology of the LUT

Th10-L2 - Sympathetic
  - Internal Urethral Sphincter Contraction (α1)
  - Detrusor Relaxation (β)
S2-S4 - Parasympathetic (M3)
  - Detrusor Contraction
  - Internal Urethral Sphincter Relaxation
S2-S4 - Somatic Nervous System
  - Urethral Contraction
  - Levator Ani Muscle Contraction

Obrigado!
nucelio@gmail.com
www.neurodisfuncao.med.br

REFERENCES

The End of Nerve-Sparing Radical Hysterectomy

Sven Becker
Frankfurt University Women’s Hospital

I have no financial relationships to disclose.

Discuss the following statement:

While Nerve-Sparing Radical Hysterectomy is an interesting technical concept, it does not fit with current oncologic understanding of cervical cancer treatment.

Four Main Points

1. Cervical Cancer with extensive parametrial involvement and node-positive Cervical Cancer should be treated with primary radiation.
2. Early Stage - node negative cervical cancer can be operated on with minimal parametrial resection.
3. Extensive Parametrial resection does not fit into our modern concept of cervical cancer treatment.
4. Without extensive parametrial resection, nerve-sparing techniques are unnecessary.

The Study that's the Elephant in the Room

Randomised study of radical surgery versus radiotherapy for stage Ib-Ia cervical cancer

Lancet, 1997
Indications for Adjuvant Radiochemotherapy

- Positive Lymphnodes
- Tumor-Size > 4 cm
- (Extensive) Parametrial Infiltration
- Positive Margins
- Inadequate Lymphonodectomy (< 15 pelvic nodes)
- L1, V1

Querleu – Morrow Classification

A - Minimal Resection of Paracervical Tissue
Dissection/Visualization of Ureters without Mobilisation
Goal: Complete Removal of Cervix

- Early Cervical Cancer < 2 cm
  Without nodal Involvement
  Without LVS+
- Hysterectomy after Radiation

B - Ureter-Tunnel dissected - Ureter Laterialized
+ paracervical LND instead of total lateral resection (B2)
Paracervical LND = medial of N. obturatorius
Iliacal LND = lateral of N. obturatorius
**Querleu - Morrow Classification**

C - Complete Mobilization of Ureter
  - Resection of Uterosacrale Ligament near Rectum
  - Resection of Vesicouterine Ligament near Bladder
  - C1 nerve-sparing
  - C2 not nerve-sparing

⇒ Nerve-sparing WITHOUT subsequent Radiation...?

**Four Main Points**

- 2. Early Stage - node negative cervical cancer can be operated on with minimal parametrial resection

**Oncologic Tailoring instead of unnecessary parametrial resection with nerve-sparing approach?**
Four Main Points

1. Extensive Parametrial resection does not fit into our modern concept of cervical cancer treatment

2. Without extensive parametrial resection, nerve-sparing techniques are unnecessary

3. Extensive Parametrial resection does not fit into our modern concept of cervical cancer treatment

4. Without extensive parametrical resection, nerve-sparing techniques are unnecessary
The big, unanswered question:

Is Landoni right?
Is Surgery plus Radiochemotherapy really unacceptable?

Could radical laparoscopy and nerve-sparing-surgery PLUS adjuvant radiochemotherapy yield different morbidities?

Summary

1. Cervical Cancer with extensive parametrial involvement and node-positive Cervical Cancer should be treated with primary radiation

2. Early Stage - node negative cervical cancer can be operated on with minimal parametrial resection

3. Extensive Parametrial resection does not fit into our modern concept of cervical cancer treatment

4. Without extensive parametrial resection, nerve-sparing techniques are unnecessary
CULTURAL AND LINGUISTIC COMPETENCY

Governor Arnold Schwarzenegger signed into law **AB 1195** (eff. 7/1/06) requiring local CME providers, such as the AAGL, to assist in enhancing the cultural and linguistic competency of California’s physicians (researchers and doctors without patient contact are exempt). This mandate follows the federal Civil Rights Act of 1964, Executive Order 13166 (2000) and the Dymally-Alatorre Bilingual Services Act (1973), all of which recognize, as confirmed by the US Census Bureau, that substantial numbers of patients possess limited English proficiency (LEP).

**California Business & Professions Code §2190.1(c)(3)** requires a review and explanation of the laws identified above so as to fulfill AAGL’s obligations pursuant to California law. Additional guidance is provided by the Institute for Medical Quality at [http://www.imq.org](http://www.imq.org).

**Title VI of the Civil Rights Act of 1964** prohibits recipients of federal financial assistance from discriminating against or otherwise excluding individuals on the basis of race, color, or national origin in any of their activities. In 1974, the US Supreme Court recognized LEP individuals as potential victims of national origin discrimination. In all situations, federal agencies are required to assess the number or proportion of LEP individuals in the eligible service population, the frequency with which they come into contact with the program, the importance of the services, and the resources available to the recipient, including the mix of oral and written language services. Additional details may be found in the Department of Justice Policy Guidance Document: Enforcement of Title VI of the Civil Rights Act of 1964 [http://www.usdoj.gov/crt/cor/pubs.htm](http://www.usdoj.gov/crt/cor/pubs.htm).

**Executive Order 13166, “Improving Access to Services for Persons with Limited English Proficiency”,** signed by the President on August 11, 2000 [http://www.usdoj.gov/crt/cor/13166.htm](http://www.usdoj.gov/crt/cor/13166.htm) was the genesis of the Guidance Document mentioned above. The Executive Order requires all federal agencies, including those which provide federal financial assistance, to examine the services they provide, identify any need for services to LEP individuals, and develop and implement a system to provide those services so LEP persons can have meaningful access.

**Dymally-Alatorre Bilingual Services Act** (California Government Code §7290 et seq.) requires every California state agency which either provides information to, or has contact with, the public to provide bilingual interpreters as well as translated materials explaining those services whenever the local agency serves LEP members of a group whose numbers exceed 5% of the general population.

If you add staff to assist with LEP patients, confirm their translation skills, not just their language skills. A 2007 Northern California study from Sutter Health confirmed that being bilingual does not guarantee competence as a medical interpreter. [http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2078538].