NEW SURGICAL TECHNIQUES AND MEDICAL TREATMENT IN UROGYNECOLOGY

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Treatment of Stress Urinary Incontinence, Pelvic Floor Defects, and Overactive Bladder in Women

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I dedicate this book to my teachers, colleagues,
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FOREWORD

Urogynecology is an evolving subspecialty that is gaining public health interest and importance given the aging of the population. Urogynecology is a surgical subspecialty of gynecology that is acknowledged in most European countries.

The current edition of *New Surgical Techniques and Medical Treatment in Urogynecology*, by Prof. Alois Martan, is an exceptional book that discusses all of the major aspects of pelvic floor disorders, such as their anatomy, physiology, examination and pathophysiology; it summarizes surgical procedures for incontinence and prolapse as well as drug therapy for incontinence and overactive bladder. The chapters describe evidence-based results and comprehensively address the various issues with support from the author's long-standing clinical and scientific experience.

The book is a pearl for all persons in training for urogynecology and will serve as a handbook well worth reading even for the experienced surgeon. Novel techniques as well as complex aspects of pharmacotherapy are presented in a comprehensive manner. Overall, the reader will have an up-to-date overview of the complex field of urogynecology.

It will be beneficial for general gynecologists with an interest in urogynecology as well as urologists.

In the future, almost all specialties in medicine will be confronted with an aging population. In urogynecology in particular, it is important to offer a certain "repertoire" of surgical techniques that permit the individualization of surgical treatments.

This book aids in understanding and determining the best technique for a given individual.

Professor Dr. Med. Annette Kuhn
Frauenklinik Bern, Switzerland

CONTENTS

ABBREVIATIONS

ADH .... antidiuretic hormone
ATFP.......................... tendinous arch of the pelvic fascia (Arcus tendineus fasciae pelvis)
ATP .... adenosine triphosphate
AUGS .... American Urogynecological Society
BBB.......................... blood-brain barrier
BFLUTSQ.................. Bristol Female Lower Urinary Tract Symptoms Questionnaire
BMI.......................... body mass index
CDV.......................... color Doppler velocity
Charr........................ Charrière
CI .... confidence interval
CLPP .... cough leak point pressure
CNS.......................... central nervous system
CRADI .... Colo-Rectal-Anal Distress Inventory
CRAIQ .... Colo-Rectal-Anal Impact Questionnaire
DOI........................... 2,5-dimethoxy-4-iodophenylizopropylamine
EMG......................... electromyography
FDA.......................... Food and Drugs Administration
gh .... genital hiatus
ICIQ-UI SF................ International Consultation on Incontinence Questionnaire Short Form
ICS .... International Continence Society
IEF............................ Incontinence Episode Frequencies
I-QOL........................ Incontinence-Specific Quality of Life Questionnaire
IIQ .... Incontinence Impact Questionnaire
ISD .... intrinsic sphincter deficiency
IUGA .... International Urogynecological Association
IVS .... intravaginal slingplasty
IVU........................... intravenous urography
LPU .... low pressure urethra
LUTD .... lower urinary tract dysfunction
LUTS......................... lower urinary tract symptoms
MAUDE.................... manufactured and user facility device experience
MMK........................ Marshall-Marchetti-Krantz (procedure)

MUCP........................maximum urethral closure pressure
MUP..........................maximum urethral pressure
NE.............................norepinephrine (noradrenaline)
OAB...........................overactive bladder
OD.............................obstructive discomfort
pb..............................perineal body
PDS...........................poly-p-dioxanone suture
PFMT.........................pelvic floor muscle training
PISC12......................Pelvic Organ Prolapse / Urinary Incontinence Sexual Function Questionnaire
POP...........................pelvic organ prolapse
POPDI.......................Pelvic Organ Prolapse Distress Inventory
POPIQ.......................Pelvic Organ Prolapse Impact Questionnaire
POP-Q.......................Pelvic Organ Prolapse Quantification
PPIUS........................Patient Perception of Intensity of Urgency Scale
PVD...........................paravaginal defect
PVDR.........................paravaginal defect repair
PWT..........................pad-weighing test
Q...............................urine flow
QoL...........................quality of life
RR.............................risk ratio
RVT...........................retroversion flexion
SANS.........................Stoller afferent nerve stimulation
SIMS.........................Single-incision mini-slings
SIS.............................Single-incision sling
SMUS........................standard midurethral slings
SNRI..........................serotonin norepinephrine reuptake inhibitor
SUI............................stress urinary incontinence
TOT............................transobturator tape (out-in)
TVL...........................total vaginal length
TVT...........................tension-free vaginal tape
TVT-O.......................transobturator tape (in-out)
TVT-S........................TVT Secur system
UDI............................Urinary Distress Inventory
UI..............................urinary incontinence
UIQ............................Urinary Impact Questionnaire
US.............................ultrasound imaging
USI............................urodynamic stress incontinence
UVJ...........................urethrovesical junction
VCU..........................video cystourography
VLPP.........................Valsalva leak point pressure
VUDS........................video urodynamics

1 INTRODUCTION

The aging of our population and the pursuit of a good quality of life for women in old age has led to an attempt to solve the problem of pelvic organ prolapse. Such difficulties often occur later in life and may be associated with problems such as urine and stool incontinence, as well as feelings of tension and stress in the genitals. New investigative techniques and an improved understanding of the pathophysiology of these disorders facilitate their effective treatment. Unfortunately, questions sometimes arise concerning who should handle these problems: a gynecologist, urologist, or colorectal surgeon. In the treatment of some complicated cases, the cooperation of all experts is ideal. At present, we are training specialists who will handle these cases based on additional specialized education.

The International Continence Society (ICS) and the International Urogynecological Association (IUGA) are currently addressing pelvic organ prolapse and urinary incontinence (UI). One of their main aims is to standardize terminology for the function of the lower urinary tract and pelvic organs. Such standardization will facilitate good communication among professionals who handle these problems. UI in women is not a disease in the strict sense but rather a symptom that has different causes. It is defined as the complaint of any involuntary leakage of urine.

Large epidemiological studies suggest that the prevalence of UI in women ranges between 25 and 40% [1, 2]. Stress urinary incontinence (SUI), a passive leakage of urine through the urethra due to increased intra-abdominal pressure resulting from insufficiency of the locking mechanism without simultaneous contraction of the detrusor muscle, affects approximately 50% of incontinent women. Overactive bladder (OAB) has a typical set of symptoms of dysfunction of the lower urinary tract. Urgency is the primary symptom of OAB; it is often associated with incontinence and with frequent urination and nocturia. This syndrome affects the physical and emotional well-being of patients and significantly decreases the quality of life. In the general population over 40 years, the prevalence of OAB is approximately 18%. It increases in frequency with age, and in people over 75 years of age, the prevalence of OAB ranges from 31 to 42% [3, 4].

New medical treatments for OAB are more effective and have lower risks of side effects. Current surgical procedures are also better at treating problems associated with SUI and pelvic floor reconstruction. Postoperative recovery is shorter, and operations are more likely to succeed. Therefore, many women consider the inconveniences that incontinence, symptoms of urgency, or pelvic organ prolapse bring to their daily life, decide to address this problem, and entrust doctors with the treatment of their condition.

REFERENCES

1. Hannestad YS, Rortveit G, Sandvik H, et al. A community-based epidemiological survey of female urinary incontinence: The Norwegian EPINCONT Study. J Clin Epidemiol. 2000;1150–7.
2. Hunskaar S, Burgio K, Diokno AC, et al. Epidemiology and natural history of urinary incontinence. In: Abrams P, Cardozo L, Khoury S, et al., editors. Incontinence. Plymouth, UK: Health Publication Ltd. 2002; p. 165–201.
3. Milsom I, Abrams P, Cardovo L, et al. How widespread are the symptoms of an overactive bladder and how are they managed? A population-based prevalence study. BJU Int. 2001;87:760.
4. Martan A, Horčička L, Hanuš T, et al. Prevalence of women with overactive bladders in the Czech Republic. [Article in Czech] Ceska Gynekol. 2011;76:144–50.

2 ANATOMY OF THE LOWER URINARY TRACT

The normal function of the lower urinary tract depends on maintaining its internal integrity and positioning, as well as the mobility of organs in the pelvic floor [1, 2, 3, 4].

2.1 BLADDER

The urinary bladder is a hollow muscular organ located in the lesser pelvis with a capacity of approximately 500 ml. The inner surface is covered by transitional epithelium and is attached to the submucosal tissue. The bladder wall consists of three layers of smooth muscle tissue known as the detrusor muscle. The outer longitudinal layer passes along the inner longitudinal layer into the urethra. Fibers of the outer longitudinal layer originate laterally and posteriorly to the urethra. At the transition to the urethra, they have an oblique to circular shape, forming the detrusor loop. The inner longitudinal layer of the detrusor passes smoothly into the urethra. Its caudal portion forms a loop that is in opposition to the loop of the outer layer. The medium oblique or circular layer ends at the internal urethral orifice, where its fibers encircle the urethral opening [5]. Differentiation of these layers is possible at the base of the bladder, whereas at the vertex, this distinction is unclear. The detrusor consists of a tangle of fibers, and it is very difficult to differentiate each layer. The part of the bladder wall that surrounds the proximal urethra is called the neck of the bladder. The trigone is the portion of the bladder located between the openings of the ureters and the inner opening of the urethra. Within the trigone, we can differentiate the three layers described above. The trigone area has a different embryonic origin than the rest of the bladder and has no developed submucosal tissue. The blood supply to the bladder comes from the internal iliac artery and includes the superior and inferior vesical arteries. The venous network consists of vesical veins that carry blood to the internal iliac vein. The muscles of the bladder receive their motor innervation mainly from parasympathetic fibers (Chapter 3.3).

2.2 URETHRA

In women, the urethra is approximately 30 to 40 mm long and consists of three portions—the intramural, middle and distal (perineal) parts. The intramural part of the urethra runs through the bladder wall, and the middle part runs between the bladder and the perineal membrane (urogenital diaphragm). The urethra then passes through the perineal membrane and finally reaches the distal, perineal portion. The proximal two-thirds of the urethra consist of stratified transitional epithelium, which passes distally into non-keratinized stratified squamous epithelium. The venous plexuses in the urethral area are in the submucosa. In old age, the cavernous plexuses disappear as estrogen levels decrease; this disappearance has been associated with changes in the locking mechanism of the urethra. Externally, the urethra possesses a thicker inner longitudinal and thinner outer circular layer of smooth muscle, which are sometimes referred to as the internal sphincter muscles of the urethra. This structure most likely maintains a certain basal tension in the wall of the urethra. Outside the middle section of the smooth muscle of the urethra is a cross-striated muscle that can span between 20 and 80% of the urethral length. This muscle is strongest on the front surface of the middle third of the urethra and is known as the rhabdosphincter, or the external sphincter muscle of the urethra. In the proximal two-thirds of the urethra, the muscle fibers are oriented in a predominantly circular direction. The distal segment of the external urethral sphincter surrounds not only the urethra but also the vagina and is therefore known as the urethrovaginal sphincter. Cross-striated type I muscle fibers (slow-twitch fibers) cause low-intensity contractions that have long-term resistance to muscle fatigue. These fibers form most of the cross-striated muscle of the urethra and maintain its long-term tone. Cross-striated type II muscle fibers (fast-twitch fibers) cause high-intensity contractions that last a few seconds and have a low resistance to fatigue. The type II fibers generate a short-term increase in intraurethral pressure, which plays a major role in maintaining urinary continence during sudden increases in intra-abdominal pressure [6]. The urethral arteries originate from the inferior vesical arteries and the vaginal artery, which is a branch of the uterine artery. The outer portion of the urethra is supplied by the internal pudendal artery. The smooth muscle of the urethra is innervated predominantly by the sympathetic nervous system, and the cross-striated muscle is innervated via the pudendal nerve.

To ensure continence (particularly during periods of increased intra-abdominal pressure), the bladder, its neck, and the urethra must be fixed in the correct position, which is facilitated by the muscles and fascia of the pelvic floor as well as the ligaments that position the urethra among the surrounding structures. The pelvic floor and perineal membrane (urogenital diaphragm) provide structural integrity for the bottom of the abdominal cavity.

2.3 PELVIC FLOOR (PELVIC DIAPHRAGM)

The levator ani is a cross-striated muscle that forms the levator hiatus at the midline, which includes the urogenital hiatus proper. The levator ani consists of several parts, including the puborectal, pubococcygeus (sometimes defined together with the pubovisceral muscle), iliococcygeus, and coccygeus (ischiococcygeus) muscles. The ischiococcygeus muscle is often rudimentary; it extends from the ischiadic spine to the coccyx and is located on the surface of the sacrospinous ligament. The iliococcygeus muscle originates from the obturator internus fascia and attaches itself to the edge of the coccyx and sacrum. The pubococcygeus muscle extends dorsally from the dorsal part of the pubic bone and the anterior part of the obturator membrane, connects with the fibers of the contralateral pubococcygeus muscle at the anococcygeal raphe, and then attaches to the anterior wall of S4 and the first coccygeal vertebrae. The puborectal muscle encircles the anus dorsally at the level of the anorectal junction. This last muscle is the most important muscle for the function of the pelvic diaphragm because it supports organs that pass through the diaphragm via the levator hiatus. When levator ani drops, the hiatus opens, thus increasing the risk of pelvic organ prolapse. The superior and inferior rectal arteries provide the main arterial supply to this area. Venous blood flows out of the region through the rectal veins into the inferior vena cava. The levator ani is primarily innervated by the pudendal nerve.

2.4 UROGENITAL DIAPHRAGM

The urogenital diaphragm (or the perineal membrane) has previously been described as a double fibrous structure that runs from the pubic bone to the ischium. Its fibers are fixed in the perineum, and it has a triangular shape. Among its leaves is a layer of cross-striated muscle fibers that form the compressor urethrae and urethrovaginal sphincter muscles, formerly called the deep transverse perineal muscle. On the lower leaf of the diaphragm are the surface muscles—the superficial transverse perineal, ischiocavernosus and bulbocavernosus muscles. These muscles provide little support for the lower urinary tract. A connective muscle layer, or perineal membrane, is also present. The fibrous strands, or pubourethral ligaments, perform a variety of functions. They are bilateral, symmetrical ligaments that attach the urethra to the pubic bone. In addition to collagen and elastic connective tissue fibers, the pubourethral ligaments contain a certain amount of smooth muscle fibers. The pubourethral ligaments have three parts, of which the most important is the posterior part, or the dorsal pubourethral ligament. The main vascular supply of the perineum is provided by the internal pudendal arteries and veins.

2.5 SUSPENSORY APPARATUS OF THE VAGINA

Level I

In its cranial region, for approximately 3 cm, the front and rear walls of the vagina are attached and anchored in the dorsocranial direction of the proximal paracolpium by the sacrouterine and cardinal ligaments. Defects at this level cause a descent of the vaginal apex or uterine prolapse [1, 7, 8].

Level II

In its middle part, the vagina has a butterfly-like cross-section. Proximal vaginal protrusions are attached to the levator ani. The distal protrusions are connected by short ligaments to the area of the levator muscle and rectum. The attachment of the paracolpia strengthens the muscle fascia. This strengthening is called the tendinous arch of the pelvic fascia, or the arcus tendineus fasciae pelvis (ATFP) [9]. A defect in the suspensory apparatus is known as a paravaginal defect (PVD), which is clinically expressed as a traction cystocele. Defects in fixation of the frontal vaginal edges compromise urethral support, resulting in hypermobility of the urethrovesical junction (UVJ), which may be the cause of SUI. A defect in the ligaments anchoring the rear edges of the vagina to the levator ani results in rectocele.

Level III

Cranially from the hymenal ring, the vagina is supported by a strong connection with the perineal membrane. The posterior region of this membrane combines into a solid perineal body. The distal urethra is firmly fixed to the anterior vaginal wall, where the vagina has a U-shaped cross-section. The distal type of rectocele develops when the tendinous center is defective. Studies of levator trauma have demonstrated that level III is more important than previously thought in the pathophysiology of static disorders of the pelvic floor.

REFERENCES

1. DeLancey JO. Structural support of the urethra as it relates to stress urinary incontinence: the hammock hypothesis. Am J Obstet Gynecol. 1994;170:1713–20.
2. DeLancey JO. Stress urinary incontinence: Where are we now, where should we go? Am J Obstet Gynecol. 1996;175:311–9.
3. Gosling JA. The structure of the bladder neck, urethra and pelvic floor in relation to female urinary continence. Int Urogynecol J Pelvic Floor Dysfunct. 1996;7(4):177–8.
4. Halaška M, et al. Urogynekologie. Praha: Galén; 2004. 256 p.
5. Tanagho EA, Smith DR. The anatomy and function of the bladder neck. Br J Urol. 1966;38:54–71.
6. Eardley I, Fowrer CJ. Urethral Sphincter Electromyography. Int Urogynecol J Pelvic Floor Dysfunct. 1993;4:282–6.
7. DeLancey JO. Anatomy and biomechanics of genital prolapse. Clin Obstet Gynecol. 1993;36:897–909.
8. DeLancey JO, Morgan DM, Fenner DE, et al. Comparison of levator ani muscle defect and function in women with and without pelvic organ prolapse. Obstet Gynecol. 2007;109:295–302.
9. Monga A. Fascia – defects and repair. Curr Opin Obstet Gynecol. 1996;8:366–71.