Vol. 37 - N. 3
September 2018

Rivista Italiana di Colon-Proctologia
Founded in 1982

ISSN 1973-4905

PELVIPERINEOLOGY

A multidisciplinary pelvic floor journal

www.pelviperineology.org

INSTRUCTIONS FOR AUTHORS

The manuscripts including tables and illustrations must be submitted to Pelviperineology only via the Isubmit system **www.isubmit.it**. This enables a rapid and effective peer review. Full upload instructions and support are available online from the submission site.

In **http://www.pelviperineology.org/pelviperineology_authors_instructions. html** please find the updated guidelines for the Authors.

Contents

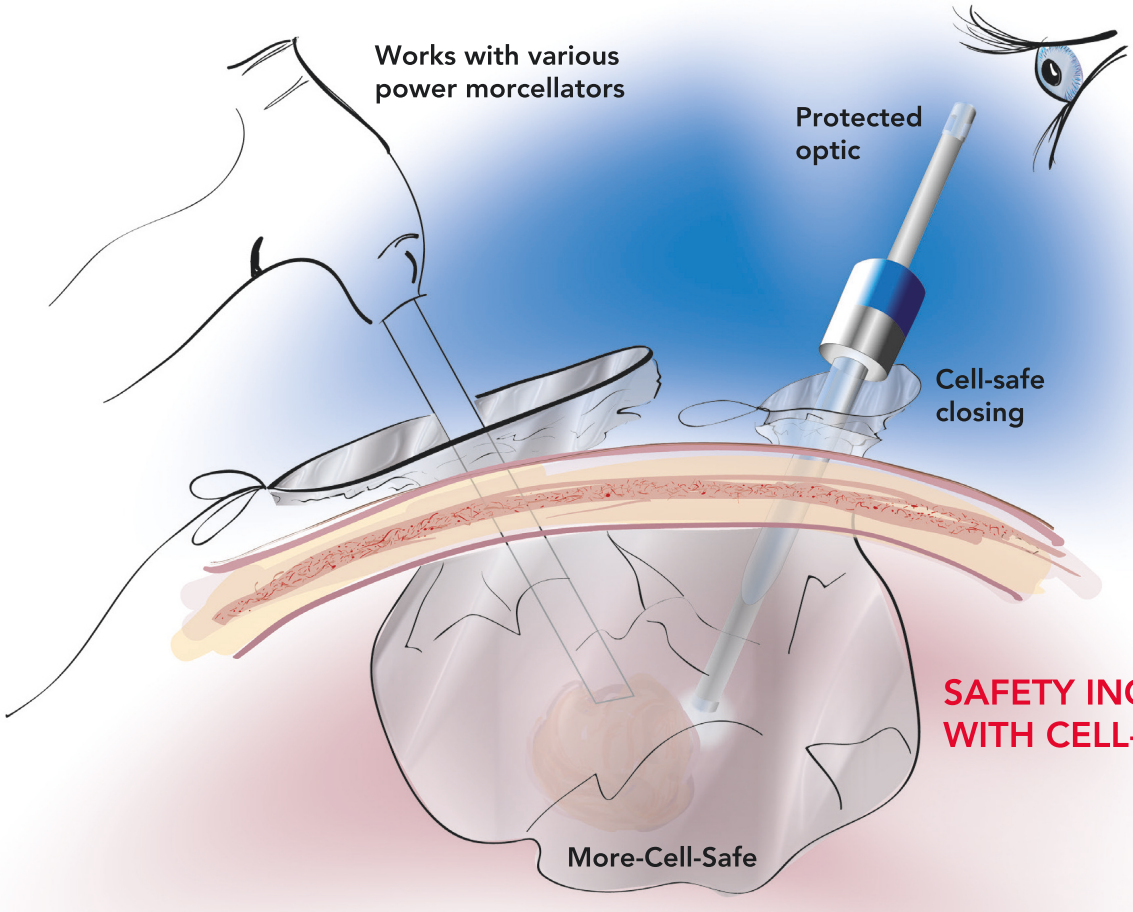
'Taxe Perçue' 'Tassa Riscossa' - Padova C.M.P.
Poste Italiane s.p.a.
Spedizione in Abb. Post. - 70% - DCB Padova

A.M.I.®

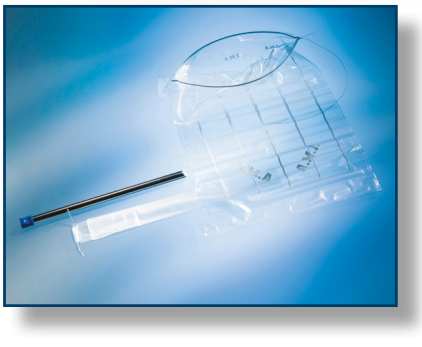
More-Cell-Safe

Increase Safety in Power Morcellation

The FIRST commercially available solution that demonstrates to significantly increase safety* against cell spillage in power morcellation.



SAFETY INCREASED WITH CELL-TIGHT BAG



System for reduction of cell spillage during power morcellation in laparoscopic surgery.

Feel confident with More-Cell-Safe

*Rimbach S. et al., 2015, A new in-bag system to reduce the risk of tissue morcellation, Arch Gynecol Obstet, DOI 10.1007/s00404-015-3788-9

A.M.I. GmbH . Im Letten 1 . 6800 Feldkirch . Austria . +43 5522 90505-0 . info@ami.at . **www.ami.healthcare**

Vol. 37
N. 3
September 2018

Rivista Italiana di Colon-Proctologia
Founded in 1982

PELVIPERINEOLOGY

A multidisciplinary pelvic floor journal

www.pelviperineology.org

Official Journal of the: International Society for Pelviperineology (www.pelviperineology.com)
Associaciòn LatinoAmericana de Piso Pelvico
Perhimpunan Disfungsi Dasar Panggul Wanita Indonesia
The Israeli Society of Urogynecology and Pelvic Floor
Romanian Uro-Gyn Society
Pelvic Reconstructive Surgery and Incontinence Association (Turkey)

Editorial Office: Benito Ferraro, Luisa Marcato
e-mail: benito.ferraro@sanita.padova.it - luisa.marcato@sanita.padova.it
Quarterly journal of scientific information registered at the Tribunale di Padova, Italy n. 741 dated 23-10-1982 and 26-05-2004
Editorial Director: Giuseppe Dodi (Direttore Responsabile)
Printer "Tipografia Veneta" Via E. Dalla Costa, 6 - 35129 Padova - e-mail: info@tipografiaveneta.it

Invitation to the International Society of Pelviperineology Congress

Dear Colleagues!

We are pleased to invite you to the International Society of Pelviperineology Congress, which will be held in 2018 in **Bucharest**, between the **4th and the 6th of October**.

This year's edition of the Congress will reunite prominent professionals in the field of pelviperineology, joining specialties such as obstetrics-gynecology, urology, urogynecology, colorectal surgery. Interesting topics will be debated during the sessions, with multidisciplinary round-table sessions with interactive participation from the audience.

The Congress will be presided by Prof. Akin Sivaslioglu, the President of the International Society of Pelviperineology, Prof. Elvira Bratila and Prof. Monica Cîrstoiu, the President and Vice-President of the Romanian Society of Urogynecology as Local Organizing Committee heads. The sessions will be held by important figures in the pelviperineology field, which will be both presenting their own work and moderating the sessions, including along with the Congress presidents: Prof. Peter Petros, Prof. Bernhard Liedl, Prof. Eray Çalişkan, Prof. Giulio A. Santoro, Prof. Erkut Attar, Prof. Joerg Neymeyer, Prof. Petre Bratila, Dr. Burghard Abendstein, Dr. Sidi Muctar, Dr. Andrei Müller-Funogea. The themes approached in the Congress will include Urinary incontinence, What can be explained with Integral Theory, Apical defect, Posterior Compartiment and Actual experinces in the use of meshes at the pelvic floor. The speakers include important personalities in the field of pelvic surgery, with huge experience in diagnosing and treating pelvic floor defects, sharing their knowledge acquired over time in pelvic organ prolapse interventions.

The Congress will be preceded by a series of two courses, including video presentations and live surgery demonstrations.

The first workshop regarding Aestethis Gynecology will be held by Prof. Akin Sivaslioglu and Prof. Eray Caliskan. It will include technique explanations and video demonstrations of Labioplasty, Hudoplasty, Hymenoplasty and Lipid injection, with an accent on the real necessity of these interventions. It will also include discussion regarding wound healing and the importance of pre and postoperative care for an optimal result.

The second workshop will discuss Native tissue repair versus mesh repair - what is the best root in mesh surgery? Laparoscopic or vaginal?, having as course director Prof. Peter Petros. The course will begin by discussing native tissue repair according to the Integral Theory, and try to explain tricks on how to avoid complications in mesh surgery. Live video surgery, realized both by vaginal and laparoscopic route will be included in the workshop, which will end with discussions and comments from the audience.

We invite you to enhance your surgical and clinical knowledge with a diversified scientific program and a line up of speakers who are not only opinion leaders but also willing to teach.

Prof. Dr. ELVIRA BRATILA, President of the Romanian Society of Urogynecology
E-mail: elvira.bratila@gmail.com

Editorial

Imaging and historical initiatives

THE EDITORS
PELVIPERINEOLOGY

Pelviperineology is pleased to announce two initiatives, a section on images and videos and a historical section. In a sense, these two seem contrary to each other. The first reflects the imperative of conveying important concepts to "time poor" readers. The 2nd is delving into a past era, where virtually any medium besides the written word did not even exist. The remarkable technology initiated by Apple's iphone has converted every practitioner of the pelvic floor into a cameraman. It has brought the consulting room and the operating theatre into real time. It is just a matter of pulling out the iphone, placing it onto "video" mode and start filming. The next step, a very simple one, is to put the images onto something like Youtube, which makes them even more accessible. The phone images are surprisingly good, certainly sufficient for teaching purposes, which is the objective of the section.

Of course images, videos from a proper digital camera are always to be preferred. Such "instant" offerings unfortunately have little value unless they are accompanied by a scientific analysis and argument. Therefore Pelviperineology has defined two types of imagings for this section, a short version to outline a point and a more comprehensive longer version which sets out to explain a concept or procedure. Both will, where possible, be subjected to comments, either invited, or preferably, from our readers.

The historical initiative is intentioned to introduce medicine from another era. It encompasses a broad spectrum, from a time early last century where Galenic remnants remained, the pre-antibiotic and even where relevant, the post-antibiotic era.

Pelviperineology is honoured to have the first contribution in this section from Dr Jose M Gil-Vernet, himself a distinguished Urologist, writing about his grandfather, Salvador Gil Vernet (SGV).

In Salvador's time, medical doctors were classically trained in Ancient Greek and Latin. Indeed, in many universities, expertise in Latin was a compulsory entrance subject. The tools doctors of that era had to investigate were understandably very limited, anatomy and the deductive logic mode of thinking inherent in these ancient languages. This methodology is evident on reading this short summary of Salvador's Lifetime work. Indeed, it is encapsulated in Gil Vernet's famous statement, that an answer was required to the question of *"what is it for."* SGV also stated *"Precise, almost mathematical knowledge of anatomy is a highly fertile source of surgical applications, suggesting new techniques and helping perfect and simplify existing surgical methods, making them less mutilating and more benign and, in short, raising surgery to the rank of true science"*.

In later issues, we hope to present some of SGV's magnificent drawings and descriptions and to show how even today, some are highly relevant to the understanding of structure and function of the pelvic floor.

Original article

A new method to evaluate the part of stress in pain: injection of dextrose 5% (neural prolotherapy) on acupuncture points corresponding to the stellate, coeliac and mesenteric ganglions. A pilot study

JACQUES BECO[1], JACK MOUCHEL[2], LAURENCE SEIDEL[3], ADELIN ALBERT[3,4]

[1] *Department of Gynecology and Obstetrics, University Hospital of Liège, Liège, Belgium*
[2] *Avenue d'Haouza, Le Mans, France*
[3] *Biostatistics, University Hospital of Liège, Liège, Belgium*
[4] *Department of Public Health Sciences, University of Liège, Liège, Belgium*

Abstract: In neuralgia (neuropathic pain), the skin rolling test is painful (allodynia to pinch) but when painful everywhere on the body (polyneuralgia) it often indicates that the patient lives stressed out, in a fight of flight situation. Thus, when starting a treatment, it is important to differentiate between these patients and those who have perineal pain only.
The aim of this study was to evaluate the effect on pain and stress of a neural prolotherapy treatment (dextrose 5% injections) at seven acupuncture points linked with orthosympathetic ganglia. The studied population comprised 55 patients treated in two private clinical settings (authors 1 and 2). The short-term effect on pain was studied by comparing the pain induced by the arm skin rolling test before and 15 minutes after injections. To evaluate the long term effect on pain, the average level of body pain during the two weeks preceding the treatment was compared with that following treatment. The WHO (Five) Well-Being Index was used to evaluate the patient's level of stress before and two weeks after injections. Fifteen minutes after dextrose injections, pain induced by the skin rolling test at the arm level was decreased (-3.0 ± 1.6; p<0.0001). Two weeks after treatment, the global pain score was significantly reduced (-2.0 ± 0.7; p<0.0001) and the total WHO score increased (+21.0 ± 20.5; p<0.0001). Treatment of polyneuralgic patients with neural prolotherapy of seven acupuncture points significantly improves well-being sensation and reduces pain.

Keywords: Fibromyalgia; Acupuncture; Neural prolotherapy; Post-traumatic stress disorders; Chronic pain

INTRODUCTION

When pain occurs in a specific area, a diagnosis of neuralgia (neuropathic pain) can easily be done by the skin rolling test (pinch test, Kibler's fold test)[1-4]. This test is painful (or positive) in case of allodynia to pinch, one of the classical sign of neuralgia. A painful skin rolling test at perineum level is one of the three clinical signs of the pudendal syndrome[5]. When initiating care management in a patient with perineodynia (perineal pain), it is of utmost importance to differentiate patients with perineal pain only from patients who have pain everywhere on the body (polyneuralgia). In the latter, the skin rolling test is painful everywhere on the body surface and perineodynia is just part of a general "illness" which could be called fibromyalgia or central sensitization. This indicates that the patient lives stressed out, under pressure, in a fight of flight situation (with possible heightened sensitivities across all senses: touch, light, sound, odor). All senses become hypersensitive probably due to a mammal adaptation aiming to better detect the approach of a potential predator.

Quite often, this state is part of a post-traumatic stress disorders (PTSD)[6]. Severe chronic pain or stressful experiences in the patient's history (rape, aggression, surgery, death of a close relative, etc.) are the main causes of this psychological state. Pain intensity during the arm skin rolling test tends to be correlated with the patient's stress level (personal unpublished data).

Strong emotional events can stimulate the sympathetic nervous system for a long time[7]. According to recent studies, the stellate ganglion is connected with the emotion centers such as the amygdala known to be involved in the development of PTSD based on functional MRI studies (Figure 1)[6,8]. There is substantial evidence that stellate ganglion blocks have a significant effect on PTSD[8,9]. Sadly, inadvertent intra-arterial injection of a local anesthetic during stellate ganglion blockade may cause life-threatening complications[10]. According to Wancura-Kampik[11], each sympathetic ganglion can be treated indirectly by acting on some acupuncture points. Neural prolotherapy (perineural injection therapy with dextrose 5%) as described by John Lyftogt may be considered as an effective method to treat neuralgias [12, 13].

The aim of this pilot study was to evaluate the effect of neural prolotherapy on seven acupuncture spots linked to three sympathetic ganglions in the management of stress and polyneuralgia.

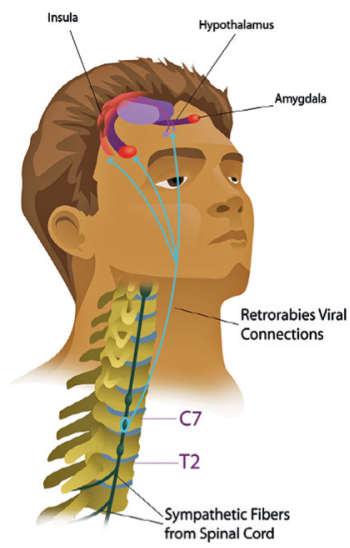


Figure 1. – Sympathetic fibers originate from the spinal cord at the thoracic level and enter the sympathetic chain leading to the brain. Reprinted from "Sympathetic system modulation to treat post-traumatic stress disorder (PTSD): a review of clinical evidence and neurobiology" from Lipov E, Kelzenberg B., J Affect Disord 2012;142:1-5, Copyright by Elsevier[8] (reprinted with permission).

MATERIAL AND METHODS

The study material consisted of 55 patients (54 women and 1 man), aged 45.2 ± 10.3 years, from two private clinical practices (Author 1, N=41 and Author 2, N=14); all patients had a positive skin rolling test at the level of the arm (pain level 4 or more).

The patients had to fill in the WHO (Five) Well-Being Index questionnaire (OMS 1998)[14, 15], which is a simple method to measure emotional well-being during the two weeks preceding the visit. It consists of five items related to positive mood, vitality and general interests. Each value must be an average for the last fifteen days. It has been shown as a reliable measure of emotional functioning and a good screener for depression[14]. Each of the five items is rated from 0 (absent) to 5 (constantly present). Scores are added and multiplied by four giving values between 0 and 100. A score below 50 is indicative of low mood. A score of 28 or below indicates likely depression. After having filled in the questionnaire, patients had also to give an average level of body pain on a 10 cm visual analog scale (VAS) for the last 2 weeks before the visit (all pain inclusive).

Treatment consisted of injecting seven acupuncture points with a dextrose 5% solution buffered with bicarbonate to have a neutral pH (needle 27G)[13]. These spots were selected according to Wancura-Kampik[11]. Most of them were clearly painful on palpation or by using the skin rolling test (allowing for a more precise location). They were marked precisely with a cross on the skin using a ballpoint pen. The two Spleen 6 points (SP 6 - Sanyinjiao in Chinese) are located on the medial aspect of the lower leg 4 fingers breadth (or 3 cun; one cun = one Chinese anatomical inch[16]) above the medial malleolus on the posterior border of the tibial bone. They are painful on palpation. The two Pericardium 6 points (PC6 - Neiguan) are located on the palmar aspect of the forearm, 3 fingers breadth (2 cun) above the transverse crease of the wrist between the tendons of m. palmaris longus and m. flexor carpi radialis. They are rarely painful. The three remaining spots are located on the Conception Vessel (CV) meridian (or Ren Mai). This meridian is situated in the anterior midline. CV 6 – Ren 6 (Qihai) is also known as "Sea of energy". It is located two finger widths (1.5 cun) below the center of the belly button. It is easily identified by using the pinch test perpendicularly to the meridian. CV 12 – Ren 12 (Zhongwan) is situated half way between umbilicus and sternocostal notch. This point is also painful by using the pinch test. CV17-Ren 17 (Tanzhong) is known as "Sea of tranquility" because it can be used in acupressure to reduce stress. It is located at the level of the 4th intercostal space, at the midpoint between the two nipples. It is usually painful at palpation and/or with skin rolling. According to Wancura-Kampik[11], CV17 and PC6 are connected with the stellate ganglion while CV6 and SP6 are linked with the mesenteric ganglions and CV12 with the celiac ganglion. Four of these points were injected subcutaneously with 1-2 ml of dextrose 5% (two SP6 and two PC6) while the others were treated intra-cutaneously forming 1.5 cm "quaddles" according to the German neural therapy approach [2] (Figure 2). The points were injected in the following order: two SP6, CV6, CV12, two PC6 and at the end CV17.

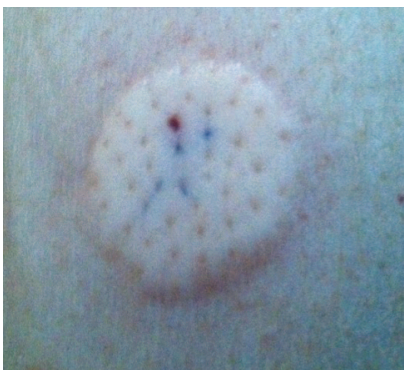


Figure 2. "Quaddle" after intracutaneous injection.

The skin rolling test was performed at the right arm level (all around) before and 15 min after the injections. Pain levels were evaluated using the 0-10 cm VAS.

Two weeks after the treatment patients had to complete again the WHO (Five) Well-Being Index questionnaire and to evaluate pain on the VAS. Moreover they had to inform the investigator on the questionnaire about any other change (e.g. sleep, bowel, urinary).

Statistical analysis: Results were expressed as mean ± standard deviation (SD). Frequency tables were used for categorical data. Group mean values were compared by the Student t test while within patient mean differences were compared by the paired t test. The comparison of proportions was done the classical chi-squared test. The correlation coefficient was calculated to assess the association between two variables. Results were considered significant at the 5% critical level ($p<0.05$). All calculations were performed with the SAS version 9.4 and R version 3.3.3 statistical packages.

RESULTS

Fifteen minutes after dextrose injections, pain induced by the skin rolling test at the arm level was significantly reduced from 7.1 ± 1.5 to 4.2 ± 1.9 ($p<0.0001$). There was also a clear improvement of the global WHO score which increased from 36.8 ± 18.1 to 57.8 ± 22.2 ($p<0.0001$) 14 days after treatment. As seen in Table I, the mean value of all items of the WHO index increased markedly after injection, although improvement was less significant for the fifth item: "My daily life has been filled with things that interest me". The global pain value was also significantly reduced two weeks after treatment (6.0 ± 2.1 before vs. 4.1 ± 2.5 after; $p<0.0001$).

Table 1. WHO score before and 14 days after treatment (N=55).

WHO index	Before injection Mean ± SD	After injection Mean ± SD	P-value
Item 1 (/5)	2.1 ± 1.1	3.0 ± 1.2	<0.0001
Item 2 (/5)	1.7 ± 1.2	3.0 ± 1.2	<0.0001
Item 3 (/5)	1.6 ± 1.3	2.8 ± 1.3	<0.0001
Item 4 (/5)	1.3 ± 1.2	2.6 ± 1.4	<0.0001
Item 5 (/5)	2.5 ± 1.5	3.0 ± 1.3	0.0036
Total score (/100)	36.8 ± 18.1	57.8 ± 22.2	<0.0001

WHO-1: I have felt cheerful and in good spirits; WHO-2: I have felt calm and relaxed; WHO-3: I have felt active and vigorous; WHO-4: I woke up feeling fresh and rested; WHO-5: My daily life has been filled with things that interest me.

Results from authors 1 and 2 were comparable except for pain induced by the skin rolling test at the arm level before and after treatment. Pain induced by Author 1 before treatment was significantly stronger than that induced by Author 2 (7.5 ± 1.4 vs. 6.1 ± 1.2; $p=0.0028$) and likewise after treatment (4.7 ± 1.9 vs. 2.8 ± 1.3; $p=0.0012$) but pain reduction was similar for both authors (-2.80 ± 1.7 vs. -3.4 ± 1.3; $p=0.26$).

No correlation was found between pain intensity reduction during arm skin rolling test after treatment and WHO score improvement after two weeks ($r=-0.17$, $p=0.21$) but this correlation was almost significant for global pain reduction ($r=0.26$, $p= 0.058$).

Soon after the treatment, patients felt in general completely "Zen" and their muscles relaxed. Some patients described warming of the arms and face. Pain in different body areas often had disappeared before the patient left the office. A number of patients slept in their car before driving. Several stress related symptoms disappeared (e.g. restless legs, urinary frequency, urge incontinence, heartburn, or diarrhea).

DISCUSSION

In this pilot study, dextrose injections on seven acupuncture spots linked with the sympathetic ganglions had a marked immediate effect on stress. Most often patients left the office free of stress and this state persisted for some days. Moreover, after 2 weeks, results were seen as highly positive because a 10% improvement of the WHO score is already considered as clinically significant[14].

The novel treatment approach described herein may be used to evaluate the part of pain due to stress in the patient's condition. It opens doors for communication about past psychological trauma and adapted care (EMDR, hypnosis). It could also help many patients who suffer awful stress to feel better immediately. Hyperactivity of the sympathetic system may partly explain fibromyalgia (or polyneuralgia) because short-term improvement of pain was obtained with low-dose of propranolol or by Xenon irradiation of the stellate ganglion[17, 18]. Failure in case of strong chronic pain suggests that the trigger pain must be treated before using psychological treatments.

Polyneuralgic patients are at risk of inappropriate and useless surgeries (for pain or psychosomatic induced illnesses) and should be diagnosed as soon as possible. The skin rolling test at the arm level is in our experience the best screening test but it could be also painful in case of brachial neuralgias independently of stress (radial, medial antebrachial, intercosto-brachial, medial brachial cutaneous). In case of doubt, the skin rolling test must be done at many different places of the body to confirm the diagnosis (painful everywhere). According to the German neural therapy approach, quaddle injections are far more effective than subcutaneous injections [2]. This can be explained by the fact that 90 % of all autonomic nerve substances are in the skin and that the nerve endings and bulbs have no more connective tissue sheath at this level, letting dextrose 5% solution having a direct interaction with the neural tissue[2]. However, because the skin is so thin on SP6 and PC6, injections were done subcutaneously at these points.

This is a pilot study. The skin rolling test and the injections were done by the two same physicians who were not blinded. It is likely that the pressure induced by the fingers was not exactly similar before and after the injections or between physicians (a statistically significant difference was observed between Author 1 and Author 2). Since there was no sham treatment and the patients were completely informed of the study objective, a significant placebo effect may partly explain the results. Long term efficacy of the method has to be evaluated. Probably, a single treatment will not suffice, knowing that an isolated neuralgia requires on average 3 neural prolotherapy sessions (at two weeks interval) to heal. The choice of the acupuncture points to be injected can also be discussed. It could be that treating only CV17 with the two PC6 (which are connected with the stellate ganglion) will be sufficient to obtain relaxation but we preferred to relieve a great part of the sympathetic system by adding the four other points. The efficacy of this approach in reduction of stress and pain suggests that treatment of other acupuncture points with dextrose 5% injections should help healing other illnesses.

CONCLUSION

Treatment of polyneuralgic patients with dextrose 5% injections at seven acupuncture points connected with three sympathetic ganglions significantly improves their well-being sensation and reduces their pain. If the present findings are confirmed by well-controlled studies, this treatment could become quite helpful in the management of stressful and painful patients and probably in many psychosomatic disorders. It could also be attempted in cases of acute stress.

DISCLOSURES

This study has been approved by the Ethic Committee of Liège University. Jacques Beco, Jack Mouchel, Laurence Seidel and Adelin Albert have no conflicts of interest or financial ties to disclose.

REFERENCES

1. Carnett JB. Intercostal neuralgia as a cause of abdominal pain and tenderness. Surg Gynecol Obstet, 1926, 42, 625-632.
2. Dosch P. Manual of neural therapy according to Huneke. Heidelberg: Haug Publishers, 1984.
3. Maigne R. Low back pain of thoracolumbar origin. Arch Phys Med Rehabil 1980, 61, 389-95.
4. Carnett JB, Bates W. The Treatment of Intercostal Neuralgia of the Abdominal Wall. Ann Surg 1933, 98, 820-9.
5. Beco J, Climov D, Bex M. Pudendal nerve decompression in perineology : a case series. BMC Surg 2004, 4, 15.
6. Liberzon I, Martis B. Neuroimaging studies of emotional responses in PTSD. Ann N Y Acad Sci 2006, 1071, 87-109.
7. Westerhaus MJ, Loewy AD. Central representation of the sympathetic nervous system in the cerebral cortex. Brain Res 2001, 903, 117-27.
8. Lipov E, Kelzenberg B. Sympathetic system modulation to treat post-traumatic stress disorder (PTSD): a review of clinical evidence and neurobiology. J Affect Disord 2012, 142, 1-5.
9. Mulvaney SW, Lynch JH, Hickey MJ et al. Stellate ganglion block used to treat symptoms associated with combat-related post-traumatic stress disorder: a case series of 166 patients. Mil Med 2014, 179, 1133-40.
10. Chaturvedi A, Dash H. Locked-in syndrome during stellate ganglion block. Indian J Anaesth 2010, 54, 324-6.
11. Wancura-Kampik I. Segmental anatomy. The key for mastering acupuncture, neural therapy and manual therapy. Munich: Elsevier Gmbh, 2012.
12. Lyftogt JA. Pain Conundrums: Which Hypothesis? Central Nervous System Sensitization versus Peripheral Nervous System Autonomy. Australasian Musculoskeletal Medicine 2008, 72-74.
13. Lyftogt J. Subcutaneous prolotherapy treatment of refractory knee, shoulder, and lateral elbow pain. Australasian Musculoskeletal Medicine 2007, 12, 110-112.
14. Topp CW, Ostergaard SD, Sondergaard S et al. The WHO-5 Well-Being Index: a systematic review of the literature. Psychother Psychosom 2015, 84, 167-76.
15. Henkel V, Mergl R, Kohnen R, et al. Identifying depression in primary care: a comparison of different methods in a prospective cohort study. BMJ 2003, 326, 200-1.
16. Coyle M, Aird M, Cobbin D et al. The Cun Measurement System: an Investigation into its Suitability in Current Practice. Acupunct Med 2000, 18, 10-14.
17. Nakajima F, Komoda A, Aratani S et al. Effects of xenon irradiation of the stellate ganglion region on fibromyalgia. J Phys Ther Sci 2015, 27, 209-12.
18. Light KC, Bragdon EE, Grewen KM,et al. Adrenergic dysregulation and pain with and without acute beta-blockade in women with fibromyalgia and temporomandibular disorder. J Pain 2009, 10, 542-52.

Correspondence to:

Dr Jacques Beco
Avenue Hanlet 9a, B-4802 Heusy, Belgium
jacques.beco@skynet.be

Original Article

The role of detrusor rigidity in the lower urinary tract dysfunction. Hypothesis

MICHAEL D. LEVIN

State Geriatric Center, Netanya, Israel

Abstract: Objective. To define the role of detrusor rigidity in the pathogenesis of various forms of low urinary tract dysfunction. *Results*. We hypothesize that the motility of the urinary system and anorectal zone are subject to the same laws. Extrapolating the known mechanisms of fecal continence and defecation to urination, we propose a hypothesis of motor function of the lower urinary system. Changes in voiding parameters in lower urinary tract dysfunction (LUTD) suggest that detrusor contractility and efficiency decrease with age. This is characterized by a decrease in volume of the urinary bladder, and the thickening of its wall. Smooth muscle fibers are gradually replaced by connective tissue, leading to loss of elasticity and hence increased rigidity of the detrusor. Similar changes occur in the urethral sphincters. Contraction of the prostate then acts to support urinary retention in men when urination is delayed for long periods. In patients experiencing LUTD, it strikes more frequently at night than during the daytime. In this paper we discuss the mechanisms of pathological change as a result of the detrusor rigidity from the detrusor overactivity to the bladder outlet obstruction and then to the underactive detrusor are discussed. *Conclusion:* Taken in conjunction with the concept of age related rigidity of the detrusor and urethral sphincters, our proposed hypothesis of lower urinary tract motility allows us to view the pathogenesis of various impairments of urination as a single process. This makes it possible to explain all the symptoms of LUTD. Further testing of the hypothesis is necessary.

Keywords: Hypothesis; Physiology of urination; Prostate; Rigidity; Urodynamic dysfunction; Urethral sphincters.

Abbreviations:
BPH – benign prostatic hypertrophy; LUTS – lower urinary tract symptoms;
BOO – bladder outlet obstruction; DO – detrusor overactivity;
DU – detrusor underactivity; LUTD - lower urinary tract dysfunction;
IAP – intra-abdominal pressure; TP-1 - threshold pressure-1 (filling);
TP-2 - threshold pressure-2 (urge); TP-3 - threshold pressure-3 (urgency);
IUS – internal urethral sphincter; EUS – external urethral sphincter;
PRM – puborectalis muscle.

INTRODUCTION

According to the International Continence Society's 2002 standards lower urinary tract symptoms (LUTS) can be divided into three groups: storage symptoms (increased daytime frequency, nocturia, urgency, urinary incontinence); voiding symptoms (slow stream, splitting or spraying, intermittent stream, hesitance, straining, terminal dribble); and postmicturition symptoms (feeling of incomplete emptying, post micturition dribble)[1]. On the basis of urodynamic studies of patients where acute and chronic prostatitis, neurological diseases, urethral stricture or injury, and surgeries are excluded, the following syndromes are diagnosed: bladder outflow obstruction (BOO), detrusor overactivity (DO) and detrusor underactivity (DU)[1,2].

Most men eventually develop histological benign prostatic hypertrophy (BPH) if they live long enough. Approximately half develop benign prostatic enlargement, and about half of these cases develop BOO with high bladder pressures and low flow, which in turn leads to detrusor wall hypertrophy. Many of these men only have LUTS, but a significant number also suffer complications from BPH[3]. While many men develop increased outlet resistance with aging as a result of prostatic hypertrophy, no anatomic corollary exists in women. It has been shown that female detrusor contractility and effectiveness decrease with age[4]. The common symptoms of voiding dysfunction in older women - such as a slow urine stream, straining to void, a feeling of incomplete bladder emptying, need to re-void and position-dependent micturition - do not differ much from symptoms in older men, except in cases with BOO[1-4].

Condition of the bladder wall in LUTD

The ultrastructure of the detrusor corresponds perfectly to its urodynamic behavior with time[5]. In control patients the detrusor muscle bundles were composed of smooth muscle cells closely packed together with very little intervening connective tissue. In contrast, and irrespective of age, in patients with prostatic hypertrophy, detrusor muscle from trabeculated bladders were found to contain many muscle bundles in which the constituent cells were of relatively small diameter and were widely separated from each other by dense masses of connective tissue[6].

Ultrasound measurement of bladder wall thickness showed a highly significant association with DO[7,8,9]. Studies of autonomous bladder micromotions in urinary storage and voiding showed that in LUTS, efferent control of the bladder can be impaired due to peripheral "patchy" denervation. This impairs regulation of micromotility initiation and propagation, potentially allowing the emergence of an overactive bladder and, with progression DO[10]. In the elderly, the main alteration in voiding function is due to higher prevalence of DO. Despite the increased prevalence of DO, detrusor contractility declines with age. This may be due to age-related changes in detrusor muscle function, urethral function and sensory function[11]. When detrusor specimens from elderly subjects with impaired contractility were examined by electron microscopy, they displayed widespread degeneration of muscle cells and axons[12]. Biological aging significantly decreases bladder smooth muscle caveolae number and morphology, with associated selective alteration in caveolin protein expression. Since caveolae are protected membrane regions that regulate signal transduction, age-related alteration in caveolae and caveolin protein expression could alter bladder smooth muscle contractility, resulting in bladder dysfunction in the elderly[13].

In BOO the pattern was characterized by widely separated muscle cells with reduction of intermediate cell junc-

tions, collagenosis, (i.e. abundant collagen plus some elastic fibers) in the markedly widened spaces between individual muscle cells, and abundant profiles characteristic of enlarged, hypertrophic muscle cells. Features of a myohypertrophy pattern, with or without superimposed degeneration, can explain the overall weakness of the obstructed detrusor despite hypertrophy of its cells[12].

Bladder function in LUTD

Changes in the structure, metabolism and innervation of the bladder may occur with BOO and with aging itself. These changes lead to voiding dysfunction, but it is difficult to distinguish the effect of BOO from those of aging, since both can trigger similar pathological processes and outcomes[14]. Cystometric parameters have revealed a significant age-related decrease in bladder capacity ($p<0.001$) and bladder compliance ($p=0.004$). Pressure flow study has revealed a significant decrease in voiding efficiency ($p=0.029$), and voided volume ($p<0.001$)[15]. The study of Mori et al. indicates that 15 month matured rats exhibit bladder overactive and underactive conditions as evidenced by increased non-voiding contraction and decreased maximum voiding pressure with increased residual volume, respectively[16].

Prostate

Benign prostatic hyperplasia (BPH) is fundamentally a histologic diagnosis that refers to a non-malignant proliferative process of the cellular elements of the prostate. It usually begins as a simple micronodular hyperplasia with a subsequent macroscopic nodular enlargement that may result in BOO and the development of LUTS. As the prostate enlarges, it constricts the urethra, inducing various symptoms such as: weak urinary stream, incomplete bladder emptying, nocturia, dysuria, and BOO[17]. Although LUTS are associated with urinary flow and prostate size, there is substantial evidence that men can have symptoms even in the absence of BPH, enlarged prostate on physical examination, or abnormal urinary flow rates. This is partly because LUTS can be caused by multiple mechanisms, including prostate and bladder smooth muscle tone and contractility. Moreover, the prevalence of LUTS in women is not too dissimilar to that in men[18].

DISCUSSION

We analyze the different forms of urinary tract dysfunction in light of our proposed hypothesis of lower urinary tract motility[19].

Normal lower urinary tract motility – a hypothesis.

Based on the assumption that all peristaltic organs obey the same laws, we offer a hypothesis of the motor function of the lower urinary tract. In an empty bladder the pressure on its wall is equal to the intra-abdominal pressure (IAP). The accumulation of urine in the bladder occurs at a constant pressure – threshold pressure of the 1st order (TP-1), which is slightly higher than IAP. When urine volume reaches 300-400 ml (the main volume), the pressure in the bladder is increased to the threshold pressure of the 2nd order (TP-2), which causes relaxation of the internal urethral sphincter (IUS). Urine penetrating to the neck of bladder stimulates the urge to urinate. At this moment, retention of urine is provided by the contraction of the external urethral sphincter (EUS) and puborectalis muscle (PRM). If urination is not possible, the detrusor relaxes, adapting to the new volume and intravesical pressure decreases from TP-2 to TP-1, which leads to a reflex contraction of IUS and passive relaxation EUS and PRM. Inflow to the bladder of an additional urine volume again causes an increase in pressure to TP-2, following by relaxation of the IUS and contraction of the EUS and PRM. While the EUS and PRM contract, the IUS relaxes to recover its contractile capacity and vice versa. This ensures continued retention of urine. Urination begins with tension of the abdominal wall, which causes an increase in intra-abdominal pressure and an increase in pressure in the bladder from TP-2 to TP-3. All sphincters (IUS, EUS, and PRM) relax, and the urine under pressure flows through the opened urethra as the result of coordinated contraction of the bladder micromodules. The maximum volume of urine after a long delay can be up to 1 liter (including the main and reserve volume, which enters the bladder as the result of forced delay). In the event of a bladder overflow, the prostate plays a role in the retention of urine. When the volume in the bladder exceeds the main plus reserve volume, the arrival of a new portion of urine does not cause relaxation of the bladder; instead the bladder pressure rises to TP-3, which leads to the reflex contraction of the prostate.

Pathophysiology of lower urinary tract dysfunction. A hypothesis

Drake believes that the basic functional unit of the detrusor is a circumscribed area of muscle known as a module. In the right circumstances, each module can contract independently. Activity in neighbouring modules can be co-ordinated so that a large proportion of the bladder wall becomes synchronously active. In detrusor overactivity, the modules are abnormally active and closely co-ordinated[20]. In a further article, Drake and colleagues argue that in this "... impairs regulation of micromotility initiation and propagation, potentially allowing emergence of overactive bladder and, with progression, detrusor underactivity"[21]. This well-known phenomenon of the combination of decreasing detrusor contractility and bladder overactivity in the elderly does not have a convincing explanation. There is no apparent logic to the combination. If detrusor contractility declines with age, how could it lead to the bladder being overactive?

On the basis of clinical studies and animal models, age-related changes in bladder function have been found in both sexes. Time of onset of symptoms and their severity depends on genetic predisposition and risk factors (gender differences, atherosclerosis and oxidative stress)[22]. Age-related changes in the bladder wall are characterized by the presence of a myohypertrophy pattern, with or without superimposed degeneration, with an increased volume of connective tissue. This can explain overall weakness of the detrusor despite hypertrophy of the bladder wall. As a result of these changes the wall of the bladder loses its elasticity, i.e. becomes more rigid. This stops the bladder stretching and accommodating normal main and reserve volumes of urine, and causes the force of its contraction during urination to be significantly weakened. Age-related rigidity of the bladder helps explain the significant decrease in voided volume, decrease in bladder capacity and compliance, and decrease in voiding efficiency.

Despite the change in some parameters, we have assumed that all the basic laws of lower urinary tract motility in elderly patients remain the same as in controls. In healthy volunteers small-volume vesical distention effected no significant urethral or vesical pressure changes, while distention with 350 and 400 ml of saline produced elevated vesical pressure and decreased urethral pressure[23]. On our view, 350-400 ml of fluid exceeds the basic volume; as a result the bladder ceases to relax and the bladder pressure

rises from TP-1 to TP-2. In DO a urine volume of 100-150-250 ml (it is different in each case) causes a rise in bladder pressure, because after its introduction into the bladder the rigid wall is no longer able to relax and intravesical pressure rises from the TP-1 to TP-2. We therefore believe that age-related changes in the bladder wall, which are similar to the changes occurring in other tissues of the body, lead to rigidity of the wall and LUTD.

Bearing in mind the significance of tissue rigidity, and on the basis of our proposed hypothesis of normal physiology of the lower urinary tract, it is possible to explain all forms of LUTD.

"Detrusor overactivity"

The rigidity of the detrusor is caused by degeneration of muscle cells and axons and peripheral "patchy" denervation of micromodules. This chronic progressive process causes increased collagen deposition and decreased elasticity. As a result, there is a weakening of the contractions, and a discoordination of the contractions of different modules during voiding.

Storage symptoms: Since the main volume of the bladder is reduced to 150-200 ml, compared to 400 ml in normal bladders, with normal given daily volume of urine the *frequency of urination increases*. *Nocturia* differs from daytime urination only in that the intervals between voiding can be longer, since the subject waking depends on the depth of sleep. *Urgency* is a symptom of a more severe degree of rigidity of the bladder wall, when the reserve volume of the bladder approaches zero. In such cases, after raising the intravesical pressure from TP-1 to TP-2, the pressure rises rapidly to TP-3. This state easily changes into *urinary incontinence*, which also depends on changes in sphincter function.

Voiding symptoms: A *slow stream* is the result of weakening contractions and discoordination of the contractions of the different modules, which does not exclude the possibility of narrowing of the urethra. A rigid detrusor is not able to maintain the stability of intravesical pressure. When the pressure is reduced from TP-3 to TP-2 during urination, a reflex contraction of EUS arises. This natural, but not paradoxical contraction of EAS leads to the termination of urination. Gradually, the pressure rises to TR-3 and urination resumes - bringing *symptoms of intermittent stream*, hesitance and straining. A *terminal dribble* is the result of sphincter weakness. In this way, the symptoms of intermittent stream and detrusor sphincter dyssynergia are explained. Rigidity of the bladder therefore explains the pathogenesis of the symptoms of *post-void residual volume*.

We suggest that age-related changes in the bladder wall, which are similar to the changes occurring in other body tissues, lead to rigidity of that wall and hence to LUTD. Similar changes take place in the IUS, which is a thickened continuation of the bladder wall, as well as in the EUS and PRM. A rigid EUS relaxes during urination, but its inner lumen, i.e., urethral diameter, is not returned to normal. Narrowing of the urethral lumen causes resistance to urinary flow, which leads to increased intravesical pressure and a slow urinary stream. Rigidity in the EUS is manifested not only in partial relaxation of the urethra during voiding, but also by weak sphincter contraction during storage, which is the reason for dribbling.

Bladder outlet obstruction

The main and reserve volume gradually decrease due to rigidity of the detrusor. This means that the time between the first desire to void (TP-2) and urgency (TP-3) arising becomes shortened. Since intravesical pressure rises to TP-3 with smaller amounts of urine, it happens more frequently than normal, both at night and during the day. In men, every time the pressure rises to more than TP-3 (overflow), prostate contraction takes place to aid urinary retention. The prostate contracts more often not only at night, but also in the daytime. This frequent contraction of the prostate is the reason for its hypertrophy.

Thus, a vicious circle arises. Age-related changes lead to rigidity of the tissues and more frequent contraction of the prostate, which causes the development of prostatic hypertrophy and narrowing of the urethral lumen. This causes an increase in intravesical pressure, hypertrophy and rigidity of the bladder wall.

The pathogenesis of BOO differs from the pathogenesis of DO only in its greater degree of urethral obstruction, which leads to a decreased maximum flow rate, an increase in detrusor pressure at maximum flow, and an increased urethral resistance factor. It is accompanied by radiographic evidence of prostatic obstruction in men, and increased post-void residual urine in women.

Detrusor underactivity

Our assumption is that DU is the result of the stretching of the bladder by the large volume of urine during acute urinary retention. This condition can be compared with a balloon which deflates after having been inflated. As a result of losing its elasticity, the balloon does not return to its former state. In the rigid wall of the detrusor, the separated muscle cells are replaced by fibrous tissue, and the distance between weakened micromodules dramatically increases. The detrusor becomes so weakened that it cannot generate the pressure needed for the removal of quantities of urine below a certain threshold. At this volume the pressure in the bladder is equal to IAP. It begins to contract only after the inflow of an additional amount of urine, when the intravesical pressure rises from IAP to TP-1. After partial emptying, when the bladder pressure is lowered again to IAP, urination ceases and the same volume of urine is left in the bladder at low pressure. Our hypothesis is consistent with the hypothesis of Chancellor that the underactive bladder is a result of the progression of an overactive bladder[28].

CONCLUSION

The proposed hypothesis of motor function of the lower urinary tract in conjunction with the concept of age related rigidity of detrusor and urethral sphincters allows us to view the pathogenesis of various impairments of urination as a single process. This makes it possible to explain all the symptoms of LUTD. This hypothesis needs to be further tested.

DISCLOSURES

I am the only author of this theoretical work. I did not receive any support while working on it. The ideas of this work were not published before, and this article was not sent to other journals.

REFERENCES

1. Abrams P, Cardozo L, Fall M et al. The standardisation of terminology in lower urinary tract function: report from the standardisation sub-committee of the International Continence Society. Urology. 2003 Jan; 61 (1): 37-49.
2. Abrams P, Cardozo L, Fall M et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. Neurourol Urodyn. 2002; 21 (2): 167-178.

3. Speakman MJ, Cheng X. Management of the complications of BPH/BOO. Indian J Urol. 2014; 30 (2): 208-213.
4. Zimmern P, Litman HJ, Nager CW et al. Effect of aging on storage and voiding function in women with stress predominant urinary incontinence. J Urol. 2014; 192 (2): 464-468.
5. Elbadawi A, Hailemariam S, Yalla SV, Resnick NM. Structural basis of geriatric voiding dysfunction. VII. Prospective ultrastructural/urodynamic evaluation of its natural evolution. J Urol. 1997 May; 157 (5): 1814-22.
6. Gosling JA, Dixon JS. Structure of trabeculated detrusor smooth muscle in cases of prostatic hypertrophy. Urol Int. 1980; 35 (5): 351-5.
7. Galosi AB, Mazzaferro D, Lacetera V et al. Modifications of the bladder wall (organ damage) in patients with bladder outlet obstruction: ultrasound parameters. Arch Ital Urol Androl. 2012; 84 (4): 263-267.
8. Serati M, Salvatore S, Cattoni E et al. Ultrasound measurement of bladder wall thickness in different forms of detrusor overactivity. Int Urogynecol J. 2010 Nov; 21 (11): 1405-11. doi: 10.1007/s00192-010-1194-1. Epub 2010 Jun 10.
9. Rachaneni S, Balogun M, Latthe P. Bladder-wall-thickness ultrasound scan in the investigation of LUTS in women: challenges and limitations. Int Urogynecol J. 2013; 24 (5) 725-728.
10. Drake MJ, Kanai A, Bijos DA et al. The potential role of unregulated autonomous bladder micromotions in urinary storage and voiding dysfunction; overactive bladder and detrusor underactivity. BJU Int. 2016 Jul 22. doi: 10.1111/bju.13598. [Epub ahead of print] Review.
11. Basu M, Postlethwaite C, Cheema K, Duckett J. The effect of age on pressure flow parameters in women with lower urinary tract symptoms. J Obstet Gynaecol. 2013 Nov; 33 (8): 873-6. doi: 10.3109/01443615.2013.820265.
12. Elbadawi A, Yalla SV, Resnick NM. Structural basis of geriatric voiding dysfunction. II. Aging detrusor: normal versus impaired contractility. J Urol. 1993 Nov; 150 (5 Pt 2): 1657-67.
13. Lowalekar SK, Cristofaro V, Radisavljevic ZM et al. Loss of bladder smooth muscle caveolae in the aging bladder. Neurourol Urodyn. 2012 Apr; 31 (4): 586-92. doi: 10.1002/nau.21217. Epub 2012 Feb 28.
14. Nordling J. The aging bladder – a significant but underestimated role in the development of lower urinary tract symptoms. Exp Gerontol. 2002 Aug-Sep; 37 (8-9): 991-9.
15. Beltrame F, Ferreira FT, Lorenzetti F et al. Bladder function in obstructed men - does age matter? Aging Male. 2015; 18 (3): 143-8. doi:10.3109/13685538.2015.1025377. Epub 2015 May 22.
16. Mori K, Noguchi M, Tobu S et al. Age - related changes in bladder function with altered angiotensin II receptor mechanisms in rats. Neurourol Urodyn. 2016 Nov; 35 (8): 908-913. doi: 10.1002/nau.22849. Epub 2015 Aug 7.]
17. Eleazu C, Eleazu K, Kalu W. Management of Benign Prostatic Hyperplasia: Could Dietary Polyphenols Be an Alternative to Existing Therapies? Front Pharmacol. 2017 Apr 28;8:234. doi: 10.3389/fphar.2017.00234. eCollection 2017.
18. Hollingsworth JM, Wilt TJ. Lower urinary tract symptoms in men. BMJ. 2014 Aug 14;349:g4474. doi: 10.1136/bmj.g4474. Review.
19. Levin MD. Normal lower urinary tract motility. Hypothesis. Pelviperineology. 2017. June; 36 (2): 37-40.
20. Drake MJ. The integrative physiology of the bladder. Ann R Coll Surg Engl. 2007 Sep; 89 (6): 580-5. doi: 10.1308/003588407X205585.
21. Drake MJ, Williams J, Bijos DA. Voiding dysfunction due to detrusor underactivity: an overview. Nat Rev Urol. 2014; (11): 454-464.
22. Kullmann FA, Birder LA, Andersson KE. Translational Research and Functional Changes in Voiding Function in Older Adults. lin Geriatr Med. 2015 Nov; 31 (4): 535-48. doi: 10.1016/j.cger.2015.06.001. Epub 2015 Jul 23.]
23. Shafik A, Shafik AA, El-Sibai O, Ahmed I. Effect of vesical contraction on the non-sphincteric part of the urethra: recognition of vesicourethral inhibitory reflex. Int J Urol. 2004 Apr; 11 (4): 213-7.

Correspondence to:

Michael Levin
Amnon veTavar 1/2 - Netanya 42202 - Israel
E-mail: nivel70@hotmail.com

Original article

Evolution of the TOT OUT/IN technique: retropubic TOT. Morbidity and 5-year functional outcomes

VINCENT BARBIER[1], CÉLINE DUPERRON[2], EMMANUEL DELORME[3]

[1,2] *Centre Hospitalier Universitaire François Mitterand, Service Urologie, Dijon, France*
[3] *Hopital Privé Sainte Marie, Service Urologie, Chalon-sur-Saône, France*

Abstract: Objectives: To describe the retropubic transobturator tape (TOTRP) technique for treating female stress urinary incontinence (SUI). To evaluate morbidity and 5-year functional outcomes. *Materials and methods:* A single-centre, observational, retrospective, single-surgeon study was carried out. The patients included had a TOTRP placed between 2009 and 2012. The originality of the technique is the horizontal transobturator and non-oblique route of the ancillary. The perioperative characteristics were recorded. The functional outcomes were evaluated pre-surgery and between March and April 2016 using the Urinary Symptom Profile (USP) questionnaire. *Results:* 88 patients were evaluated after 5 years. The lost-to-follow-up rate was 7.4%. No perioperative complications were found. There was no tape erosion, no pain over the 5 years. The SUI was improved in 92% of the cases and cured in 72.7% of cases. The de novo overactive bladder (OAB) rate was 15.9%. In patients presenting with pre-operative mixed UI, the SUI was improved in 100% of cases and cured in 63.6% of cases. The OAB was improved in 45.5% of cases. *Conclusion:* The TOTRP is associated with an absence of perioperative morbidity and no erosion in the long term. The TOTRP technique gives functional outcomes after 5 years that are similar to the data in the literature for the conventional TOT technique, whilst reducing morbidity.

Keywords: Functional Outcomes; Morbidity; Questionnaire Urinary Symptom Profile symptom; Retropubic TOT; Stress urinary incontinence.

INTRODUCTION

Mid-urethral sling implantation is the reference technique in female SUI surgery. It was Ulmsten that described the tension-free mid-urethral sling technique via the retropubic route (RPT) 1996[1]. The medium-term outcomes have demonstrated its efficacy[2]. According to the work done by Petros, the tape should be positioned under the middle third of the urethra away from the bladder neck[3]. We descried a variant of TVT, the TOT in 2001[4]. Since 2004, with the aim of reducing complications (perioperative perforation of organs, subsequent visceral tape erosion) and improving functional outcomes, we modified the technique to describe the TOTRP or horizontal TOT.

The aim of our study was to describe the surgical technique for implanting a TOTRP to treat female SUI and to evaluate the morbidity and 5-year functional outcomes.

MATERIALS AND METHODS

This observational retrospective study included patients who had undergone SUI surgery involving the implantation of a hypoelastic retropubic transobturator tape, Cyrene (Abiss, Saint-Etienne, France) between January 2009 and December 2012. Patients who had already undergone surgery for SUI or for pelvic floor dysfunction were excluded from the study.

Before the operation, the patients were comprehensively interviewed and the main characteristics compiled (age, body mass index, obstetric status, exposure to tobacco, diabetes, chronic constipation, hysterectomy). Bladder symptoms were evaluated using Urinary Symptom Profile (USP) scoring. This questionnaire was described by Haab F et al. [5] apice in 2007 and has been validated by the *Association Française d'Urologie* (AFU). Comorbidities were evaluated with the Charlson score. Each patient underwent an in-depth clinical examination as well as urodynamic testing.

IRB approval has not been considered necessary as the TOTRP is only a modification from the original TOT and not a new surgery procedure. Furthermore, all surgeries have been carried out by the same surgeon who performed the original TOT. He currently keeps on using this approach.

Surgical technique:

Two Allis clamps on each side of the urethral meatus expose the vaginal wall behind the urethra widely. The beginning of the incision is 5 mm from the meatus. It is a sagittal retro-urethral incision through the full thickness of the vaginal wall and must be wide enough to enable the insertion of a finger. The lateral dissection from the urethra must be between the fascia and the urethra, never between the fascia and the mucosa, because that increases the risk of vaginal erosion by the tape. The dissection stops before opening the perineal membrane, because the needle passing through the perineal membrane will act as a pulley directing the tape to the middle third of the urethra.

A punctiform cutaneous incision is made at the horizontal level between the urethral meatus and the clitoris, exactly against the external edge of the bone in the corner between the pubic bone and the ischiopubic ramus where the bone is narrowest. A straight needle is usually used, but it is possible to use a helical needle. The needle course is obtained by aiming for the urethral meatus with the tunnelling device. A finger is inserted as a sentinel inside the incision, lateral to the urethra. But the finger is right behind the pubic bone and higher we can avoid damaging the perineal membrane. The ball of the index finger in the vaginal incision is used to push the urethra back upwards and inwards, protecting it from the needle.

The horizontal course of the tunnelling device is in three steps:

- First step: strong contact with the ischiopubic ramus and follow the bone from inside to out.
- Second step: when the needle leaves the bone, immediately turn behind the bone and get a frank contact with the finger which is behind the pubic bone and not laterally under the ischiopubic bone branch. The blind needle passage is very short between the needle leaving the bone and coming into contact with the finger. This blind passage crosses the obturator muscles.
- Third step: the needle is pushed through the perineal membrane and it is driven by the finger inside the vaginal incision. The needle perforates the perineal membrane lateral to the urethra in the acute angle between the ischiopubic ramus and the urethra, close the meatus to come up against the middle third of the urethra.

The aim of this movement is to trace a perineal trajectory with the surgical instrument whilst remaining below the superior fascia of the Levator Ani muscle and to drive the device lateral to the middle third of the urethra. Once complete, it is advisable to look and check that the vagina has not been pierced by the tunnelling device. The tip of the tape is fixed to the tip of the needle and then drawn into place. Adjustment of the tape behind the urethra is difficult. The adjustment technique depends on the elasticity of the tape. There is no easily reproducible technique to propose. The only advice that we can give is to always use the same kind of tape.

With a low-elasticity tape with a strong grip, such as CYRENE®, a visible space must be left between the tape and urethra. The technique to adjust CYRENE is very reproductive. The right angle forceps makes a plication of the middle of the tape and there is an urethral catheter 16 french. The arms of the tape are pull strongly. When the tape is against the urethra, the forceps is remove and the adjustment of the tape is fit. At the beginning of this series we did not do this technique of adjustment that explain the voiding dysfunction we had.

With a high-elasticity tape, the tape must rest against the urethra with no pressure. The excess tape outside the skin is cut off. The vaginal incision is closed with a few simple absorbable sutures. The obturator incisions do not need to be sutured, but care should be taken to separate the skin from the tape. The anatomical and surgical study confirms that the horizontality of the transobturator route of the needle participates in the positioning of the needle in the perineal space between the levator muscle and the perineal membrane, corresponding to the middle 1/3 of the urethra (Figure 1).

The perioperative complications and immediate post-operative complications during the hospital stay were analysed. Later complications were recorded: recurrent urinary infections, overactive bladder (OAB) and how they were treated, erosion-type complications, repeat operations, the appearance of chronic pelvic and perineal pain. The patients were contacted between March and April 2016. They were given the USP questionnaire to complete to evaluate the long-term functional outcomes. The results of the USP questionnaire done after the surgery were compared to those of the questionnaire done prior to surgery. To describe as precisely as possible the intensity of the symptoms, the patients were divided into three groups according to their SUI, OAB and dysuria scores. SUI was defined as mild if the score was below 3, moderate if the score was between 4 and 6 inclusive and, finally, severe for a score between 7 and 9. Post-surgery, SUI was considered as cured if the score was 0 or 1. OAB was defined as mild if the score was below 7, moderate if the score was between 8 and 14 inclusive and, finally, severe for a score between 15 and 21. Dysuria was defined as mild if the score was below 3, moderate if the score was between 4 and 6 inclusive and, finally, severe for a score between 7 and 9. The values for the quantitative variables were expressed as mean +/-standard deviation. The values for the qualitative

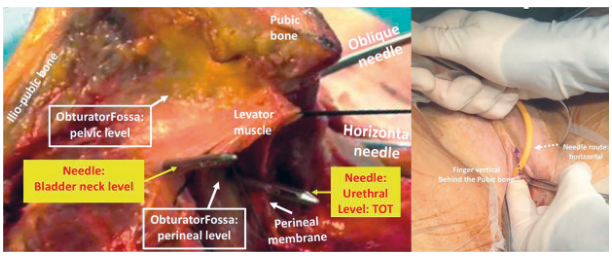


Figure 1. – Anatomic study. Needles routes Retropubic TOT and Oblique TOT.

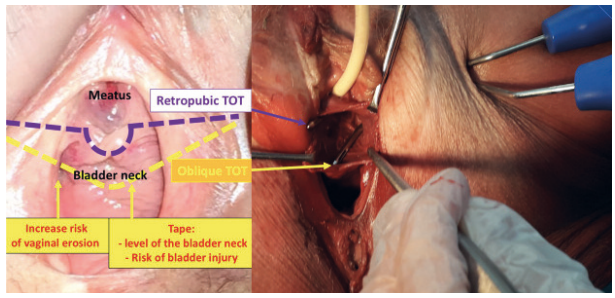


Figure 2. – Anatomic study . The positioning of the tape.

variables were expressed as a number of patients per group, frequency (%). Difference between score before surgery and 5 years after surgery were assessed using chi2 Mantel Haenszel's test for categorical variables. All statistical analysis were performed with SAS version 9.4.The significance was evaluated by calculating value p. A result was judged significant if $p \leq 0.05$.

RESULTS

95 patients were implanted with the TOTRP to treat SUI between 2009 and 2012. They had never been operated on before for urinary incontinence or pelvic floor dysfunction. Out of 95 questionnaires sent out to patients between March and April 2016, 70 were completed by hand. 18 patients were re-contacted by telephone and the questionnaire was then completed orally. 7 patients could not be contacted. 88 patients were therefore included in our study. The response rate was 92.6% and the lost-to- follow-up rate was 7.4%. The average duration of follow-up was 59 months. While filling in their applications forms, patients gave both written and oral agreements to participate to this study. This is notified in their medical history. The average age of our population was 54.7 years, with an average BMI of 27 kg/m2. 63.2% of the patients had a BMI of ≥ 25, including 3 patients with morbid obesity. Regarding their obstetric history, the women had had on average 2 vaginal deliveries, 9 were nulliparous. Only 12.6% of our patients had been exposed to tobacco. 8.4% of the patients suffered from diabetes. 12 patients, or 13.6% had undergone a hysterectomy, 8 for benign causes (uterine fibroid, endometriosis) and 4 due to endometrial cancer. 33 patients, or 37.5% of the sample had chronic constipation. Significant rachialgia was found in 36 patients, or 40.9% of the sample. Most of the patients (75.8% of the sample) had a low score on the Charlson comorbidity index, between 0 and 2 inclusive. On clinical examination, the patients all presented SUI with jet leakage on coughing corrected by urethral support manoeuvres. All the patients had cervico- urethral hypermobility, none had an immobile urethra. The urodynamic test results were not prejudicial to operating in any of the patients. None of the patients had a dysuric curve in the uroflow test with a maximum flow rate on average of 30 ml/s. None of the patients had significant posit-void residual urine. There were no cases of sphincter deficiency. The average maximum urethral closure pressure was 68cmH20. Finally, all the patients had normal bladder compliance. There were no perioperative complications (organ perforation, haemorrhaging). Six patients (6.8% of the sample) had immediate post-operative dysuria with post-void residual urine of over 80 cc on 2 occasions. They were successfully treated by surgical loosening of the tape between D3 and D6. No tape erosion was found in our series post- surgery. Four patients (4.5% of the sample) had recurrent lower urinary tract infections in the 5 years following surgery. 12 patients were given anticholinergenic drugs (AC) for overactive bladder in the first two years

TABLE 1. Distribution of patients according to intensity of pre-operative and long-term post-operative SUI, OAB and dysuria.

score	pre-operative n (%)	post-operative n (%)	P value
SUI			< 0.0001*
mild	0 to 3	0 (0)	73 (83)
moderate	4 to 6	40 (45.5)	11 (12.5)
severe	7 to 9	48 (54.5)	4 (4.5)
OAB			0.0328*
mild	0 to 7	77 (87.5)	67 (76.1)
moderate	8 to 14	11 (12.5)	19 (21.6)
severe	15 to 21	0 (0)	2 (2.3)
Dysuria			0.7763*
mild	0 to 3	83 (94.3)	83 (94.3)
moderate	4 to 6	5 (5.7)	4 (4.5)
severe	7 to 9	0 (0)	1 (1.2)

* Mantel-Heanszel Chi2 test

after surgery. Among these 12 patients, due to OAB refractory to AC treatment, two patients underwent surgery (Botulinum toxin injection and sacral neuromodulation). Only one patient was still taking an AC at the time of the final evaluation. In most cases, the AC was stopped in the year after its introduction. 3 patients did not see an improvement in the SUI by the operation in the immediate post-operative period. They benefited from a successful surgical plication of the tape within two years of the initial operation. None of the 88 patients had chronic pelvic and perineal pain immediately after the operation or in the longer term. The patients were divided into 3 groups according to the intensity of their SUI as defined by the score calculated using the USP questionnaire pre-surgery and post- surgery (Table 1).

Pre-surgery, 40 patients had moderate SUI, 48 had severe SUI. 5 years after surgery, 73 patients had mild SUI or it was cured, 11 had moderate SUI and 4 had severe SUI. The distribution of the patients in the different subgroups between pre- operative status and post-operative status was significantly different (p<0.0001). The patients were considered as having improved when they were in a lower intensity SUI group after surgery, namely 81 patients. The improvement rate for SUI after 5 years was therefore 92%. Four patients (4.5% of the sample) were in the same group post-surgery and were considered as not having improved. Three patients (3.5% of the sample) were in a group with a higher score post-surgery and had therefore suffered either a recurrence or a worsening of the SUI after 5 years. The patients were considered as cured and continent when they had an SUI score between 0 and 1 inclusive. 50 patients had a score of 0, 14 a score of 1. The cure and continence rate for our series was therefore 72.7% after 5 years. The patients were also divided into 3 groups according to the intensity of their OAB as defined by the score calculated using the USP questionnaire pre-surgery and post-surgery (Table 1).

The pre-operative OAB rate (moderate OAB or severe OAB) was 12.5% and therefore concerned 11 patients. Post-surgery, 19 patients had moderate OAB, two had severe OAB. The post-operative rate was therefore 23.9%. Among these 21 patients, 14 patients had non-significant mild pre-operative OAB. They therefore presented de novo OAB at 5 years, that is 15.9% of our sample. The distribution of the patients in the different subgroups between pre-operative status and post-operative status was not significantly different (p=0.033). The dysuria scores calculated from the USP questionnaires completed pre-surgery and at long-term follow-up after surgery are presented in Table 1. Of the 5 patients who had moderate or severe dysuria post-surgery, 3 did not present pre-operative dysuria. One patient presented de novo dysuria associated with early recurrence of SUI. One patient presented de novo dysuria associated with de novo moderate OAB. One patient presented de novo dysuria associated with de novo severe OAB refractory to anticholinergenic treatment. The distribution of the patients in the different subgroups between pre-operative status and post-operative status was not significantly different (p=0.78). 11 patients in our series had mixed urinary incontinence pre-surgery. 63.6% of them were cured of the SUI, and 100% were improved. The OAB was cured in 45.5% of cases, unchanged in 45.5% of cases, and worse in 9% of cases. Thus, the treatment of mixed UI by implanting a tape was very effective in correcting the SUI and moderately effective in correcting OAB.

TABLE 2. Studies evaluating long-term outcomes with TOTs.

Authors	n	Lost to follow-up (%)	Follow-up (years)	Continence (%)	Improvement satisfaction (%)	Exposure (%)	De novo OAB (%)	Revision surgery for recurrence (%)
Abdel-Fattah et al. (6)	341	30	3	73,1	NC	1,8	NC	6
Rajendra et al. (7)	419	55	3	NC	89,7	2,4	NC	NC
Schierlitz et al. (8)	164	10	3	NC	NC	NC	NC	20
Lienhart et al. (9)	331	24	7	72	80	0,3	27	0,9
Our study	88	7,4	5	72,7	92	0	15,9	3,4

DISCUSSION

Compared to the main series in the literature dealing with the long-term outcomes of TOT (Table 2), our sample was smaller[6,7,8,9]. Our study was carried out in a single centre by a single surgeon with strict inclusion rules. However, the lost- to-follow-up rate was much lower (7.4%) than in the studies previously mentioned and others[2,10,11], which gives the study more force. The main reasons why patients did not respond to the contact by letter were a lack of time, forgetfulness and a questionnaire deemed too complicated to complete. The average follow-up time in our study was 5 years. The cure rate in our series was 72.7%, which is in line with the average in the literature[6,9]. The subjective success/improvement rate found in the published studies on the transobturator route is between 64 and 73% inclusive[6,12]. A recent study by Karmakar et al[13] evaluated the functional outcomes over a period of 9 years. Their study concerned a series of 341 patients divided into 2 groups, "inside/out" (TVT- 0) and "outside-in" (TOT). The response rate was low at 67.8%. Success was evaluated at 80% after 1 year with no significant difference between the 2 groups. At 3-year follow-up continence was 73.1%, at 9 years 71.6%. The rate of surgical revision in their study was 7.9%. The erosion rate was 4.5%. In our series, the de novo OAB rate was 15.9%. We find de novo OAB rates in the literature of between 9 and 27% inclusive[9,11,13,14].

The rate of surgical revision for recurrence of SUI in our series was 3.4%. In fact 3 patients underwent successful plication of the tape some time after the operation. In the literature, after an average follow-up period of 5 years, the outcomes are quite conflicting, with revision rates between 0.9 and 14% inclusive[6,9,11,15]. Six patients presented post-operative dysuria which required early surgical revision to loosen the tape. This rate is higher than in the literature. However, our effectiveness criteria on the return of micturition were demanding. Indeed, if PVR was greater than 80 cc on 2 occasions on D1 then this was taken as an indication to loosen the tape. The cause of this

initial dysuria may be secondary to the TOTRP technique, to an excessive surgical adjustment or to the characteristics of the MUS (low elasticity and good grip of the tape in the tissues). The early loosening of the tape performed in our series successfully treated the dysuria in all cases without altering the outcome on continence. It seems to us that the best treatment for post-operative dysuria is prevention.

This requires pre- operative detection of inadequately contractile bladders and perfect adjustment of the tape during the operation. This adjustment depends on the type of tape used, mainly its elasticity. The usual treatment for post-operative dysuria in patients not known to be dysuric before the operation is the sectioning of the tape[16]. Loosening seems to be more effective if it is done early[17]. During the operation no patients had complications such as haemorrhaging, perforation of the urethra, bladder, vagina. We had no visceral complications (bladder, urethral, vaginal erosion) in our series. Furthermore, an earlier study also evaluating TOTRP with 185 patients followed up after 3 years did not report any vaginal or visceral erosion[18]. In the literature, the long-term erosion rate is between 2 and 6% inclusive[7,9]. The particularity of the TOTRP technique was the initial route of the tape, horizontal whereas in the original technique, the route was initially oblique. With the TOTRP technique, keeping the tape under the middle 1/3 of the urethra, limiting the risk of slipping down towards the bladder neck, is achieved by two technical tricks:

• The horizontal route of the needle, which crosses the obturator muscles horizontally, corresponding to the middle 1/3 of the urethra.

• The needle going through the perineal membrane in the angle between the urethral meatus and the ischiopubic ramus.

The positioning of the tape at the right level in relation to the urethra seems to be decisive in limiting functional disorders (persistent incontinence, chronic pain) and reducing the risk of perforating the bladder or the urethra. The anatomical study confirms our clinical outcomes (figure 2). On the one hand the sling straps are retro- and subpubic, and therefore do not cross the latero-urethral vaginal fornices; there is therefore no risk of lateral vaginal erosion. Precise dissection in the plane between fascia and urethra allows a fascia-mucosa suture of the vaginal incision, reducing the risk of median vaginal erosion.

CONCLUSION

The TOTRP is associated with an absence of perioperative morbidity (urethral, bladder, vaginal perforation) and no risk of erosion in the long term. After 5 years' follow-up, SUI was improved in 92% of the women. 72.7% of the patients were continent 5 years on. De novo OAB concerned 15.9% of the patients at 5-year follow-up. The TOTRP technique therefore leads to lower morbidity and functional outcomes that are identical to the conventional TOT OUT/IN technique. Our results will need to be confirmed by larger multi-surgeon series.

DISCLOSURE STATEMENTS

We obtained oral and written informed patient consents (notified in the medical file). Doctor Delorme is an expert for the Abiss company.

REFERENCES

1. Ulmsten U, Henriksson L, Johnson P, Varhos G. An ambulatory surgical procedure under local anesthesia for treatment of female urinary incontinence. Int Urogynecol J, 1996; 7: 81-5.
2. Svenningsen R, Staff AC, Schiotz H, Western K, Kulseng-Hanssens. Long-term follow-up of tension-free vaginal-tape (TVT): an observational multicentre study from a national incontinence registry. Abstract 253, ICS 2012.
3. The Female Pelvic Floor. Function, dysfunction and management according to the Integral theory. Second Edition. Peter Petros. Springer Medizin Verlag Heidelberg 2007.
4. Delorme E. Transobturator urethral suspension : mini-invasive procedure in the treatment of stress urinary incontinence in women. Prog Urol 2001; 11: 1306-13.
5. Haab F, Richard F, Amarenco G, Coloby P, Arnould B, Benmedjahed K, Guillemin I, Grise P. Comprehensive Evaluation of Bladder and Urethral Dysfunction Symptoms: Develpment and Psychometric Validation of the Urinary Symptom Profile (USP) Questionnaire. Prog Urol 2008; 71, 4: 646-656.
6. Abdel-Fattah M, Mostafa A, Familusi A, Ramsay I, N'Dow J. Prospective randomised controlled trial of transobturator tapes in management of urodynamic stress incontinence in women: 3-year outcomes from the evaluation of transobturator tapes study. Eur Urol 2012; 62: 843-51.
7. Rajendra M, Han HC, Lee LC, Tseng L, Wong H. Retrospective study on tension-free vaginal tape obturator (TVT-O. Int Urogynecol J 2012; 23: 327-34.
8. Schierlitz L, Dwyer PL, Rosamilia A, Murray C, Thomas E, De Souza A, Hiscock R. Three year follow-up of tension-free vaginal tape compared with transobturator in women with stress urinary incontinence and intrinsinc sphincter deficiency. Obstet Gynecol 2012; 119: 321-7.
9. Lienhart J, Vautherin R, Grisard-Anaf M, Frobert J-L. Analyse à 7 ans d'une série de 331 bandelettes I-Stop trans-obturatrices implantées pour traitement de l'incontinence urinaire d'effort de la femme. Progrès en urologie (2014) 24, 750-756.
10. Nilsson CG, Palva K, Rezapour M, Falconer C. Eleven years prospective follow-up of the TVT procedure for the treatment of stress urinary incontinence. Int Urogynecol J 2008; 19: 1043-7.
11. Groutz A, Rosen G, Cohen A, Gold R, Lessing J, Gordon D. Ten-year subjective results of the retropubic tension-free vaginal tape for treatment of stress urinary incontinence. J Minim Invasive Gynecol 2011; 18 (6): 726-9.
12. Narang S, Han HC, Lee LC, Wong HF. 5 years outcome of mid-urethral slings TVT vs TVT-O: a retrospective comparative study. Int Urogynecol J 2012; 23 (suppl. 2): S43-244.
13. Karmakar D, Mostafa A, Abdel-Fattah M. Long term outcomes of transobturator tapes in women with stress urinay incontinence: E-TOT randomised controlled trial. BJOG 2017; 124 (6): 973-981.
14. Serati M, Ghezzi F, Cattoni E, Braga A, Siesto G, Torella M et al. Tension-free vaginal tape for the treatment of urodynamic stress incontinence: efficacy and adverse effects at 10-year follow-up. Eur Urol 2012; 61: 939-46.
15. Angioli R, Plotti F, Muzii L, Montera R, Panici PB, Zullo M. Tension-free vaginal tape versus transobturator suburethral tape: five year follow-up results of a prospective, randomised tiral. Eur Urol 2010; 58: 671-7.
16. Game X, Soulie M, Malavaud B, Seguin P, Vazzoler N, Sarramon JP et al. Treatment of bladder outlet obstruction secondary to suburethral tape by section of the tape. Prog Urol 2006; 16: 67-71.
17. Long CY, Lo TS, Liu CM, Hsu SC, Chang Y, Tsai EM. Lateral excision of tension-free vaginal tape for the treatment of iatrogenic urethral obstruction. Obstet Gynecol 2004; 104: 1270-4.
18. Castaings T, Abello N, Delorme E. Prospective study on 185 females with urinary incontinence treated by an outside-in transobturator suburethral sling. Pelviperineology 2012; 31: 18-23.

Correspondence to:

Vincent Barbier
14 rue Gaffarel - Dijon 21079 Bourgogne - France
vincent.barbier@chu-dijon.fr vincebarberr@yahoo.fr

Céline Duperron celine.duperron@chu-dijon.fr,
Emmanuel Delorme delormee_2000@yahoo.fr

Original article

Validation of the patient global impression of improvement questionnaire to the Hebrew language

HENRY H. CHILL, MICHAL OLEK, RANI HAJ YAHYA, GILAD KARAVANI, DAVID SHVEIKY

Department of Obstetrics and Gynecology, Hadassah Medical Center, Ein-Kerem, Jerusalem, Israel

Abstract: *Objectives:* Validated objective tools play an important role in the evaluation of patients suffering from pelvic organ prolapse and in assessing surgical outcome. The aim of this study was to validate the Hebrew version of the Patient Global Impression of Improvement (PGI-I) questionnaire. *Methods*: A retrospective cohort study including all patients who underwent transvaginal hysterectomy and two-stitch utero-sacral ligament suspension (USLS) between October 2010 and September 2013. For the validation process a back translation method was used. A Hebrew version of the PGI-I questionnaire was created. Both Hebrew and English versions were used in a group of bilingual patients for validity. The test-retest method was then used for internal validity. *Results*: Sixty-six patients had undergone transvaginal hysterectomy and utero-sacral ligament suspension in the study period. Fifty nine of them completed the PGI-I questionnaire. A total of 22 bilingual patients participated in the validation process. The Hebrew version of the PGI-I questionnaire was found to be highly correlated with the English version with 100% correlation between the Hebrew and the English PGI-I answers. The test-retest measure in the validation process yielded a spearman correlation coefficient of 0.84 ($P<0.0001$) between the first Hebrew PGI-I, and the second Hebrew PGI-I, as answered two weeks later or more. *Conclusions:* Transvaginal hysterectomy and two-stitch uterosacral ligament suspension has high short term cure and patient satisfaction rates. The PGI-I questionnaire, now validated to Hebrew is a powerful tool to evaluate patient satisfaction.

Keywords: Pelvic organ prolapse (POP); Urogynecology; Pelvic medicine and reconstructive surgery; Patient global impression of improvement questionnaire; Vaginal hysterectomy.

INTRODUCTION

Assessment of surgical outcomes comprises of both objective and subjective measures. While the objective measures are usually clear postoperative outcomes, assessment of subjective improvement and patient satisfaction may sometimes be difficult to define.

Pelvic organ prolapse (POP) affects up to 50% of women in the United States and varies widely among different ethnic populations around the world, with ranges from 30% to 93%[1-3]. These numbers are expected to rise as population ages[4]. The assessment of patients presenting with POP includes a thorough medical history, physical exam as well as additional tests as indicated. Objective as well as subjective measures are imperative in order to give an accurate evaluation of patients' clinical status. Over the years, symptoms and quality of life (QOL) questionnaires have been developed and have become an essential part of symptom assessment as well as a measure of patients' response to treatment. For these questionnaires to be valid, patients answering them must understand the questions asked and need be able to comprehend the concepts presented. Comparison of populations around the world is only possible with proper translation and validation of such questionnaires into the native language of the population being treated.

The Patient Global Impression of Improvement (PGI-I) questionnaire is an important tool used to evaluate patients who undergo treatment for stress urinary incontinence[5]. It is a transition scale that is a single question asking the patient to rate their urinary tract condition now, as compared with how it was prior to beginning treatment on a scale from 1= Very much better, to 7= Very much worse. It is a simple, direct, easy to use scale that is intuitively understandable to patients and clinicians[5]. Although originally designed for women with stress urinary incontinence, it has widely been used in the evaluation of patients' satisfaction following POP repair and was recently validated in this population[6-8].

The aim of this study was to validate the PGI-I questionnaire in the Hebrew language in a population of patients who underwent trans-vaginal hysterectomy (TVH) with utero-sacral ligament suspension (USLS) for POP.

MATERIALS AND METHODS

This is a prospective study following a 2 step protocol of translation. Included were patients over the age of 21, fluent in both English and Hebrew who underwent TVH and USLS between October 2010 and September 2013 at the division of Female Pelvic Medicine and Reconstructive Surgery at Hadassah Medical Center, Ein Kerem, Jerusalem, Israel. The study was approved by the Institutional Review Board.

Patients were presented with the PGI-I questionnaire, at least three months after surgery, either in the clinic or by a telephone interview. Women, who were both Hebrew and English speakers, were questioned a second time, two weeks at least after the first PGI-I, by mail, for validation purposes alone.

An English version of the PGI-I questionnaire was translated into Hebrew by the back-translation method. This process comprised translation from English to Hebrew, back translation of the Hebrew version to English, and comparison of the English back-translated version with the original English version. The translation process was performed by different translators who were fluent in both English and Hebrew medical terminology. The back translation was compared with the original English version by experts in Urogynecology who are fluent in both English and Hebrew to ensure that no meaning or concepts were lost during the translation process.

After signing an informed consent, each participant was asked to answer the questionnaire in English and in Hebrew. To avoid an order-effect bias, the order of delivery of the 2 versions was determined randomly for each patient. To evaluate the reliability of the questionnaire, the test-retest technique was used.

A pre-stamped envelope with another questionnaire was given to each participant of the validation process. Participants were asked to fill out the PGI-I questionnaire again, in an interval of at least two weeks.

For statistical analysis SPSS version 18 (Chicago, IL) was used. P value of 0.05 or less was considered statistically significant. All tests were two-tailed, establishing a relationship between the variables, but without reference to directionality. The Spearman correlation test was used to assess agreement between the English and translated Hebrew version.

TABLE 1. Patient demographics and baseline characteristics.

N=22	Value
Mean Age (±SD)	71.31 (±8.68)
Parity (Mean (range))	3.41 (1-9)
Menopausal (%)	86.4
Sexually active (%)	59.1
Smoker (%)	9.1

RESULTS

Sixty six patients underwent TVH with USLS out of which 59 patients answered the PGI-I questionnaire. Of those, 22 were bilingual for both English and Hebrew, and 19 answered the Hebrew PGI-I a second time. Patients' demographic data are presented in table 1. Mean age was 71.3 years and median parity was 3.4 (range 0-9). Eighty six percent were menopausal and 59.1% were sexually active. All patients had undergone vaginal hysterectomy and two-stitch USLS.

At a median follow-up of 23.6 (2-155) weeks, nearly all POP-Q measures were significantly improved compared to preoperatively. Specifically, significant improvement was noted in the three most important points (Ba, C and Bp) with all differences being statistically significant. Anatomical cure, defined as no POP-Q point above stage 0-1, was 83.6%. Clinical cure rate was 96.4%. Most patients had concomitant procedures.

Ninety-six percent of patients stated that they felt much better or very much better postoperatively. The average time between surgery and the PGI-I questionnaire was approximately 517 days. Patients' satisfaction according to the PGI-I questionnaire are presented in table 2.

The Hebrew version of the PGI-I questionnaire was found to be highly correlated with the English version with 100% correlation between the Hebrew and the English PGI-I answers (n=22). The test-retest measure in the validation process yielded a spearman correlation coefficient of 0.84 ($P<0.0001$) between the first Hebrew PGI-I, and the second Hebrew PGI-I, as answered two weeks later or more (n=19).

DISCUSSION

In this study we present validation of the PGI-I questionnaire to the Hebrew language. Symptoms and quality of life questionnaires as well as evaluation of patient satisfaction are becoming an inseparable part of surgical outcome assessment. POP by nature is clinically important due to its detrimental effect on women's quality of life. Therefore, subjective assessment of treatment outcome is crucial in this case. Validation of assessment tools to the native language is imperative in order to guarantee the highest standard of medical care. The PGI-I questionnaire is highly accessible with its main advantage being its simplicity compared to other more cumbersome questionnaires. It gives a good indication to the patients' overall clinical status with one easy to answer question.

TABLE 2. Patient satisfaction according to PGI-I.

PGI-I frequencies n (%)	
Very much better	48 (81.4)
Much better	9 (15.2)
A little better	0 (0)
No change	1 (1.7)
A little worse	0 (0)
Much worse	0 (0)
Very much worse	1 (1.7)
PGI-I success defined as answers 1 or 2 n (%)	57 (96.6)

Our results showed very high correlation between the English and Hebrew versions of the questionnaire as well as test-retest reliability. The main strengths of the study include the standard validation method used as well as the long term follow up achieved. The latter is an important point since the PGI-I questionnaire was shown to be valid in the Hebrew language for long term follow up as well.

The main limitation of this study is recall bias. Moreover the patients in this study were assigned as their own control a fact which may increase the rate of similar answers given between the English and Hebrew versions. Our solution to this was randomization of the order in which the English and Hebrew versions were presented to the patients in the study. Another limitation is the fact that since most women expressed high satisfaction, variability of patients' answers was low. This may have had an effect on the validation process, though we believe this point does not undermine the results of the study.

In conclusion the PGI-I questionnaire is now validated to the Hebrew language. Using this tool, we have shown that two-stitch vaginal uterosacral ligament suspension is a POP repair procedure associated with high satisfaction rate. We believe this questionnaire may prove helpful to clinicians in evaluating this important aspect of patient-centered outcome.

DISCLOSURE STATEMENTS

There was no conflict of interest, informed patient consent was obtained, and the study was approved by the local ethical committee.

REFERENCES

1. Shull BL, Bachofen C, Coates KW, Kuehl TJ. A transvaginal approach to repair of apical and other associated sites of pelvic organ prolapse with uterosacral ligaments. Am J Obstet Gynecol 2000; 183 (6): 1365-1374.
2. Nygaard I, Barber MD, Burgio KL et al. Pelvic Floor Disorders Network (2008) Prevalence of symptomatic pelvic floor disorders in US women. JAMA; 300(11):1311-6.
3. Hendrix SL, Clark A, Nygaard I, Aragaki A, Barnabei V, McTiernan A. Pelvic organ prolapse in the Women's Health Initiative: gravity and gravidity. Am J Obstet Gynecol 2002; 186: 1160-6.
4. Eilber KS, Alperin M, Khan A et al. Outcomes of vaginal prolapse surgery among female medicare beneficiaries: the role of apical support. American college of obstetricians and gynecologists 2013; 122 (5): 981-987.
5. Yalcin I, Bump R. Validation of two global impression questionnaires for incontinence. Am J Obstet Gynecol 2003; 189: 98-101.
6. Lawndy SS, Kluivers KB, Milani AL, Withagen MI, Hendriks JC, Vierhout ME. Which factors determine subjective improvement following pelvic organ prolapse 1 year after surgery? Int Urogynecol J. 201; 22 (5): 543-9.
7. Srikrishna S, Robinson D, Cardozo L. A longitudinal study of patient and surgeon goal achievement 2 years after surgery following pelvic floor dysfunction surgery. BJOG. 2010; 117 (12): 1504-11.
8. Srikrishna S, Robinson D, Cardozo L. Validation of the Patient Global Impression of Improvement (PGI-I) for urogenital prolapse. Int Urogynecol J. 2010; 21 (5): 523-8.

Correspondence to:

Henry Chill - Hadassah Medical Center, Hebrew University - Jerusalem 91120 - Israel
E-mail: henchill@gmail.com

Articolo originale

A slow growing pelvic actinomyces related abscess in a premenopausal patient mimicking genito-urinary malignancy - Case report and literature review

KREININ ANDREY[1], YAEL YAGEL[2], ALLA KHASHPER[3], BOAZ SHEIZAF[1], DAVID YOHAY[1], ADI Y. WEINTRAUB[1]

[1] *Department of Obstetrics and Gynecology, Soroka University Medical Center, Faculty of Health sciences, Ben-Gurion University of the Negev, Beer Sheva, Israel.*
[2] *Infectious Disease Unit, Soroka University Medical Center, Faculty of Health sciences, Ben-Gurion University of the Negev, Beer Sheva, Israel.*
[3] *Department of Clinical Radiology, Soroka University Medical Center, Faculty of Health sciences, Ben-Gurion University of the Negev, Beer Sheva, Israel.*

Abstract: Actinomycosis in the pelvic region is an uncommon diagnosis. This infection in most cases is caused by Actinomyces israelii, a gram-positive anaerobic saprophyte bacterium, although other Actinomyces pathogens have also been reported. This bacterium is a normal inhabitant of the upper intestinal and genital tracts in humans. Pelvic actinomycosis is difficult to diagnose, and in many cases the preliminary suspicion is of a neoplastic process in the pelvic organs, as this infection may mimic pelvic and abdominal malignancies. We report a rare case of a 52-year-old female patient with a fixed pelvic mass within the vesico-vaginal fascia, located between the urinary bladder, uterine cervix and anterior vaginal wall. The diagnosis and treatment of pelvic actinomyces related inflammatory disease are discussed in this report. Care providers should be aware of this rare infection that is slow growing and may mimic a malignant process, leading to morbidity that can be caused by unnecessary treatment.

Keywords: Actinomyces Israeli; Pelvic abscess; Intrauterine device; Infection.

INTRODUCTION

Actinomyces is a gram positive, non-spore-forming anaerobic microaerophilic rod. Actinomyces israelii causes most Actinomyces infections in humans, although other forms such as Actinomyces Odontolyticus, Actinomyces Viscosus, Actinomyces Meyeri, Actinomyces Gerencseriae, and Propionibacterium Propionicum have also been reported to cause infections in humans[1]. Actinomyces israelii is a part of oral and genital tract flora with infections being reported in the oral-cervicofacial, thoracic, abdominal, pelvic, central nervous system, musculoskeletal regions as well as causing disseminated disease. Actinomyces infections may also be polymicrobial, although in our case a single agent was suspected to cause the infection. We describe a rare case of a slow growing pelvic abscess, mimicking a uterine cervix malignancy in a premenopausal woman. The patient's history was remarkable for a longstanding neglected intrauterine device (IUD) of 15 years, which was removed two years prior to the diagnosis of an infection with Actinomyces.

CASE REPORT

A 52-year-old woman married and mother of three, was referred to the internal medicine emergency room (ER) due to severe abdominal pain and suspected urinary tract infection with bilateral moderate hydronephrosis that was diagnosed by ultrasound from an outpatient clinic.

During her evaluation in the ER the patient was found to have an elevated C-reactive protein (CRP) – 163 mg/L, leukocytosis 19 10^3/ul and neutrophilia 14 10^3/ul. The urinary culture which was obtained two weeks earlier was sterile.

She was admitted to the hospital and an abdominal computerized tomography (CT) scan revealed bilateral hydronephrosis and a cystic or necrotic space occupying lesion located between the uterine cervix and urinary bladder, anterior to the vaginal wall. A thick and enhanced bladder wall was noted, accompanied by significant stranding of the adjacent fat. The origin of the lesion was uncertain, raising possibility of a genito-urinary malignancy (Fig. 1).

With these findings the patient was sent for a gynecological consultation. She complained of lower urinary tract symptoms consistent with mixed urinary incontinence including stress incontinence, nocturia, frequency, urgency and dysuria that lasted for the past two months. No other complaints were reported by the patient. Her medical history was uneventful.

A gynecological transvaginal ultrasound examination demonstrated a non-cystic mass, which was also palpated through the anterior vaginal wall and measured 39x44 mm. It was mostly hypoechoic with hyperechogenic foci and surrounded by enhanced peripheral blood flow. However, the origin of the lesion was unclear. She was admitted to the gynecological ward. The vital signs were unremarkable: blood pressure 140/78 mm/Hg, temperature: 37.1°C, heart rate: 72 bpm. The laboratory findings were as follows: hemoglobin: 11.7 g/dl, white blood cells: 19.14 10^3/ul, neutrophils: 14.17 10^3/ul, C-reactive protein: 163.7 mg/dl. Other findings including the tumor markers such as CEA, CA 19-9, CA15-3, CA 125, were within normal limits.

Due to these findings the patient underwent a gynecologic oncologist consultation including a colposcopy. The uterine cervix appeared to be normal.

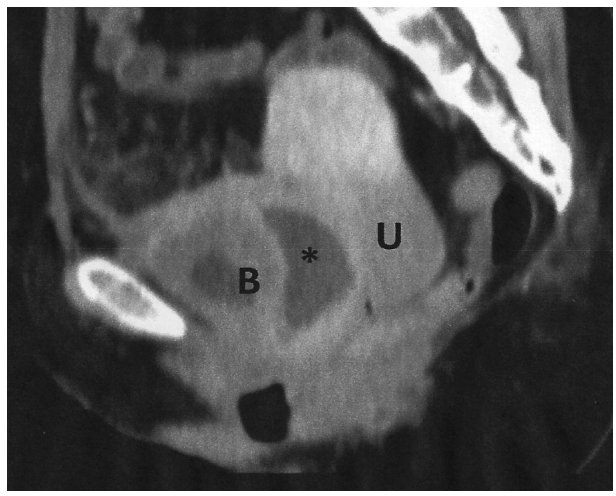


Figure 1. – The CT scan revealed necrotic mass (*) between urinary bladder (B) and uterine cervix (U), surrounded by fat stranding. The bladder wall is markedly thickened.

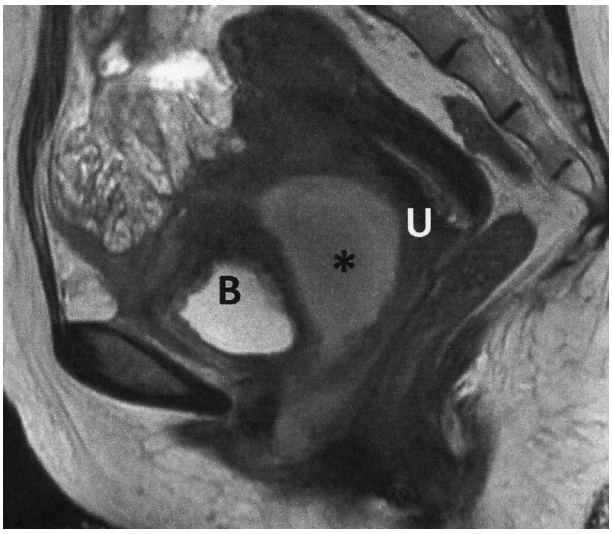


Figure 2. – A sagittal T2 weighted MRI shows the abscess (*) between urinary bladder (B) and uterine cervix (U). Uterine cervix is unremarkable.

Further evaluation included a cystoscopy which showed normal mucosa of the urinary bladder with no signs of malignant invasion. However, extrinsic compression probably due to the pelvic mass was noticed.

An abdominal MRI was performed. The study showed similar findings to those demonstrated on CT and ultrasound of a necrotic pelvic mass, localized behind the urinary bladder and anterior to the uterine cervix that was compatible with an abscess (Fig. 2). Significant inflammatory changes were seen in the urinary bladder walls, pelvic fat and adjacent small bowel loop. Small bowel perforation or another intestinal pathology such as Meckel's diverticulum were also suggested as possible explanations for the abscess formation. The uterine cervix was ruled out as a possible origin of the mass.

General surgeon consultation indicated that the possibility of gastrointestinal involvement was of low probability and assumed that the findings most probably originate from the genitourinary system due to marked urinary symptoms.

A decision was made to perform a CT guided aspiration of the abscess. During the procedure about 50 ml of pus were aspirated and sent to bacteriology (Fig. 3) and hystopathology. After the drainage the patient reported a marked improvement in her symptoms. The patient was afebrile during the entire hospitalization period. She was discharged with a recommendation for antibiotic treatment for pelvic inflammatory disease and to continue follow up in the outpatient clinic.

Bacteriologic analysis of the abscess fluid was sterile, however the hystopathologic findings showed branching filament formation consistent with Actinomyces infection and Actinimycosis like bacterial colonies. During repeated anamnesis when asked specifically about an IUD, the patient reported that two years prior to admission, she had removed an IUD which was inserted 22 years earlier. A pathological specimen, sent from the uterine cavity at the time of extraction, revealed bacterial colonies compatible with Actinomycosis, and antibiotic treatment was prescribed, but the patient did not take it. We do not have the information about the type of IUD. A repeated pelvic ultrasound revealed a collection of 30 ml.

Due to these findings suggestive of a slow growing abscess with Actinomyces together with an infectious disease specialist and consultant gynecologists the patient was readmitted for further treatment with intravenous antibiotics.

She was given three weeks of IV Penicillin G, 24 million units, divided every 4 hours. The patient continued antibiotic treatment in the gynecologic unit. After 4 days of treatment, there was a decline in leucocyte count to the normal range: 10.38 10^3/ul, neutrophils: 7.23 10^3/ul. Other laboratory findings were also within normal limits. The patient's vital signs appeared normal: blood pressure 138/83 mm/Hg, temperature: 36.8°C, heart rate: 64 bpm, and the patient reported marked improvement in her urinary complains. A PICC Line was inserted and the patient continued the treatment until it was stopped after she developed marked eosinophilia. The antibiotic treatment was changed to oral amoxicillin 500 mg, every 6 hours. The patient's symptoms resolved completely shortly after beginning treatment, and eosinophil levels decreased to near-normal values.

DISCUSSION

We report a rare case of Actinomyces abscess which was located in the vesicovaginal fascia, between the urinary bladder, uterine cervix and anterior vaginal wall, in a 52-year-old patient that two years previously had a neglected IUD removed.

The genus Actinomyces consists of several species such as Actinomyces Odontolyticus, Actinomyces Viscosus, Actinomyces Meyeri, Actinomyces Gerencseriae, and Actinomyces Israelli – which is the most common isolate in human disease. These bacteria are gram-positive, non-spore-forming bacteria, most of which grow at anaerobic conditions and tend to form branching filaments[1].

Actinomycotic disease is a rare diagnosis especially in developed countries. The overall annual incidence being 1: 100,000 to 1: 300,000, and due to unknown reasons, the rate is threefold higher in men. Most cases are seen in adolescents and middle-aged adults[2].

Actinomycotic infection may be associated with IUD usage. Chatwani and Amin - Hanjani 3 in their study including 1,520 women with IUD, showed that the colonization rate increases with the duration of IUD use, reaching an overall colonization rate of 11.4%. The authors suggested that patients with IUD should undergo annual cytological smears[3]. Likewise, other data show that the incidence of IUD-associated pelvic actinomycosis is 1.65% to 11.6% of IUD users and infection is more common in women who have had an IUD for more than four years[4].

Actinomyces israelii is a saprophyte found in various organs and in particular situations such as in mucosal lesion or in areas with a low oxygen level it becomes pathogenic. This

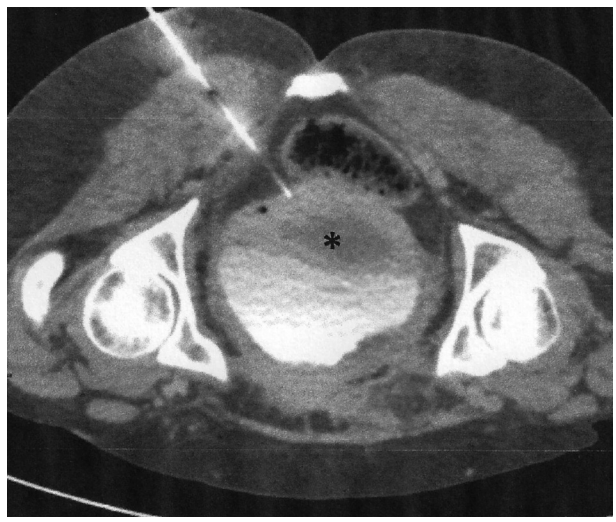


Figure 3. – CT scan obtained during imaging guided abscess drainage showed the needle placed into the abscess (*), avoiding damage of the rectum and major pelvic neuro-vascular structures.

condition allows the penetration of actinomyces through the mucosa and initiates an inflammatory process leading to the formation of abscesses and pseudo tumors. The abscesses tend to grow slowly and become symptomatic when they apply pressure on adjacent structures, form fistulas or perforate[4].

Apart from IUD, some predisposing events for abscess formation may include previous bowel surgery and endoscopic manipulation, perforated gastric ulcers, loss of gallstones after laparoscopic cholecystectomy, trauma, diverticulitis, pancreatitis and immunocompromised patients[4].

Actinomycosis abscess has been reported to affect the colon, ileum, ovaries, vulva, liver, abdominal wall, pancreas, greater omentum, retroperitoneum, kidney and abdominal wall[4]. However, to the best of our knowledge, this is the first report of an actinomyces abscess in the vesicovaginal fascia or the uterine cervix[4].

The disease is characterized by an infiltrative and granulomatous inflammation, which may result in multiple abscesses, and sinuses that contain Sulphur granules. However, this is not always a pathognomonic sign, because other species such as *Staphylococci*, *Nocardia*, *Aspergillus* and *Streptomyces* can also form Sulphur granules[5].

The differential diagnosis, in patients who present with an abdominal or pelvic mass depends on the patient's gender and age and includes: ovarian lesions, leiomyoma, ectopic pregnancy, pelvic inflammatory disease, appendicitis, diverticulitis, inflammatory bowel disease, and tuberculosis. A diagnosis of a malignant tumor of various structures is also frequently made. The ileocecal site is the most frequently affected in patients with abdominal actinomycosis[5]. The involvement of the vesicovaginal fascia located between the urinary bladder, uterine cervix and anterior vaginal wall, in this case made a diagnosis of genito-urinary malignancy even more reasonable.

Imaging findings of actinomycosis may vary greatly. Lesions may be single or multiple, and they may look like tumors, sometimes with foci of necrosis, or may present as abscesses. This behavior of the pathogen makes it very challenging to reach the correct diagnosis prior to an invasive intervention and as most cases of actinomycosis are based on tissue diagnosis[6].

Preoperative diagnosis aided by aspiration or biopsy of the lesion as was done in our case, may avoid surgical intervention and unnecessary morbidity in patients affected by actinomyces. Actinomyces is a slow growing pathogen and in many cases the bacteriologic analysis is uninformative. In our case there were no positive cultures from aspirated pus, however histopathologic findings, which were positive for branching filaments consistent with Actinomyces infection and Actinimycosis like bacterial colonies, as well as a history of neglected IUD helped us in reaching the correct diagnosis.

In such cases an antibiotic treatment rather the operative approach is required.

The cornerstone of the treatment for actinomycosis is prolonged antimicrobial treatment with penicillin. The recommended antibiotic regimen is Penicillin G (18-24 million units/day) for 2-6 weeks. After several weeks of parenteral penicillin treatment, a prolonged treatment with amoxicillin for a 6-12-month period is advised, with or without surgical drainage for bulky disease[5].

Where penicillin allergy exists, treatment with tetracycline, clindamycin, or doxycycline has been reported[5].

In cases, when there is no benefit, and general health conditions continue to deteriorate after a week of antibiotic treatment or it is not possible to exclude a potential malignancy, surgery may also be required.

In the case presented here, the combination of a long-standing IUD heavily colonized with Actinomyces, together with a probable mucosal damage caused by the traumatic extraction of an IUD, gave the pathogen an ability to cause an infection outside the uterine cavity. The long interval between IUD removal and the development of symptoms, points out to the unique infectious clinical syndrome caused by this organism. This highlights the importance of thorough history taking and specific questioning regarding long standing IUD presence in all patients with unexplained sub-acute symptoms and abnormal findings on pelvic imaging. The issue of whether to treat asymptomatic women with a histological finding of actinomyces colonies in the presence of IUD is still debatable, but in the presence of symptoms of endometritis – IUD removal and a short course of penicillin treatment is recommended. In our case, the patient had no clinical symptoms of endometritis at the time of IUD removal and the first evidence of actinomyces infection appeared two years later. We believe that antibiotic treatment given in the presence of actinomyces to prevent deterioration to a more serious infection is still a matter of clinical judgment, taking into account the time elapsed from the insertion of the IUD, and the traumatic potential of the extraction procedure.

In fact, pelvic actinomycosis is a rare chronic suppurative disease caused by Actinomycosis israelii and related species, that may result in an infiltrative mass lesion, which is often indistinguishable from malignancy at the beginning of the patient's evaluation.

In the majority of cases, a high index of suspicion is needed in order to reach a diagnosis. The diagnosis should be supported by a thorough anamnesis, imaging, bacteriology and histopathological findings, as in some cases only imaging and bacteriological findings are not enough.

The most challenging task for the management of actinomycosis is to reach a correct diagnosis before surgical intervention, as an accurate preoperative diagnosis is rare. However, if the diagnosis is promptly achieved, the gold standard treatment is based on prolonged high - dose antibiotic therapy, in particular penicillin, rather than a surgical approach.

DISCLOSURE STATEMENTS

There was no conflict of interest, informed patient consent was obtained.

REFERENCES

1. Russo TA. Agents of actinomycosis. Principles and Practice of Infectious Diseases. Mandell GL, Bennett JE, Dolin R, eds. 4th Ed. New York, NY: Churchill Livingstone; 1995: 2280-2288.
2. Sehouli J, Stypin JH, Schlieper U et al. Actinomycotic Inflammatory Disease and Misdiagnosis of Ovarian Cancer. A Case Report. Anticancer Research 2006; 26: 1727-1732.
3. Chatwani A, Amin-Hanjani S. Incidence of actinomycosis associated with intrauterine devices. J. Reprod Med 199439: 585-587.
4. Acquaro P, Tagliabue F, Confalonieri G et al. Abdominal wall actinomycosis simulating a malignant neoplasm: Case report and review of the literature. World J Gastrointest Surg 2010; 2 (7): 247-250 ISSN 1948-9366 (online) © 2010 Baishideng.
5. McFarlane MEC, Coard KCM. Actinomycosis of the colon with invasion of the abdominal wall: An uncommon presentation of a colonic tumor. International Journal of Surgery Case Reports 2010; 1: 9-11.
6. Uehara Y, Takahashi T, Yagoshi M et al. Liver Abscess of Actinomyces israelii in a Hemodialysis Patient: Case Report and Review of the Literature. 2010 The Japanese Society of Internal Medicine.

Correspondence to:

Andrey Kreinin
Rager blvd, 151 - Beer Sheva 84101 - Israel
E-mail: dr.kreinin@gmail.com

Review

A 20 year experience of microsurgical removal of the Bartholin's glands for refractory vulvodynia

RICHARD I. REID

Former affiliation (retired): Hunter New England Health Service, NSW, Australia

Abstract: Since the 1980s, a flood of women have presented with introital dyspareunia and chronic unexplained vulvar discomfort, for which no clear-cut somatic diagnosis can be found. Three decades of research has failed to attribute this syndrome to a structural disease process. Pathogenesis reflects an interaction between individual hypersensitivity and an external irritant, creating a self-sustaining pain reflex. This reflex has well defined afferent (sensory), central (dorsal horn) and efferent (motor) arms. As such, vulvodynia fits the model of a complex regional pain syndrome. Most women respond to conservative treatment, involving membrane stabilizing drugs (to downregulate pain transmission through the dorsal horn) and a biofeedback-controlled exercise program (to stabilize electrical transmission within the efferent arm the spinal pain reflex). In refractory cases, there is sometimes a need to excise the tissue from which the most intense pain signals are arising. This has been most commonly done by vestibulectomy. This article describes a microsurgical technique for Bartholin's glands excision, as a less 'anatomy-altering' and more effective alternative. During calendar years 1999-2014, 99 patients were adjudged suitable for microsurgical removal of the Bartholin's glands. Of these 99 women, pain free intercourse was re-established in 93 (94%) patients, and another two (2%) had partial improvements. There was a 4% failure rate (four women). No major complications were encountered.

Keywords: Vulvodynia; Bartholin's gland; Surgery; Chronic pelvic pain; Pain.

INTRODUCTION

Historically, complaints of chronic vulvar pain were readily attributable to somatic diseases (Table I). Since the 1980s, however, there has been a flood of women presenting with introital dyspareunia and chronic unexplained vulvar discomfort, for which no clear-cut somatic diagnosis can be found.

Chronic and seemingly incurable pain is a potent cause of anxiety, anger and reactive depression, even in mature and socially successful individuals. Vulvodynia primarily affects nulliparous women in their formative years. Symptoms of intractable vulvar pain place key interpersonal relationships under duress and may even impact the ability to work, thus explaining the emotional distress that is so manifest in these young women. Not surprisingly, subsequent research found these psychological symptoms to be the result (not the cause) of the chronic sexual pain in vulvodynia[1,2].

There is now a consensus that vulvodynia is actually a chronic pain disorder[3-5]. It fits the model of a *complex regional pain syndrome* (in past terminology, a "sympathetically maintained pain syndrome" or a "reflex sympathetic dystrophy") consistent with a self-sustaining spinal reflex, with afferent (sensory), central (dorsal horn) and efferent (motor) arms.

The pathogenesis of vulvodynia is thought to reflect the interaction of hypersensitivity (i.e., a genetic susceptibility to an excessive inflammatory response) and an external irritant (i.e., exposure to an extrinsic factor that triggers an idiosyncratic inflammatory cascade) (Table 2).

• *Hypersensitivity:* Many clinical investigators have recognized that 90% of affected women have a fair complexion and a tendency to "sensitive" skin. Goetsch[6] reported that one third of vulvodynia patients have a female relative with dyspareunia or tampon intolerance, thus highlighting the extent to which vulvodynia runs in families. Witkin et al[7] reported that 53% of vulvodynia patients (versus 5% of controls) had a genetically impaired ability to switch off interleukin 1 mediated inflammatory responses[7].

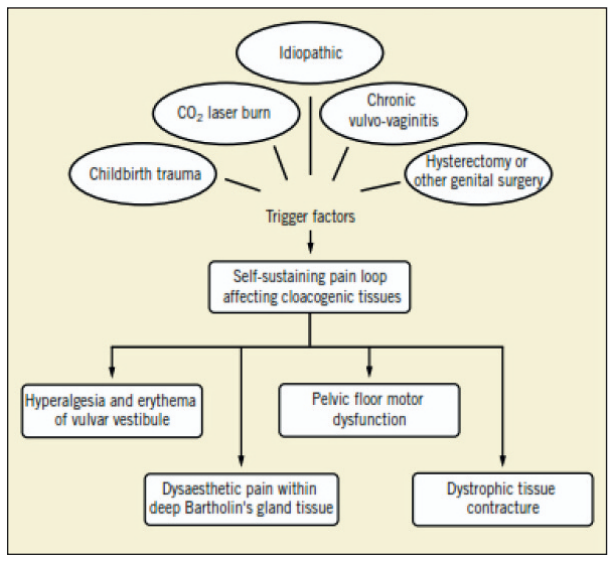
• *External Irritants:* It is likely that the pain reflex might be triggered an external irritant, usually by bacterial vaginosis and chronic candidiasis. However, specific external irritants cannot always be identified. Vulvodynia is not sexually transmitted, and is not a form of subclinical papillomavirus infection[8].

TABLE 1. Classic differential diagnosis of chronic vulvo-vaginal pain.

- Cutaneous vulvar infections (cyclic candidiasis, seborrhoeic dermatitis)
- Secondary irritation from a vaginal discharge (bacterial vaginosis, trichomoniasis)
- Contact dermatitis secondary to chemical or drug irritations (acute and chronic eczematoid dermatitis)
- Vulvar dermatoses (lichen sclerosus, lichen planus, psoriasis, pemphigus)
- Neoplastic epithelial disorders (vulvar intraepithelial neoplasia, Paget's disease, melanoma)
- Vulvar scarring (fibrotic hymen, fourchette contracture band)
- Urethral pain (diverticulum, posterior urethritis)
- Vulvar dysaesthesia (causalgia, pudendal neuralgia)

The end result is a complex regional pain syndrome with several distinct elements. Namely, a nociceptive element (triggered by physical contact with hyperalgesic foci surrounding the Bartholin's and Skene's ostia on the vestibule); a neuropathic element (secondary to sympathetic-somatic nerve fibre cross-talk within foci of surface erythema or the hyperalgesic Bartholins' glands); and a myal-

TABLE 2. A proposed model of pathogenesis.



gic element (secondary to an ischaemic lactic acid build up within chronically hypertonic pelvic floor muscles).

Most women benefit significantly from conservative therapy. The primary thrust is to break the causative self-sustaining pain reflex. This objective can potentially be achieved in several ways:

1. The afferent limb of this spinal reflex is largely sustained by cross-talk between hyperaesthetic perivascular sympathetic nerve fibres and the adjacent somatic pudendal nerve fibres. Dye laser photothermolysis has the capacity to selectively destroy the engorged blood vessels within the painful erythema on the vulvar vestibule[3], thus disrupting this pain loop.
2. Nociceptive and neuropathic pain transmission through the dorsal horn can be impeded with local anaesthetic and membrane stabilizing drugs, such as lignocaine, amitriptyline, gabapentin or pregabalin[9]. Medication can be delivered either orally or topically.
3. Residual neuropathic pain can often be further downregulated with remedial massage of painful trigger points within the anterior vaginal wall[10,11].
4. Myofascial pain within the chronically hypertonic pelvic floor musculature can be targeted using biofeedback, to stabilize electrical transmission within the efferent arm the spinal pain reflex. Biofeedback is a specialised technique, which measures baseline muscle function via surface EMG electrodes, and then transmits these signals to a television monitor in real time. By studying the monitor, patients can learn to isolate and break their chronic pelvic pain loop[12].
5. Sexual pain at this point in life can have damaging emotional consequences. Some couples also benefit from relationship counselling for associated psychosexual disorders.

In a prospective observational study of 725 women with vulvodynia over a 5 year period, selective FEDL photothermolysis of hyperalgesic erythema on the vulvar vestibule secured lasting pain relief in 70.2% (118 of 168) of subjects[3]. Significantly, 43 of the 50 photothermolysis failures reported a severe deep pain on palpation of their Bartholin's glands. Following a lead from Miklos and Baggish[13], our group pioneered a minimally invasive technique for Bartholin's glands excision, using a microsurgically adapted carbon dioxide (CO_2) laser. Gland removal increased final success rate to 93%. However, the development of the Glazer protocol for breaking the vulvodynia pain loop with muscle relaxation obviated the need to use of FEDL photothermolysis beyond 1996[12]. Nonetheless, in refractory cases, there can be a need to excise foci of hyperaemic tissue from which the most intense pain signals are arising. This has been most commonly done by vestibulectomy[8,14]. However, I have continued to rely on Bartholin's glands excision, as a less 'anatomy-altering' and more effective alternative.

This paper reports on my experience with microsurgical Bartholin's glands excision over the last two decades, 1997 to retirement 2016.

CLINICAL ASSESSMENT OF THE REFRACTORY VULVODYNIA PATIENT

The degree of disability associated with vulvodynia varies from nuisance level to sexually and emotionally disabling. The predominant symptom is always introital dyspareunia, sometimes accompanied by unprovoked vulvar discomfort, usually described as a sense of rawness or dryness. Symptoms do not respond to topical antifungal or antibacterial therapies. Vulvodynia symptoms tend to remain relatively constant day to day, meaning that the severity of the patient's presenting complaints provide a guide to the likely treatment response.

• The usual history is that of *secondary vulvodynia*, meaning the sudden occurrence of sexual pain after years of pleasurable intercourse. Provided that any ongoing trigger factors are controlled, such cases usually respond well to muscle relaxation therapy.

• A minority of women *primary vulvodynia,* due to the presence of occult pathology from a young age. Presenting complaint is that of severe and enduring introital dyspareunia from the time of first intercourse, whenever that occurs.

• Occasional vulvodynia patients present with *vaginismus* but no signs of surface vulvodynia.The true nature of the problem is revealed by the finding of a characteristic lancinating pain on Bartholin's glands palpation.

In my experience, the women with primary vulvodynia and unexplained vaginismus are more likely to fail conservative protocols, and may eventually become candidates for surgery.

Examination evaluates four main physical phenomena:

• Chronic dysaesthetic pain, emanating from inflammatory foci on the mucosa of the vestibule.

• Similar inflammatory foci within the tissues of the Bartholin's glands themselves.

• Secondary to this chronic inflammation, the levator muscles exhibit chronic painful spasm[3].

• There can also be dystrophic shrinkage of adjacent tissues (notably hymenal fibrosis, posterior fourchette contracture bands and stenosis of the inflamed Bartholin's ducts). A small YV flap is an easy option for resolving posterior fourchette contracture, and is much superior to a Fenton's procedure[15].

TREATMENT RESULTS

During calendar years 1999-2014, approximately 500 patients were referred to my private gynaecology practice in Sydney for the management of intractable dyspareunia. Patients were first evaluated to identify and grade their various pain components, and to resolve whatever trigger factors might be helping sustain their vulvodynia[16,17]. A conservative therapy regimen was then employed, in an attempt to break the self-sustaining pain reflex driving the vulvar hyperalgesia syndrome. This regimen combined membrane stabilizing drugs to downregulate pain transmission through the dorsal horn[9] and a biofeedback-controlled program to stabilize electrical transmission within the efferent arm the spinal pain reflex. Biofeedback is a specialised technique, which measures baseline muscle function via surface EMG electrodes, and then transmits these signals to a television monitor in real time. By studying the monitor, patients can be taught to isolate and break their chronic pelvic pain loops within their chronically hypertonic pelvic floor muscles[12]. Occasionally, such additional measures as remedial massage for refractory myofascial pains in secondary muscle groups or hormone creams for symptomatic skin fissuring were needed. Some couples also benefited from relationship counselling for associated psychosexual disorders.

About 85% of patients responded permanently to conservative therapy. However, small subsets of patients require a combination of medical and surgical treatment. Surgery was used in two circumstances:

• To break an otherwise refractory local pain reflex, by excising an area of tissue from which the most intense pain signals are arising. This objective is traditionally approached by vestibulectomy. However, in that these foci of painful, hyperemic vessels are consistently seen to emanate

from the ostia of the Bartholin's glands. I have preferred to continue with the strategy of microsurgical gland removal[3]. The procedure requires learning some new operative skills, but has the advantage of being less 'anatomy-altering' and more effective than simple vestibulectomy.

• Reconstructive surgery was sometimes required to release a painful introital narrowing. Small contracture bands are easily and cosmetically corrected by YV advancement. With more severe deformities, I relied on vulvoplasty with transposition of a pair of sensate skin flaps (based on the terminal distribution of the posterior labial artery and nerve)[15]. This aspect is not further discussed in this paper.

Over the course of this 15 year period, 99 patients were adjudged suitable for microsurgical removal of the Bartholin's glands. Beginning in the fourth postoperative week, all patients began the use of a #4 or #5 glass vaginal dilator, to forestall the scar contracture that attends a inevitably attends the maturation of a semicircular peri-orificial scar. It is vital to begin dilator use while the scar is still in the elastic *red scar stage*. During this stage, these immature scars can always be stretched. If dilator use is delayed until the inelastic *white scar stage*, dilator use will only evoke tearing and further cicatrization. As such, at least half of these women will develop severe scar dyspareunia. Patients were also counselled that surgery is not, in itself, curative. Rather the objective of surgery is to remove sites of intractable pain messaging, so that the other elements of their pain loop can be resolved. Hence, all patients were instructed to continue with their biofeedback pelvic floor program until normal muscle tone had been restored. Of these 99 women, pain free intercourse was re-established in 93 (94%) patients, and another two (2%) had partial improvements. There was a 4% failure rate (four women). No major complications were encountered.

OPERATIVE TECHNIQUE FOR MICROSURGICAL REMOVAL OF THE BARTHOLINS' GLANDS

(a). Proper exposure of the operative field: The patient is prepped and draped in lithotomy position. A Lone Star retractor is applied and the frame anchored to the patient's body (by placing two sutures through the groin skin and tying them across the retractor screws) (Fig 1). An outer ring of six elastic hooks are applied at the level of the pilosebaceous line, to evert the vestibular and stabilise the surface epithelium. It is important not to insert hooks into the glaborous skin of the interlabial sulci or labia minora, as they will tear out.

(b). Staining of the Bartholin's ducts and glands: Using surgical loupes or an operating microscope, a search is made for the ostia of the Bartholin's ducts. If not immediately visible, gentle digital pressure over the Bartholin's fossa will often express a droplet of clear mucous from the ostia. Unfortunately, the ducts will have atrophied shut about one quarter of patients, making subsequent dissection much more difficult. If the ducts are still patent, the underlying gland can be made easier to locate and dissect by instilling a few drops of Bonney's blue or gentian violet through a paediatric intravenous cannula. It is vital not to use methylene blue as the staining agent, because this dye rapidly spreads across the gland capsule. End result will be diffuse staining of the surrounding tissues, thus totally masking all surgical landmarks. Once the ducts have been stained, the submucosal erectile tissue is carefully infiltrated with local anaesthetic and adrenaline. Because of the vascularity of this region, these injections should be very slow and the blood pressure must be watched carefully because of the risk of rapid systemic absorption.

(c). Making the incision: The sulcus just distal to the hymen on the side to be dissected first is circumscribed with either a focused carbon dioxide (CO_2) laser beam or a #15 blade. Depth of the incision is kept very shallow, to expose the shiny white and relatively tough fascia (Gallaudet's fascia) overlying the Bartholin's fossa. This is a key landmark that must be identified and cleanly incised, to facilitate accurate closure after gland removal. Failure to do this will cause unaesthetic introital gaping, even in young nulliparas.

(d). Establishing tension and countertension throughout the surgical field, to facilitate sharp dissection: It is impossible to microdissect a flaccid wound. Good technique for dissecting the Bartholin's fossa begins by retracting the

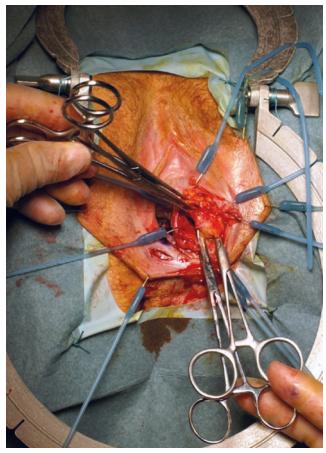


Figure 2. – Mobilizing the posterior pole of the Bartholin's gland.

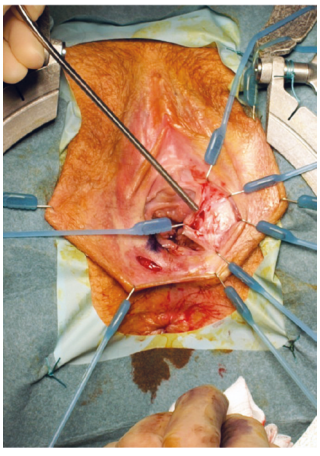


Figure 1. – Use of the Lone Star retractor to expose operating site and create tension-countertension.

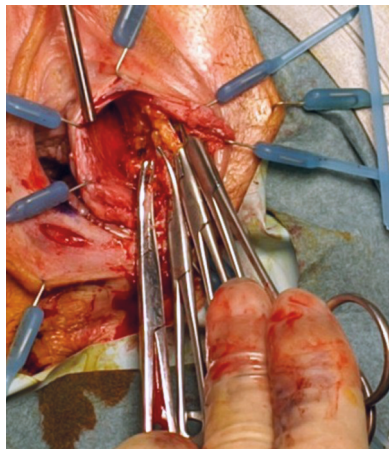


Figure 3. – Blood vessels clamped ready for suture ligation.

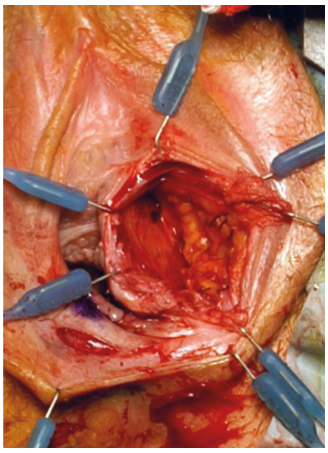


Figure 4. – Pedicles ligated, but Bartholin's fossa not yet closed.

mucosal incision margins with four more hooks. This second row of hooks widely exposes the Bartholin's fossa, providing unrivalled visibility and freeing the assistant to keep tis very vascular dissection dry with an ENT suction. More importantly, these four hooks create the tension-countertension needed for gland identification and removal.

(e). Identifying the Bartholin's glands: The mucosal incision is taken down through the thin superficial (Colles') fascia, to expose the point where the blue-stained Bartholin's ducts descend on the medial side of the gland, to penetrate the deep (Gallaudet's) fascia. Incising the thick Gallaudet's fascia exposes the inferior (superficial) surface of the Bartholin's glands. Key anatomic relations are as follows: Medial (investing fascia of vaginal wall); Lateral (bulbocavernosus muscle); Anterior: the gland is attached to the vestibular bodies; Posterior (the ischioanal fossa); Superior/deep (perineal membrane/inferior fascia of urogenital diaphragm and pubococcygeus muscle). The easiest identification point is the posterior pole, which can be grasped and elevated with a paediatric Allis forceps (Fig. 2). Note that an adult size is totally unsuited to this task. The gland is vascularized by small blood vessels that penetrate the capsule both medially and laterally. As such, there is a potential space between the superior (deep) surface of the gland and the perineal membrane, bounded medially and laterally by the vascular bundles. A closed haemostat can be slid into this space. The lack of resistance to the forward passage of the haemostat is highly characteristic, and provides confirmation that the gland has been correctly identified.

(f). Excising the Bartholin's glands: Mosquito forceps are inserted into the space between the perineal membrane and the deep surface of the gland, to clamp the lateral and medial vascular bundles emanating from the urogenital diaphragm (Fig. 3). After transection, these pedicles are suture ligated with Vicryl 000 on an 18 gauge round bodied needle (Fig. 4). Finally, the posterior part of the vestibular body is clamped and ligated, allowing gland removal. This technique will forestall significant bleeding. However, any dissection of erectile tissues may present some persistent oozing from other parts of the Bartholin's fossa. Haemostasis is improved by suturing together the adjacent Bartholin's fossa soft tissues, and completed by closing Gallaudet's fascia.

(g). Wound closure: In order to leave this important sexual anatomy essentially undisturbed, the edges of the Gallaudet's fascia incision must be accurately re-approximated with Vicryl 000 sutures (Fig. 5). This fascial closure must be done with interrupted stitches, because of the risk of ischaemia and consequent wound infection with a continuous suture. Not repairing the deep vulvar fascia will cause introital gaping, thus eroding some of the advantage that microsurgical gland removal has over vestibulectomy. Finally, the hymen must be excised before mucosal closure with 000 Vicryl Rapide. Preserving the hymen carries an unacceptable risk of painful introital scarring and a need for surgical revision.

DISCUSSION

Acute and most chronic pain seen in surgical practice is *nociceptive pain*. Some form of tissue damage (e.g., trauma, infection, malignancy) activates specialised pain receptors, resulting in the conduction of an impulse from the site of trauma to the interneurons in the dorsal horn. From here, the signal is transmitted to pain projection neurons in the brain stem, where these signals are recognised by the cortex as pain. Nociceptive pains usually have distinctive symptom patterns. Pain is typically sharp and highly localised. Severity is proportionate to the force of the initiating insult, and worsens steadily if tissue trauma continues to increase. A biopsy from a site of nociceptive pain will usually identify the responsible histological process. Histochemical studies have identified a specific inflammatory cascade involving prostaglandins, substance P and other vasoactive peptides. As such, pain can be relieved (to some extent) by corticosteroids, nonsteroidal anti-inflammatories and opiates. Although the initial trauma may provoke transient hyperaesthesia at the site of injury, nociceptive pain is associated with a minimum of sustained autonomic afferent activity. Finally, nociceptive pain always resolves when the eliciting process is removed.

There is, however, a completely different system of pain generation, known as *sympathetically-maintained pains (SMPs)* or *complex regional pain syndromes (CRPS)*. Although generally unfamiliar to gynaecologists, these neuropathic pain disorders are a major reason for referral to a pain clinic. SMPs generally arise as a disabling but idiosyncratic response to a trivial trauma. The pathophysiology involves pain dysregulation in both the sympathetic and central nervous systems, with likely genetic, inflammatory and psychological contributions[1,2,6,7]. SMPs are generally described as a diffuse burning pain which the patient cannot localize. Clinical features classically follow a regional (rather than a dermatomal or peripheral nerve) distribution and tend to favor the distal part of the affected region. Biopsy shows normal tissue, apart from nonspecific features like round cell infiltration, oedema, vascular ectasia and trophic changes. Unlike nociceptive pain, SMPs do not respond to steroids, nonsteroidal anti-inflammatories and

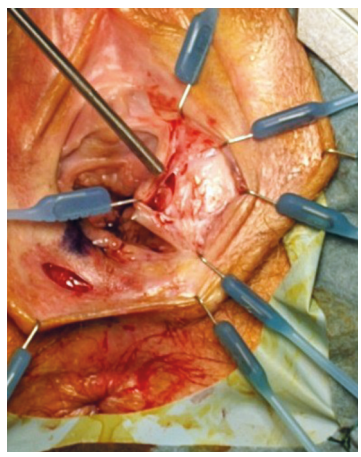


Figure 5. – Gallaudet's fascia closed, but vulvar skin edges still retracted.

opiates. However, neuropathic pains will often respond to antidepressants, anticonvulsants and sympathetic blockers, Another important contrast is the presence of diffuse autonomic dysfunction, such as hyperalgesia, allodynia, sudomotor and vasomotor abnormalities.

Pain severity is disproportionate to the degree of tissue injury and symptoms persist beyond the expected time for tissue healing.

The features of vulvodynia resemble an SMP rather than a nociceptive pain. Specifically, vulvodynia begins as a sudden idiosyncratic response to an often trivial tissue insult – such as a yeast infection or childbirth trauma. Once established, the syndrome manifests as a disabling, poorly localised pain centred on Bartholin's and Skene's glands. Vasomotor instability begins as patches of painful erythema on the vestibular surface, extending down into the gland itself in more severe cases. Oedema, hymenal fibrosis and fourchette contracture are common. In essence, vulvodynia is a self-sustaining pain loop (passing from vulvar sensory afferents to the dorsal horn neurons, then synapsing with the upper neuronal tracts, before terminating at pelvic floor muscles). Experience has shown that symptoms can be abolished by measures that interrupt any part of the pain loop. Prior to the discovery that the efferent arm of this pain loop could be suppressed with pelvic muscle relaxation therapies[9], we had successfully used the pulsed dye laser to disrupt the afferent arm[3]. Yellow (577 nm) light was used to selectively coagulate hyperemic vessels around the Bartholin's ducts, without damaging the vulvar epithelium. These painful vessels subsequently underwent vascular sclerosis, thus shutting down crosstalk between the hyperaesthetic perivascular sympathetic fibres and adjacent somatic afferents. During the course of this study, persistent inflammation deep within the Bartholin's gland was identified as the dominant factor in failed FEDL photothermolysis therapy.

CONCLUSIONS

Bartholin's gland removal is a technically difficult operation, but one with low morbidity and excellent success rate. It works on a similar principle to vestibulectomy (namely, by decreasing the intensity of chronic pain signaling generated from the inflamed vulvar skin and vestibular glands).

REFERENCES

1. Meana M, Bibik Y, Khalife S, Cohen D. Bio-psycho-social profile of women with dyspareunia. Obstet Gynecol. 1997; 90: 583-90.
2. Jantos M. Vulvodynia: a psychophysiological profile based on electromyographic assessment. Appl Psychophysiol Biofeedback. 2008: 29-38.
3. Reid RI, Rutledge L, Precop S et al. Flashlamp dye laser therapy of idiopathic vulvodynia is safe and efficacious. Am J Obstet Gynecol. 1995; 172: 1684-1701.
4. Guthmiller K, Dulebohn S. Pain, complex regional pain syndrome (Reflex Sympathetic Dystrophy, RSD, CRPS). www.ncbi.nlm.nih.gov/books/NBK430719/
5. Harden RN, Oaklander AL, Burton AW, Perez RS et al. Reflex sympathetic dystrophy syndrome association. Complex regional pain syndrome: practical diagnostic and treatment guidelines, 4th edition. Pain Med. 2013: 180-229.
6. Goetsch. MF. Vulvar vestibulitis: prevalence and historic features in a general gynecologic practice population. Am J Obstet Gynecol. 1991; 164: 1609-14.
7. Witkin SS, Gerber S, Ledger WJ. Influence of interleukin-1 receptor antagonist gene polymorphism on disease. Clin Infect Dis. 2002; 34: 204-9.
8. Reid R. Genital condylomas, intraepithelial neoplasia and vulvodynia. Obstet Gynecol Clin N Am 1996; 4: 917-91.
9. Ben-David B, Friedman M. Gabapentin therapy for vulvodynia. Anesthesia & Analgesia 1999; 89: 1459-62.
10. Jantos M, Johns S, Torres A, Baszak-Radomanska E. Mapping chronic urogenital pain in women: insights into mechanisms and management of pain based on the IMAP. Part 2. Pelviperineology. 2015; 34: 28-36.
11. Jantos M, Johns S, Torres A, Baszak-Radomanska E. Can pain mapping in vulvodynia cases provide insights into mechanisms and management of pain. J Lower Genital Tract Disease. 2015; 19.3 Supplement p: S12.
12. White G, Jantos M, Glazer H. I. Establishing the diagnosis of vulvar vestibulitis. J Reprod Med, 1997; 45: 157-160.
13. Miklos JR, Baggish MS Vulvar pain syndrome: A review. Obstet Gynecol Surv. 1995; 50: 613-27.
14. Kliethermes CJ, Shah M, Hoffstetter S et al. Effect of vestibulectomy for intractable vulvodynia. J Minim Invasive Gynecol. 2016: 1152-1157. Epub 2016 Aug 25.
15. Reid RI. Local and distant skin flaps in the reconstruction of vulvar deformities. Am J Obstet Gynecol. 1997; 177: 1372-84.
16. Reid RI, Campion MJ. How to treat vulvar disease – Part 1. Australian Doctor Dec 5, 2011, pages 27-34.
17. Reid RI, Campion MJ. How to treat vulvar disease – Part 2. Australian Doctor Dec 5, 2011, pages 25-32.

Correspondence to:
Dr Richard Reid MBBS;FACS; FRCOG; FACOG; FRANZCOG
8 Crestleigh Close
Woongarrah, NSW 2259 Australia
richard_reid42@yahoo.com

Video

Urethrolysis and Martius flap graft for recurrent urinary stress incontinence with fixed urethra

PAOLO PALMA[1], CASSIO RICETTO[1], DANILO LEITE ANDRADE[2], MARICEL ZOCCO[2]

[1] *Dept of Urology, Campinas University, Brazil*
[2] *Division of Gynecology, Fundacion Favoloro, Buenos Aires Argentina*

Abstract: This video discloses a 59 year old patient with recurrent USI after two previous failed sling and fixed urethra. She underwent urethrolysis, had a urethral lesion repaired immediately and a Martius flap to restore normal mobily. Re-sling may be performed should it became necessary.

Keywords: Pipestem urethra; Urethrolysis; Martius fat graft.

https://youtu.be/iqTQMQjQJgA

Correspondence to:
ppalma@uol.com.br

Comment

Consideration of Martius graft as a salvage and treatment procedure in current pelvic floor reconstruction patients

MAX HAVERFIELD

The Northern Hospital Epping, Victoria, Australia

There are, as with most procedures, a few "surgical pearls" which need to be highlighted to enhance the simplicity of the surgery and decrease the risk of repair and graft failure and complications. The video did highlight the fact that there is a significant and growing need for this procedure to be part of the armamentarium of all Pelvic Floor Reconstructive Surgeons today[13].

In my experience, most of which was in South Africa during the 1970's at the Baragwanath/Soweto hospital, management of vesico-vaginal and urethra-vaginal fistulae as a consequence of obstructed obstetrical cases in the main involved bladder base and proximal urethra. The Unit was part of the Johannesburg University Tertiary Hospital campus and the Department Head at the time was Professor D. Lavery.

Approximately 60-70 case presentations were seen per year and often these staged over several months, depending on their complexity and size of the injury. Approximately 10-20% of cases were considered to benefit from adjunctive modified Martius graft procedures.

It is estimated that between 1 and 2 million women (possibly grossly underestimated) suffer this injury per year. In first world countries the injury is most likely to be iatrogenic.[1,2,3]

The Martius Labial Fibro adipose Flap Graft (M.L.F.F.G.) was first described by H. Martius in 1928 and involved transposition of bulbocavernosis muscle and vulvo fibro adipose tissue for urethro vaginal fistula repair.[4.]

Since the discovery of this procedure it has been modified many times and now refers to the M.L.F.F.G. without the dissection of the bulbous cavernosus and ischio cavernosus muscles. The exclusion and avoidance of these muscles reduces the risk and added complications of haemorrhage and haematoma formation. Hence it is important to dissect lateral to these structures. The labial "fat pad" is enveloped in a fascial sheath. Hydro dissection is helpful in the isolation and preservation of blood supply and in creating the tunnel from the vaginal operating site, lateral under the vaginal sulcus, to the site of labial graft which has been harvested. The tunnel must be 4-5cms wide. The blood supply to the graft is from the external pudendal artery superiorly and major supply is from the internal pudendal vascular complex arising inferio-postero lateral. The pedicle graft is usually separated and dissected superiorly without compromising the viability of the graft which must be handled very gently with non-traumatic instruments taking care to not compromise the blood supply of the pedicle graft with passage through the tunnel and attachment of it to the contra lateral side and the positioning of the graft over the vaginal repair site without tension and sutured to the peri vaginal fascia and periurethral fascia to prevent slippage of the pedicle. The vaginal and labial incisions are closed in layers and if vascular, small negative pressure soft drain tubes may need to be employed.

The above diagram has been modified from Copyright by the Polish Urological Association (an open access article[13])

Martius graft diagram

1. Labial / Fibro adenomatous lipoma
2. Incision of right labia majora
3. Tunnel for graft
4. Lateral vaginal sulcus
5. Repair of VVF / Ureterolysis
6. Left labia majora
7. IDC
8. Speculum

Post-operative instructions:

1. IDC / bladder drainage – preferable to use low negative pressure soft drain system for 7 – 10 days (silastic catheter size 14-16)
2. Appropriate prophylactic antibiotics.

Relative indications for M.L.F.F.G consideration in my opinion would be:

- Increased success rate of first procedure with regard to:
  - Scarring and tethered vaginal syndrome
  - Post-menopausal
  - Radiotherapy
  - Atrophic tissues
  - Repair and excision of mesh complications
- Any repair / procedure which may benefit from graft protection and increased blood supply and to reduce recurrent scarring
  - eg urethrolysis and protection of the fragile urethra
  - repair and excision of urethral and bladder base mesh erosions [5,6,7.]
  - Urethral diverticulectomy
  - Vesico and urethral fistula repair of the more complex cohort of cases[8]

Pre-existing stress urinary incontinence (SUI) may persist. The trans positioning of M.L.F.F.G is not itself a continence procedure. There is an increased incidence of SUI with vesico and urethral fistulae repair.[9.]

The M.L.F.F.G. makes the appropriate tensioning of the continence device difficult because of the possibility of compromise to the graft itself. It is more appropriate to stage any SUI procedure to a later date for optimal outcomes. However, the alternative as described in[10], of a urethral salvage procedure performed at the time for severe SUI in the presence of a very fragile urethra and the need for a difficult urethrolysis and direct repair of the proximal 2/3 of the urethra was successfully achieved by using a full thickness bridge of vaginal mucosa as an enhancement pedicle graft over the repaired and compromised urethra. This bridge graft is more robust than the M.L.F.F.G. enabling a Tissue Fixation System (TFS) tape prosthesis to be used as a treatment of SUI to accurately enhance the pubo urethral ligament resulting in an outstanding success and long-term continence cure for this patient.

The M.L.F.F.G. procedure has minimal complications and morbidity. Complications are uncommon but well documented and include:[11]

Haematoma and bleeding
Infection
Lymphedema of the vulval donor site
Pain / hypersensitivity
Hyposensitivity
Cosmetic unacceptance
Altered sexual function

It is important to obtain consent and notify the patient of all the risks and complications.

Positives for M.L.F.F.G.

Small additional surgical time (+20 minutes) in experienced hands

Can improve outcomes in complex and difficult cases

My South African experience would endorse this approach. My understanding from my discussions with Hamlins Ethiopian experience was that their need for a primary once only opportunity of success was the utilisation of a M.L.F.F.G. with their repair of a V.V.F. hence the M.L.F.F.G. rates were much higher than at Baragwanath (90%) with the "luxury" of a staged closure repair. The rates of M.L.F.F.G. were much lower (approx. 10%) at Baragwanath, however the statistic may have changed since the 1970's.

I cannot confirm these statistics as I have been unable to find any journal article data to verify these paradigms. I have however discovered a paper by Browning of a series of 440 obstetrical VVF repairs which showed M.L.F.F.G. had little benefit on outcomes. He found higher SUI rates and a higher incidence of complications.[12] Browning's data may require further clarification and any comparisons of first world / emerging third world experiences will need to be compared.

REFERENCES

1. Dossa NI, Zunzunegui MV, Hatem M et al. Fistula and other adverse reproductive health outcomes among women victims of conflict related sexual violence: a population based cross-sectional study. Birth 2014;341:5-13. 20.1111/birth.12085 (PubMed) (Cross Ref).
2. Adler AJ, Ronsmans C, Calvert C et al. Estimating the prevalence of obstetric fistula: a systemic review and meta-analysis BMC Pregnancy Childbirth 2013 30; 13: 246 (PMC free article) (PubMed).
3. DeRidder D. An update on surgery for vesicovaginal and urethrovaginal fistulae. Curr Opin Urol 2011; 21: 297-300. 10.1097/MOU.0b013e3283476ec8 (PubMed) (Cross Ref).
4. Martius H. Die operative WiederHellstellung der volkommen fehlenden Harnhohare unde des Sclessmuskels derselben. Zentralbl Gynakol 1928; 52: 480-6.
5. Hansen BL, Dunn GE, Norton P et al. Long term follow up of treatment for synthetic mesh complications. Female Pelvic Med Reconstr Surg 2014; 20: 126-30. 10.1097/SPV.0000000000000084 (PubMed) (Cross Ref).
6. Mortimer A, Khunda A, Ballard P. Martius graft for TOT extrusion: a case series. Int Urogynaecol J 2016; 27: 113-6. 10.12007/s00192-015-2799 (PubMed) (Cross Ref).
7. Abrams P, DeRidder D, De Vries C et al. Obstetric fistula in the developing world. An International consultation on the Vesicovaginal fistula. Marrakech, Morocco 2010 Oct 13.
8. Kasyann G, Tupikina N, Pushkar D. Use of Martius flap in the complex female urethral surgery. Cent European J Urol 2014; 67: 202-7. 10.5173/ceju.2014.02.art20 (PMC free article) (PubMed).
9. Matte A, Delorme E. The Martius flap in stress urinary incontinence treated by sub urethral sling Prog Urol 2012; 22: 725-30. 10.1016/j.purol.2012.07.008 (PubMed) (Cross Ref).
10. Haverfield M, Petros P. Salvage operation for urethral perforation caused by TVT removal for severe urinary incontinence. A case report Pelviperineology J 2012; 1: 27-28.
11. Lee, Dillon BE, Zimmern PE. Long-term morbidity of Martius labial fat pad graft in vaginal reconstruction surgery. Urology 2013; 82: 1261-6 10.1016/j.urology.2013.08.032 (PubMed) (Cross Ref).
12. Browning A. Lack of value in the Martius fibrofatty graft in fistula repair. International Journal of Gynaecology & Obstetrics 2006; 93: 33-7. 10.106/j.ijgo.2006.01.003 (PubMed) (Cross Ref).
13. Kasyan G, Tupikina N, Pushkar, D. Use of Martius flap in the complex female urethral surgery. Cent European J Urol. 2014; 67 (2): 202-207.

Correspondence to:
Vimax.haverfield@nh.org.au

Original article

A critical review of TFS ligament repair. Part 3: The role of ligaments in the control of bladder, bowel and pain symptoms

DARREN M GOLD[1], DAVID ENDE[2]

[1] *Colorectal Surgeon, Senior Lecturer in Surgery, St Vincent's Clinical School, UNSW, Sydney, Australia*
[2] *Urologist, St Vincents Clinic, Senior Lecturer; Notre Dame Medical School, Sydney, Australia*

Background. Fundamental to the understanding of abnormal bladder, bowel and pain symptoms is the understanding of normal control mechanisms. Essentially, pelvic symptoms can mainly be attributed to dysfunctions of organ closure (incontinence), evacuation (emptying), control of the micturition and defecation reflexes, and pelvic pain. *Aim*. To explain the role of intact ligaments and vagina in the control of these normal functions. *Methods*. Seven key anatomical points are identified by the Integral Theory for normal pelvic function. Each of these is critically analysed with reference to Parts 1& 2. The urethra and anus function as emptying tubes for evacuation of the bladder and rectum. They are opened and closed by 3 directional muscle forces contracting or relaxing in concert against anterior (PUL, pubourethral) and posterior (CL/USL cardinal/uterosacral) suspensory ligaments. *Conclusions*. These 7 basic anatomical points prepare the groundwork for Part 4, how two main ligament groups are associated with the generation of pain and major symptoms of bladder and bowel dysfunction, pubourethral ligaments anteriorly and cardinal/uterosacral ligaments posteriorly.

Keywords: TFS; Urge incontinence; nocturia; chronic pelvic pain; fecal incontinence; obstructive defecation; abnormal emptying.

INTRODUCTION

This is the third of four related papers seeking to critically analyze the TFS ligament repair system and the Integral Theory System on which it is based. The first two articles have been previously published[1,2].

The Integral Theory[3], states that: *"Pelvic organ prolapse, bladder and bowel dysfunction and some types of pelvic pain, mainly derive, for different reasons, from laxity in the vagina or its supporting ligaments, a result of altered collagen/elastin."*

The Integral Theory System or Integral System is a self-contained entirely anatomical system of female pelvic floor management. A comprehensive account can be found in the textbook *"The Female Pelvic Floor. Function, Dysfunction and Management according to the Integral Theory"*, 3rd Edition, 2010, Petros PEP, Springer, Heidelberg.

Understanding the role of ligaments in the normal mechanisms is fundamental to understanding pain, bladder and bowel dysfunctions and how to fix them. Based on the anatomy detailed in Part 1 and historical observations following repair of damaged ligaments in Part 2, it is possible to state that there are 7 key anatomical points which are important for normal function of the pelvic floor. As regards dysfunction, the key to understanding symptom cure is that laxity (mainly) in the pubourethral and cardinal/uterosacral ligaments weakens the muscle forces contracting against them. In up to 30% of women, this laxity may set off a cascade of bladder, bowel and pain symptoms.

Anatomical point 1. The urethra and anus function as emptying tubes for evacuation of the bladder and rectum[3], fig. 1.

Anatomical point 2. These evacuation tubes are opened and closed by 3-directional muscle forces acting in concert against anterior (PUL) and posterior (CL/USL) suspensory ligaments[3-6], fig. 1.

How the 3 directional forces close bladder neck: with reference to fig. 1, LP (Levator Plate) inserts into the posterior rectal wall. It pulls the rectum, vagina and bladder base backwards via their attachments to each other (which include the vesicovaginal ligament 'VVL'). Downward contraction of the conjoint longitudinal muscle of the anus (LMA), pulls down the anterior lip of LP, rectum, vagina and bladder base. This action rotates the bladder base around the PUL and with contraction of the PCM distal to the PUL acts to 'kink' the bladder neck. See also figs 2 & 3.

How the 3 directional forces open out the urethral tube, fig1: PCM (pubococcygeus) relaxes to relieve the forward tension on the urethra. LP pulls the bladder base backwards; LMA pulls the bladder base downwards to open the outflow tract.

How the 3 directional forces close the anal tube, fig. 1: LP contracts backwards. LMA pulls down the anterior lip of LP to rotate the rectum around a contracted PRM (puborectalis muscle) to create the anorectal angle and closure. See also fig. 5.

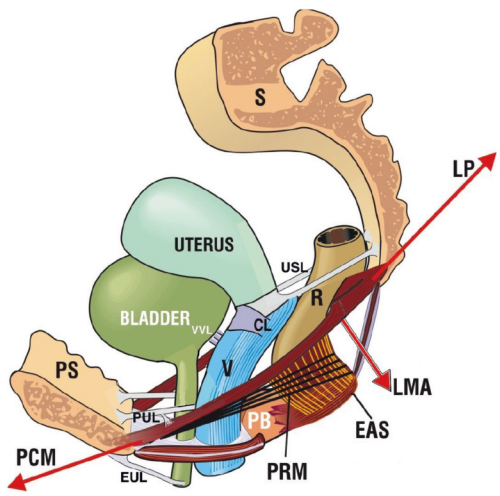


Figure 1. – Directional muscle forces and their relationship to ligaments. 3D Sagittal view, standing.
Forward contraction pubococcygeus muscle (PCM); puborectalis muscle (PRM).
Backward/downward contraction levator plate (LP); conjoint longitudinal muscle of the anus (LMA). PCM, LP contract against PUL; LP/LMA contract against CL/USL. PRM does not contract against any ligaments, only against pubic symphysis (PS); S=sacrum; V=vagina; CL=cardinal ligament; USL=uterosacral ligament; EAS=external anal sphincter; R=rectum.

(*Active opening by an external striated muscle force (LP/LMA), figure 3, exponentially decreases the internal frictional resistance to flow, inversely by the 4th power of radius change (Poiseuille's Law), enabling a much lower expulsion pressure by the detrusor[7,8]).

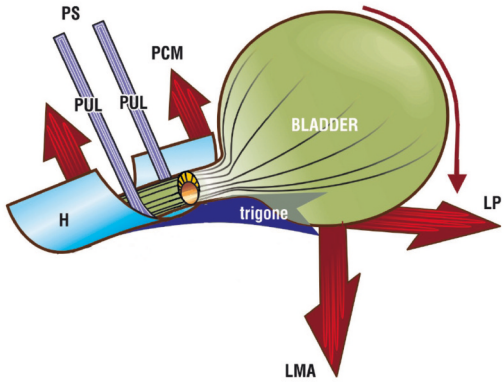


Figure 2. – Bladder neck closure mechanism. This is the main closure mechanism for urinary continence. LP contracts against PUL to stretch the trigone backwards; LMA contracts against USL to pull the trigone downwards. This action rotates the bladder neck around PUL to effect 'bladder neck' closure. The distal urethral closure is achieved by PCM pulling the distal vagina 'H' forwards to close the distal urethra. This action mainly seals the urethra.

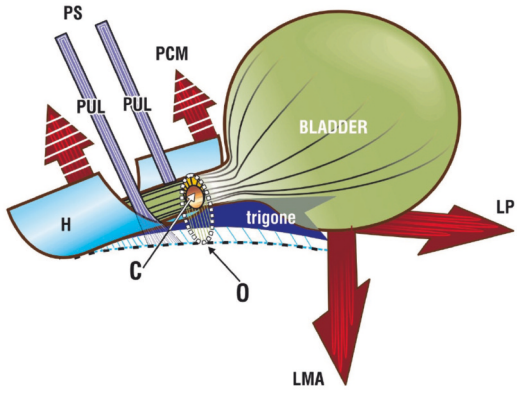


Figure 3. – Micturition, the mechanical dimension. PCM relaxes (broken lines). Initially, the LP stretches the vaginal hammock (H) and trigone backwards; next, the LMA stretches vagina and trigone downwards to open the urethra from "C" (closed) to "O" (open). External opening of the urethra vastly reduces the frictional resistance to urine flow. Arrows = muscle forces. LMA contracts against USL's. (see also fig 1).

How the 3 directional forces open the anal tube, fig. 1: PRM relaxes; LP pulls rectal wall backwards as the LMA pulls it downwards to open the posterior aspect of the outflow tract. The PCM also pulls forward opening out the anterior wall of the anus/rectum. See also fig. 5.

Anatomical point 3. Bladder closure (continence), fig. 2. On effort, a closure reflex activates the fast-twitch striated muscle fibres to close the urethral tube at the distal urethra and bladder neck. Both mechanisms require a competent PUL[3-6]. Mechanically closing the urethral tube exponentially increases the internal frictional resistance to flow (continence), inversely by the 4th power of radius change (Poiseuille's Law)[7,8].

Anatomical point 4. Micturition, mechanical dimension, fig. 3. As the bladder fills, the micturition reflex is activated: PCM relaxes (broken lines); the backward muscles, LP and LMA contract to mechanically open out the urethra; the smooth muscle of the detrusor contracts (spasms) to evacuate the urine[5,6]. This mechanism requires a competent USL (see fig. 1). A loose USL reduces the LP/LMA opening force, so the detrusor has to contract against a higher urethral resistance*. The patient perceives this as 'obstruction' to flow. There is indeed an obstruction, but it is frictional, not mechanical.

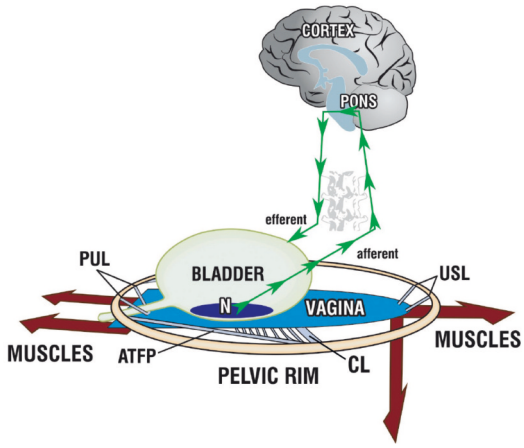


Figure 4. – Peripheral control of urgency, normal woman. Schematic 3D view. The 3 muscle forces stretch the vagina bilaterally against the suspensory ligaments* to support the stretch receptors 'N', preventing activation of the micturition reflex (small green arrows). Like a trampoline, any loose spring (ligament) may invalidate vaginal stretching, so 'N' fires off at a low bladder volume (urgency).
* mainly PUL, CL, USL.

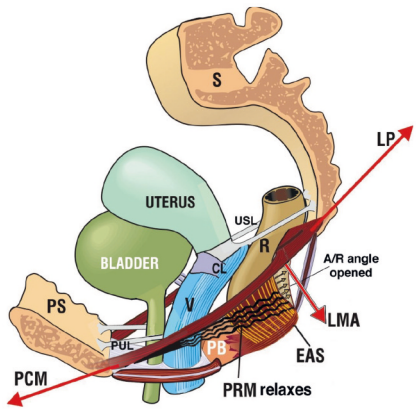


Figure 5. – Anorectal closure and defecation standing, sagittal view.
Anorectal closure Puborectalis muscle (PRM) contracts forwards; LP stretches the posterior rectal wall backwards; LMA rotates the rectal wall downwards around the contracted PRM to create the anorectal angle and closure.
Defecation Puborectalis muscle (PRM) relaxes (wavy lines). This allows the posterior vectors LP/LMA to stretch open the posterior wall of the anorectum, opening out the anorectal angle (small arrows posterior to R). PCM stabilizes the anterior rectal wall, preventing it from prolapsing inwards. Active opening exponentially decreases the internal frictional resistance, inversely by the 3rd power of radius change. The rectum contracts and empties.

Anatomical point 5. Micturition control, the neurological dimension[5-10], fig. 4. The micturition reflex is activated by stretch receptors within the bladder wall, 'N'. 'N' sends afferent impulses to the cortex which are interpreted as urge symptoms. If it is inconvenient to empty, the feedback system activates slow-twitch stretching of the vagina to support the bladder base stretch receptors: all 3 muscles, (large arrows) contract to support 'N', reducing the afferent (urge) signals.

Anatomical point 6. Defecation and anal continence[11-13]. The mechanics of anorectal continence and defecation, fig 5, are very similar to those of the bladder. During defecation, the forward muscle vector, the puborectalis relaxes; the backward LP/LMA muscle vectors open out the posterior rectal wall an-

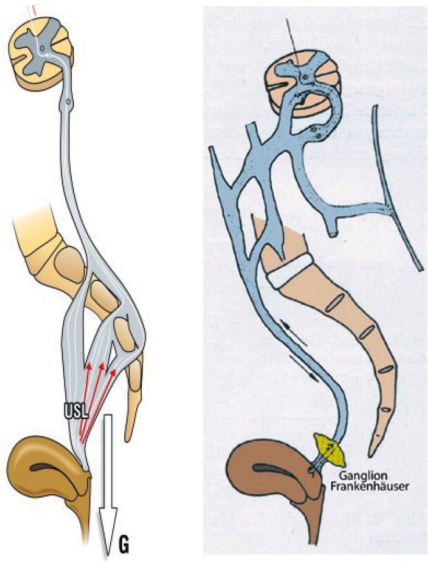


Figure 6. – Origin of chronic pelvic pain
Left figure S2-4 distribution, parasympathetic nerve pathway. If the uterosacral ligaments (red arrows) cannot provide adequate anatomical support for the nerves (thin white lines) the force of gravity (G) may stretch them, causing referred pain in the distribution of S2-4: vulva, perineum, vagina, paraurethral, low sacral, perhaps even interstitial cystitis pain.
Right figure with T12-L1 distribution, sympathetic nerve pathway, Ganglion of Frankenhauser. If the uterosacral ligaments cannot provide adequate anatomical support for the nerve plexus, anything which stretches the nerves, for example, gravity, may cause referred pain in the nerve distribution T12-L1, groin, low abdomen, abdominal, contact dyspareunia.

gle; the PCM opens out the anterior rectal wall and the rectum contracts to expel faeces. The defecation reflex is activated by stretch receptors within the rectal wall. Like the bladder, control of the reflex is reliant on adequate bilateral stretching by PCM & LP/LMA (large arrows, fig. 5).

Anatomical point 7. Origin and prevention of chronic pelvic pain. The are two types of chronic pelvic pain distributions, the sacral plexus (S2-4), fig. 6 and the sympathetic plexus of Frankenhauser (T11-12-L1)[14-17]. These derive from the inability of the uterosacral ligaments to support the nerve plexuses.

CONCLUSIONS

These 7 basic anatomical points prepare the groundwork for Part 4, how two main ligament groups are associated with the generation of pain and major symptoms of bladder and bowel dysfunction, pubourethral ligaments anteriorly and cardinal/uterosacral, perineal body ligaments posteriorly.

CONFLICTS

There are no financial conflicts.

REFERENCE

1. Gold DM, Ende D. A review of the Integral Theory of Pelvic Organ Prolapse and proposed concept of repair: Part 1-Structural components and damage. Pelviperineology, 2016: p. 74-76.
2. Gold DM, Ende D. A review of the Integral Theory of Pelvic Organ Prolapse and proposed concept of repair: part 2–the TFS ligament repair. Pelviperineology, 2017: p. 3-8.
3. Petros PE, Ulmsten UI. An integral theory of female urinary incontinence. Experimental and clinical considerations. Acta Obstet Gynecol Scand Suppl, 1990. 153: p. 7-31.
4. Zacharin RF. The Suspensory Mechanism of The Female Urethra. J Anat, 1963. 97: p. 423-7.
5. Petros PE, Ulmsten U. Role of the pelvic floor in bladder neck opening and closure I: muscle forces. Int Urogynecol J Pelvic Floor Dysfunct, 1997. 8 (2): p. 74-80.
6. Papa Petros PE, Ulmsten U. Role of the pelvic floor in bladder neck opening and closure II: vagina. Int Urogynecol J Pelvic Floor Dysfunct, 1997. 8 (2): p. 69-73.
7. Bush MB, Petros PE, Barrett-Lennard BR. On the flow through the human female urethra. J Biomech, 1997. 30 (9): p. 967-9.
8. Papa Petros PE, Bush MB. A mathematical model for micturition gives new insights into pressure measurement and function. Int Urogynecol J Pelvic Floor Dysfunct, 1998. 9 (2): p. 103-7.
9. Petros PE, Ulmsten U. Bladder instability in women: a premature activation of the micturition reflex. Neurourol Urodyn, 1993. 12 (3): p. 235-9.
10. Petros P, Ulmsten U. Is detrusor instability a prematurely activated (but otherwise normal) micturition reflex? Lancet, 1997. 349 (9050): p. 505.
11. Petros PE, Swash M. The Musculoelastic Theory of Anorectal Function and Dysfunction. Pelviperineology, 2008. 27: p. 89-121.
12. Petros P et al. Defecation 1: Testing a hypothesis for pelvic striated muscle action to open the anorectum. Tech Coloproctol, 2012. 16 (6): p. 437-43.
13. Bush M et al. Defecation 2: Internal anorectal resistance is a critical factor in defecatory disorders. Tech Coloproctol, 2012. 16 (6): p. 445-50.
14. Martius H. Über einen häufigen gynäkologischen Symptomkomplex. Archives of Gynecology and Obstetrics, 1938 (166): p. 332-335.
15. Petros PP. Severe chronic pelvic pain in women may be caused by ligamentous laxity in the posterior fornix of the vagina. Aust N Z J Obstet Gynaecol, 1996. 36 (3): p. 351-4.
16. Petros P, Ulmsten U. The posterior fornix syndrome: A multiple symptom complex of pelvic pain and abnormal urinary symptoms deriving from laxity in the posterior fornix. Scand J Urol Nephrol. 1993. 27 (153): 89-93.
17. Petros P, Richardson PA. TFS posterior sling improves overactive bladder, pelvic pain and abnormal emptying, even with minor prolapse-a prospective urodynamic study. Pelviperineology 2010; 29: 52-55.

Correspondence to:
Darren Gold
193 Macquarie St - Sydney 2000 None
Non-US/Canada - Australia
E-mail: dandjgold@gmail.com

History

Biography of Salvador Gil Vernet, eminent urologist anatomist (1892-1987)

JOSÉ M. GIL-VERNET SEDÓ

Centro Médico Teknon, Barcelona Spain

Abstract: Salvador Gil Vernet 1892-1987 was a pioneering surgeon scientist who made many innovations and surgeries. His approach was quite revolutionary at the time. He stated that it was not sufficient to describe an anatomical structure. He said that an answer was required to the question of *"what is it for"*. *"Precise, almost mathematical knowledge of anatomy is a highly fertile source of surgical applications, suggesting new techniques and helping perfect and simplify existing surgical methods, making them less mutilating and more benign and, in short, raising surgery to the rank of true science."* His innovations were many and varied. He invented a new sacral epidural anesthesia technique to be applied in prostatic surgery. In 1919, in cooperation with Dr. F. Gallart, he described, for the first time in the human being, the lower mesenteric ganglion. In 1926 he published "El Sistema Nervioso Órgano-vegetativo. Contribución a su estudio anatómico y embriológico" where he tried to unravel how anastomoses are formed between the various ganglionic areas during embryonic development. At the end of the 1920s, Gil Vernet's research was centered on the study of the topographic anatomy of the male pelvis and perineum, with a specific focus on the bladder, the neural pelvic plexus and the prostate. In 1944 in the volume "Cáncer de Próstata", which is considered the most outstanding Spanish contribution to studies in urology, highlights the importance of diet, race and, genetics in the development of prostate cancer and showing that malignant neoplasms usually originates in the prostate gland itself and not in areas of benign prostate hyperplasia. One important contribution was the discovery of the "precervical arc of Gil Vernet" which many years later provided the key to the mechanism of how the female urethra is closed by the 3 directional forces discovered by Petros & Ulmsten in their pioneering work on the midurethral sling.

Keywords: Historical; Anatomy; Urology.

Salvador Gil Vernet was born in the small town of Vandellós province of Tarragona (Spain) on August 10th, 1892. During his childhood, he showed great passion for the natural sciences and showed a great enthusiasm for botany, which he practiced during his summer holidays. In 1903, Josep Musté, a medical doctor, formerly in Vandellós, wrote in a letter to Salvador's parents. "*I was duly informed about young Salvador's outstanding performance at school. It does not surprise me at all, since many years ago I had predicted that the kid, properly supervised, would eventually become renowned*".

In 1909, at the end of his high school years, he moved to Barcelona and entered the School of Medicine of the University of Barcelona, from where he graduated with outstanding grades on June 30th, 1915. During his university years, he worked as an anatomy assistant in the Anatomy Department (Fig. 1). In 1918 he submitted his doctoral thesis and was temporarily appointed to an assistant professorship in the Anatomy Department which was at the time directed by Prof. Emili Sacanella (1860-1931). He married Mercedes Vila Sanromá in 1920 (Fig. 2), and had two children, Salvador(1921-1965) and José María (b. 1922); both would become urologists. The same year, he failed in his first competitive exams to become a Professor of Anatomy in Madrid. Prof. Santiago Ramón y Cajal, president of the board of examiners, did not give his vote for Salvador or anyone else, claiming that «*In my opinion, there are no appropriate candidates sitting these exams because some of them are too old to start working as scientific researchers and the others do not have enough experience, as they are too young*». Thus, the position remained vacant.

In 1926 he successfully became a Professor in the Anatomy department at the Universidad de Salamanca, where he asked for an extended leave of absence to pursue his professional interests in Barcelona. He obtained the position two years later, and was transferred to Barcelona. On July 4th, 1928 he officially took over the Anatomy department at the Universitat de Barcelona also performing functions as Director of the Professional School of Urology at the Hospital Clinic of Barcelona.

A few weeks after the outbreak of the Spanish Civil War, on August 19th, 1936, due to his conservative ideas, he was dismissed by the Government of the Spanish II Republic and along with other professors of the Universitat de Barcelona, was relieved of all responsibilities. Persecuted by commu-

Figure 1. – Salvador Gil Vernet (right) with his students in a practical class of Anatomy at the old Santa Creu Hospital (1918).

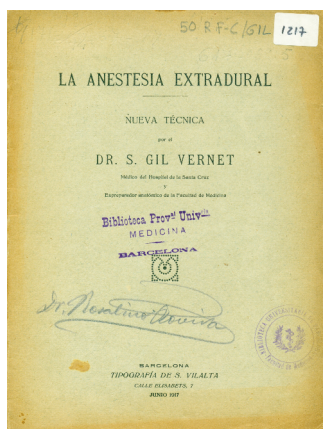


Figure 2. – The first description of a sacral epidural anesthesia (1917).

nists and anarchists, he decided to live in exile. Years later he would remember, «*When, on the evening of August 14th, 1936, from the French ship Cortes II, I thought I was saying, 'Goodbye, forever!' to my country, I experienced emotions hitherto unknown. Suddenly, I had lost everything that a man can lose, save only honor and life, and these had been saved thanks only to the charity of the diplomats of Nicaragua and France*». He lived first in Toulouse, France, and then in Italy, where he took part in the foundation of the Mediterranean Urology Association. He eventually returned to Barcelona in 1939, once again joining the Anatomy department.

In his double professional role as anatomist and urologist, Gil Vernet often noted his findings in the dissection room, and the operating theatre were uncorrelated to the descriptions in the classical topographic anatomy treatises published in the mid-nineteenth century. These contradictions prompted him to an exhaustive and careful study of male urogenital anatomy and his projection in the genitourinary physiology, which extended over more than forty years. During his long scientific career, Gil Vernet delved into his studies with great discipline and effort. As he used to say: "*Scientific inspiration does not exist if not accompanied by cerebral sweating*". His findings were crucial also to comprehending the anatomy and pathological processes of the prostate and to designing less invasive new surgical techniques for radical perineal prostatectomy.

Thanks to his vast, daunting work during the 1950s and 1960s, the Urological Department of Prof. Gil Vernet would become one of the most prestigious urologic institutes in the world, a venue hosting urologists such as Prof. Adolphe Steg (France), Prof. Ian Thompson (USA), Prof. Ermanno Mingazzini (Italy) or Prof. Willy Gregoir (Belgium) among many others (Fig. 3). As a result of the department's great international projection, Gil Vernet maintained fruitful exchanges with the Nobel Prize Prof. Charles B. Huggins through frequent correspondence (Fig. 4) and was invited as Lecturer to the University of Chicago.

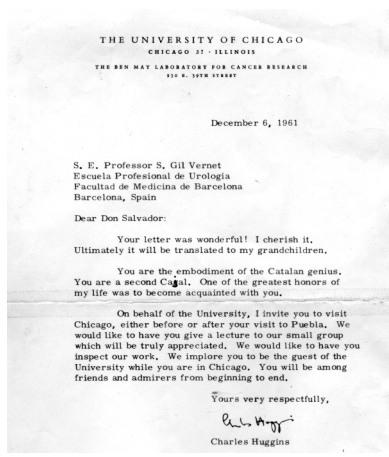
Salvador Gil Vernet retired from his professional activity when he was 75 and dedicated his last years to the cultivation of roses and lemon trees in his house by the sea in Castelldefels (Barcelona). He passed away in Barcelona on October 24th, 1987 and was buried in Vandellós.

AWARDS

In 1948, he became a full member of the Royal Academy of Medicine and Surgery of Barcelona. In 1965, he received the "Pedro Virgili" National Surgery Prize and the "Antoine Portal" Prize of the National Medicine Academy of France. He was elected President of the Societé International d'Urologie between 1967 and 1973. In 1967, he was appointed Honorary Chairman of the Spanish Urological Association, and in 1977 he was appointed Honorary Professor of the Royal National Academy of Medicine of Spain. He was also granted the distinctions of Knight of the Legion of Honour of France and Doctor Honoris Causa by the University of Toulouse (Fig. 5). Recognition also came in the form of being named an Honorary Member of the Urology Associations of France, Italy, Greece, Mexico and Colombia, and was a guest lecturer at the Universities of Chicago, Columbia, the Autonomous University of Mexico, Buenos Aires, Bogotá, Toulouse, Tokyo, Amsterdam, Johannesburg and Munich. In 1986, the received, alongside his son, José María Gil-Vernet Vila, the "Narcís Monturiol Prize" awarded by the Government of Catalonia.

Figure 3. – Salvador Gil Vernet and Mercedes Vila wedding day (1920).

Figure 4. – Salvador Gil Vernet (right) with Prof. Willy Gregoir. In the Assembly Hall of the Barcelona Faculty of Medicine, during the 1st International Urology Course (1962).



THE UNIVERSITY OF CHICAGO
CHICAGO 37 · ILLINOIS
THE BEN MAY LABORATORY FOR CANCER RESEARCH
950 E. 59TH STREET

December 6, 1961

S. E. Professor S. Gil Vernet
Escuela Profesional de Urologia
Facultad de Medicina de Barcelona
Barcelona, Spain

Dear Don Salvador:

Your letter was wonderful! I cherish it. Ultimately it will be translated to my grandchildren.

You are the embodiment of the Catalan genius. You are a second Casal. One of the greatest honors of my life was to become acquainted with you.

On behalf of the University, I invite you to visit Chicago, either before or after your visit to Puebla. We would like to have you give a lecture to our small group which will be truly appreciated. We would like to have you inspect our work. We implore you to be the guest of the University while you are in Chicago. You will be among friends and admirers from beginning to end.

Yours very respectfully,

Charles Huggins

Figure 5. – Letter from Prof. Charles B. Huggins inviting Salvador Gil Vernet for a lecture at the University of Chicago (1961).

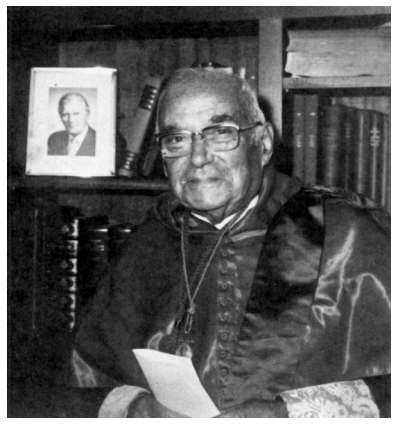


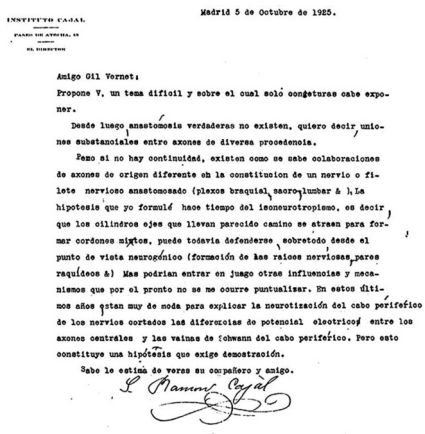
Figure 6. – Salvador Gil Vernet *Doctor Honoris Causa* by the University of Tolouse (France) ca. 1960.

SCIENTIFIC WORK

In 1917, based on his work on his studies of pelvic anatomy and in collaboration with Dr. F. Margarit, director of the Department of Anatomy at Hospital de la Santa Creu, described a new sacral epidural anesthesia technique to be applied in prostatic surgery (fig. 6). In 1919, in cooperation with Dr. F. Gallart described for the first time in the human being, the lower mesenteric ganglion[1]. In 1926 he published "El Sistema Nervioso Órgano-vegetativo. Contribución a su estudio anatómico y embriológico"[2] where he tried to unravel how anastomoses are formed between the various ganglionic areas during embryonic development. Faced with the enormous complexity of this endeavor, he sought advice from Santiago Ramón y Cajal, whom he had met in 1920 as chairman of the Opposition Committee for the chair of Anatomy. From then on, the men maintained correspondence (Fig. 7).

At the end of the 1920s, Gil Vernet's research was centered on the study of the topographic anatomy of the male pelvis and perineum, with a specific focus on the bladder, the neural pelvic plexus and the prostate. Following in the steps of German morphologist Hermann Braus, Salvador Gil Vernet considered that it is not enough to determine the "what" and the "how" of an anatomical structure, an answer is needed to the question "what for". This way he strived to develop a functional urogenital anatomy, which better-allowed doctors to understand and explain the physiology of urination, erection and, ejaculation. Likewise, Gil Vernet provided new insights into the topographic anatomy of these structures, building bridges with surgery and helping to develop more precise and scientific surgical techniques[3].

Gil Vernet was an untiring worker in a country, Spain, which after its devastating Civil War was a wasteland for scientific research. Thanks to his effort and perseverance he was able to compensate for the economic hardships of the 1940s and published four books dedicated to the study of urogenital anatomy and pathology as well as over 50 journal publications between 1917 and 1977. Possibly his chief work was "Patología Urogenital"(Urogenital Pathology) , a three-volume work composed by "Cancer de Próstata" (Prostate Cancer)[4], "Biología y Patología de la Prostata" (Biology and Pathology of the Prostate)[5] and "Enfermedades de la Próstata" (Diseases of the Prostate)[6] focused on the study of the prostate, its embryology, topographic anatomy, pathology and surgical techniques and "Morphology and Function of Vesico-Prostato-Urethral Musculature"[7] a work dedicated to the study of the topographic and microscopic anatomy of the detrusor, trigone, vesical neck,



INSTITUTO CAJAL

Madrid 5 de Octubre de 1925.

Amigo Gil Vernet:
Propone V. un tema difícil y sobre el cual solo conjeturas cabe exponer.
Desde luego anastomosis verdaderas no existen, quiero decir uniones substanciales entre axones de diversa procedencia.
Pero si no hay continuidad, existen como se sabe colaboraciones de axones de origen diferente en la constitución de un nervio o filete nervioso anastomosado (plexos braquial, sacro-lumbar &). La hipotesis que yo formulé hace tiempo del isoneurotropismo, es decir que los cilindros ejes que llevan parecido camino se atraen para formar cordones mixtos, puede todavia defenderse sobretodo desde el punto de vista neurogénico (formación de las raices nerviosas, paraquídeos &) Mas podrian entrar en juego otras influencias y mecanismos que por el pronto no se me ocurre puntualisar. En estos últimos años estan muy de moda para explicar la neurotización del cabo periférico de los nervios cortados las diferencias de potencial electrico entre los axones centrales y las vainas de Schwann del cabo periférico. Pero esto constituye una hipótesis que exige demostración.
Sabe le estima de veras su compañero y amigo.
S. Ramón y Cajal

Figure 7. – Letter form Don Santiago Ramón y Cajal to Salvador Gil Vernet (1925).

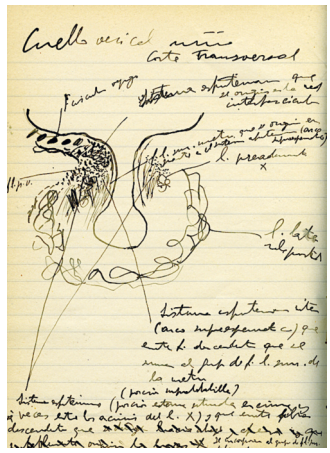


Figure 8. – Salvador Gil Vernet's field notebook.

posterior urethra, urogenital striated musculature and the vesicourethral musculature in woman.

In 1930 he started to apply the histotopographic method, a technique of anatomical study (whole-mount sections) in the uro-anatomy laboratory, which had been described by the German anatomist Otto Kalischer thirty years earlier[8]. With the help of the giant Sartorius-Werke microtome, he obtained frozen sections of the pelvic visceral block from fetal and adult specimens. About 200 preparations were collected from each specimen, with a thickness of 20 to 50 microns and measuring 12 to 9 centimeters. Microscopic observation at a magnification of 10x and 100x allowed microscopic dissection of muscle and nerve elements which would otherwise be invisible in the macroscopic examination.

Gil Vernet annotated the most interesting details in his field notebooks (Fig. 8), which would later be drawn in pencil and Indian ink by the second year students at a scale of 1:7 to 1:15. (Fig. 9) The incredible richness in the details in the drawings of the histotopographical sections was praised by Charles B. Huggins who wrote: "*Let the young surgeon study sagittal sections of the pelvis of the human male, for example, the beautiful studies of Gil Vernet*"[9]. Since 2005, a large number of drawings have been collected and restored, amounting to a total of 604 items, which now comprise the *Salvador Gil Vernet Collection of Urology Drawings*[10].

In 1944 in the volume "Cáncer de Próstata", which is considered the most outstanding spanish contribution to studies in urology, highlights the importance of diet, race and, genetics in the develpoment of prostate cancer and showing that malignant neoplasms usually originates in the prostate gland itself and not in areas of benign prostate hy-

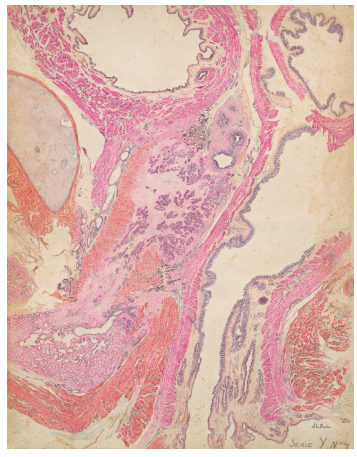


Figure 9. – Drawing from a sagittal histotopographic section. Newborn pelvis and perineum. H&E stain. Indian ink on paper, 64 x 50 cm. Artist: L. Roca, 1940.

perplasia. The chapter entitled "Anatomía Quirúrgica Prostatoperineal" describes the external urethral sphincter, for the first time in the twentieth century, as a tubular structure, vertically arranged and consisting of two layers, i.e. an internal layer formed of circularly – and longitudinally – arranged smooth muscle and an external layer of circular striated fibres which were divided into three areas: cranial, medial and caudal. He refuted the existence of a plate of muscle arranged transversely between the two ischiopubic rami, an error that was established in atlases and anatomy textbooks until the end of the 20th century. He also demostrated that the deep transverse muscle of the perineum does not exist an that the structures surroundig the bulbourethral glands are the dorsocaudal fibers of the external urethral sphincter. Also in this chapter, he shows that the vertical extension of the pelvic nervous plexus follows the posterolateral border of the prostate, forming, together with the accompanying vessels, the prostate neurovascular bundles. He also described a ventral prolongation of the pelvis plexus that forms the anterolateral and anteromedial vascualr pedicles. He wrote: *At every one of the four corners of the rectangle that makes up the prostatic cell, a neurovascular bundle is observed, and those are the bundles which carry the vessels and nerves intended for innervation and irrigation of the prostate, membranous urethra and the cavernous nerves, enabling erection*".

In "Biología y Patología de la Próstata" describes the first regional anatomical model of the prostate gland. He clearly demonstrated that the prostate is not a homogeneous gland and that it consists of three regions: the cranial, the caudal and the intermediate glands. He wrote: "*…accepting the principle of duality of the prostate gland as valid, we believe that a detailed analysis of these complex problems will not unequivocally support the final division between the cranial gland and the caudal gland. It is necessary to insert a portion between both poles, which we shall call the intermediate gland, establishing a smooth transition between the cranial and caudal portions*".

This model was urethrocentric, with areas defined according to the location of their collecting ducts opening into the urethra and was later used by McNeal, with minimal variations, as the foundation of his zonal anatomy model.

Gil Vernet observed that benign hyperplasia develops in the cranial gland and that carcinoma develops in the caudal gland. Prof. Charles B. Huggins cited this major work: "*The Gil Vernet Phenomenon wherein the human prostate is separated into two physiologically and oncologically different divisions, is of permanent value. It is a wonderful discovery*".

Also in this volume, he described a group of dorsal longitudinal smooth musculature which he called the posterior prostato-urethral muscular bundle, and which forms the relief of the mucosal fold in the infracollicular urethra known as christa urethralis. This muscular bundle originates below the ejaculatory ducts at the lower pole of the colliculus seminalis and runs dorsally and downwards ending into the penile bulb. The function of this muscle is to shorten and dilate the infracollicular urethra during ejaculation.

In "Biología y Patología de la Próstata" and in "Morphology and Function of Vesico-Prostato-Urethral Musculature" he studied the musculature of the bladder with the aim to determine the role of the different bundles of the detrusor and their relationship with the bladder neck and the prostate in urination and urinary continence. He observed that the pubovesical or puboprostatic ligaments are not really ligaments but fibers of the anterior longitudinal muscle layer of the detrusor covered by the endopelvic fascia, which run downwards and frontwards, running over the prostate and inserting into the pubis.

Gil Vernet was the first to describe the "transverse precervical arc", a triangular structure formed by the intersection of the outer, anterior and posterior longitudinal fibers of the detrusor in the caudal part of the bladder's anterior surface. The central part of this muscular triangle is mainly occupied by fibers with a vertical direction that come from the anterior wall of the detrusor. This muscular complex was called the "vesico-urethral retrosymphysial system."

In 1953 Gil Vernet described the posterior longitudinal fascia of the detrusor or the detrusor's posterior longitudinal bundle, which descends uninterruptedly from the urachus, running caudally between the ureters and covering the trigone and the dorsal wall of the internal vesical sphincter. Several medial bundles penetrate deep into the prostate, tapering, to end near the opening of the ejaculatory ducts at the colliculus seminalis. This bundle was described by Eduard Uhlenhuth[11] in the same year, although this author does not describe its caudal extension, which crosses the prostate.

REFERENCES

1. Gallart F, Gil Vernet S. El Simpàtic Abdomino-pelvià en el fetus humà. Treballs de la Societat de Biología. Publicacions de l'Institut de Ciències. Barcelona, 1918.
2. Gil Vernet S. El Sistema nervioso órgano-vegetativo. Contribución a su estudio anatómico y embriológico. Imprenta Badía. Barcelona, 1926.
3. Gil-Vernet JM, Arango O, Álvarez-Vijande R. Topographic Anatomy and its development in Urology in the 20th century. The work of Salvador Gil Vernet. Eur. J. Anat. 2016, 20 (3): 231-247.
4. Gil Vernet S. Patología Urogenital: Cáncer de Próstata. Book 1. Ed. Miguel Servet, Barcelona.1944.
5. Gil Vernet S. Patología Urogenital: Biología y Patología de la Próstata. Book 2. Vol.1. Ed. Paz Montalvo, Madrid. 1953.
6. Gil Vernet S. Patología Urogenital: Enfermedades de la Próstata. Book 2. Vol.2. Ed. Paz Montalvo, Madrid. 1955.
7. Gil Vernet S. Morphology and Function of Vesico-Prostato-Urethral Musculature. Ed. Canova, Treviso. 1968.
8. Kalischer O. Die Urogenitalmuskulatur des Dammes mit Besonderer Berücksichtigung des Harnblasenverschlusses. S Karger, Berlin. 1900.
9. Huggins C. Commentary on the tratment of prostate cancer. J Urol. 1969, 102 (2):119-120.
10. Gil-Vernet JM. The art of transforming science. Salvador Gil Vernet's modern understanding of urologic anatomy. Next Door Publishers, Pamplona, 2015.
11. Uhlenhuth E. Problems in the Anatomy of the Pelvis. An Atlas. Lippincott, Philadelphia, 1953.

Correspondence to:

Dr. José M. Gil-Vernet Sedó
Centro Médico Teknon
Vilana 12, Barcelona 08022, Spain
email: centrogilvernet@gmail.com

A MINIMALLY INVASIVE AND EFFECTIVE BRIDGE BETWEEN CONSERVATIVE THERAPY AND SURGERY FOR BOWEL INCONTINENCE

secca®

EFFICIENT
Performed in an outpatient setting

SAFE
Less than 1% complication rate*

EFFECTIVE
Up to 84% of patients experienced significant improvement*

QUICK RECOVERY
Return to normal activities in a few days

SECCA PATIENTS **84%** experienced significant improvement

Greater Quality of Life

Less than **1%** complications

MEDERI™

Distributore esclusivo:

INNOVA medica SPA

DILAGENT®

Curative “exercises” for anal fissures, haemorrhoids, hypertonic muscles and postsurgical stenosis

DILAGENT is a **soft silicone** anal dilator.
It is indicated for the treatment of anorectal diseases caused by a hypertonic sphincter, namely anal fissures, haemorrhoids and painful spasms after surgical treatment of the anorectal segment. It is also effectively used in cases of postsurgical stenosis of the anal canal.

sapimed S.p.A.
www.sapimed.com