Female Urology

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Structure and Forces of Continence

FOREWORD

"As women draw near the common goal,
can anything be sadder
than she who, mistress of her soul,
is servant to her bladder?"

Anonymous

An old Spanish proverb says, "Six men give a doctor less to do than one woman." Although this is a blatantly male chauvinistic statement, there may be an iota of truth in the words as they apply to the female patient with chronic lower urinary tract dysfunction and distress. Fortunately, however, female urology has come of age. Perhaps no phase of urologic practice in the last decade has flourished as has female urology. This book by Shlomo Raz and his contributors addresses itself to fundamentals of lower urinary tract function and disease and will be a great resource of information concerning current urologic practice.

The books begins with fundamentals, including embryology of the (female) genitourinary tract, neuroanatomy, and physiology of the bladder and urethra, then analyzes the dynamics of continence mechanisms. It addresses the evaluation of women with disorders of the lower urinary tract, logically discussing what diagnoses can be made legitimately by careful history taking, physical examination, and simple clinical tests. Endoscopy of the urethra and bladder has been greatly advanced by the advent of magnificent instruments and optics. Endoscopic photography and television have made it possible to record and document lesions, and urodynamic evaluation of the lower urinary tract has allowed us to elucidate and codify many heretofore vague and poorly understood conditions. Since most functional problems of the lower urinary tract in women do not require the detailed urodynamic studies described in this volume, the authors place these sophisticated tests in proper perspective. Finally, in this section, a review of the techniques and developments in uroradiology as they apply to the female bladder and urethra are presented in a clear and concise fashion.

Urinary incontinence in women is a multifaceted subject. Precise diagnosis of incontinence problems is now possible in the vast majority of cases. The treatment of bladder hyperreflexia is quite different from that of simple stress incontinence. However, the two conditions may coexist, and it is the aim of the authors to present the caveats and therapeutic options that may vary widely in some cases but overlap in others. Urologists admit that the treatment of simple stress incontinence is not uniformly successful. The authors of this book tell why failures occur. A substantial chapter is devoted to nonsurgical treatment of urinary incontinence and is followed by presentations of surgical technique for urethrovesical suspensions by the retropubic approach and by vaginal access. The well-trained urologist should be capable of performing transvaginal urethropexy with as much facility as retropubic suspension. The urologist today needs to be better trained in vaginal surgery.

Who understands bladder physiology and pathology better than he? Who should know how to manage urethral diverticula, periurethral fibrosis, urethrovaginal fistula, vesicovaginal fistula, urethrocele, and loss of support of the vesicourethral angle better than the urologist? We can boast an enviable record of success in treating complicated stress incontinence by either retropubic or transvaginal suspension of the bladder neck. However, some cases are unusually difficult, complicated, or intransigent. The urologist who has full awareness of the anatomic and physiologic vicissitudes is in the best position to manage such disorders.

Other options for treating urinary incontinence include the use of the artificial sphincter and Teflon injections. Doctor Raz deserves credit for including these methods even though they are admittedly esoteric. Finally, in this section, Doctors Leach and Raz address the problem of the patient with recalcitrant urinary dysfunction. They describe methods which are, to be sure, investigational. But the grievances and suffering of women who have been subjected to several unsuccessful operations pose a tremendous challenge to the ingenuity and resourcefulness of the urologist. I have witnessed the benefit that many of these urinary tract invalids have achieved as a result of the resourcefulness described in this book. Life has become tolerable for these desperate patients. I can, therefore, be sanguine with regard to such imaginative management of these very difficult problems.

The problem of urinary retention in women is not as common as urinary incontinence and yet the condition requires a special approach, quite different from that used in evaluating men. Intermittent self-catheterization for selected cases of urinary retention, acquired or purposefully induced, has made life bearable for many female patients.

Finally, a group of other commonly encountered disorders of the female urinary tract is addressed. The diagnosis and treatment of interstitial cystitis is still a controversial issue. Trauma of the lower urinary tract, fistulas, urethral diverticula, and ureteral obstruction are subjects that need to be presented in a volume such as this.

Other disorders and diseases of the lower urinary tract, such as infection and neoplasia, have purposely been omitted in this first edition, which deals primarily with functional problems and anatomy of the lower urinary tract.

In a multi-authored book, there is bound to be some overlapping of material, but it is clearly advantageous to have more than one view, and it is interesting to become aware of the areas of agreement as well as those of controversy.

Summing up, I feel that this book represents a major effort to enlighten urologists and their medical and gynecologic colleagues who share responsibility for caring for women troubled by these conditions. It provides the basis for conceptualization of the disorders, describes the precise diagnostic resources that are available, and, finally, notes the splendid advances that have been made in drug therapy, physiotherapy, and surgical therapy.

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SHLOMO RAZ

INTRODUCTION

SHLOMO RAZ, M.D.

In this book on female urology, we do not intend to present the entire spectrum of pathologic conditions of the urinary tract. Instead, we have concentrated on selected conditions occurring only or mainly in the female; conditions such as cancer, stones, reflux, infections, and so forth, which occur equally in both sexes, are not discussed.

In the urinary tract, the most important sex-related differences between the female and the male relate to the lower tract. The anatomy, physiology, and hormonal environment of the female lower tract are responsible for the vast majority of the specific conditions seen in the female only. For that reason, the majority of chapters in this book deal with diagnosis and treatment of bladder and urethral diseases of the female lower urinary tract.

The chapter on urogenital abnormalities permits a closer understanding of the sequence of events in the development of the female urinary tract. The ureter, trigone, and part of urethra are mesodermic structures closely related to genital tract development; this may explain the similarity in innervation, the hormone dependency of these structures, and, most importantly, the close anatomic relationships with the uterus and vagina.

The complexity of the lower urinary tract innervation is discussed in the chapter on neuroanatomy and physiology. The main center of micturition is located in the brain stem, and fibers from the cortex and subcortical center regulate its function. Lack of maturation of this control will produce enuresis nocturna. Many female patients with urinary incontinence in adult life have a history of prolonged enuresis in childhood. This combination should suggest the presence of hyperreflexia or unstable bladder. The pelvic and hypogastric plexuses containing the autonomic fibers from the sacral and thoracolumbar segments regulate bladder and urethral function, whereas the pudendal nerve is responsible for pelvic floor activity. These nerves are very often damaged during radical pelvic surgery, radiation, and metabolic diseases such as diabetes, leading to urinary retention or incontinence. Lesions of the spinal cord usually produce bladder hyperreflexia with bladder sphincter dyssynergia, whereas lesions above the brain stem produce hyperreflexia with good bladder sphincter coordination. The term bladder sphincter dyssynergia should be reserved for an overt neurologic condition (usually involving the spinal cord) and lack of coordination between bladder and external sphincter function. Voluntary contraction of the pelvic floor at the time of voiding may be confused with dyssynergia, but these must be clearly separated.

Biomechanical mechanisms are discussed in the chapter on the structure and forces of continence. The importance of the inner layer of the urethra (mucosal infolding and vascular supply) as well as the physical characteristics defining closing pressure of the urethra are emphasized. This chapter enables

us to understand the lack of correlation between continence, incontinence, and urethral profilometry. In profilometry, urethral pressures are recorded, but the inner tension of the urethra, which probably plays an important if not the most important role in the mechanism of female continence is not measured. Among other influences, lack of estrogen has a detrimental effect on this inner layer of the urethra, possibly explaining why the majority of patients who had childbirth trauma in their twenties and thirties only begin to exhibit stress urinary incontinence at menopause.

Although the male possesses a powerful sphincter mechanism, the continence mechanism of the female is potentially weak. Constant hormonal changes, the distortion of pregnancy, the trauma of delivery, and the lack of estrogens during menopause are important physiologic components that cause profound changes in the female sphincteric mechanisms. The close proximity of the lower urinary tract to the uterus and adnexa, together with the large variety of associated pathologic conditions and surgery performed in this area, makes the lower urinary tract of the female vulnerable to iatrogenic injuries. The support of the cervix and bladder neck is similar (pubocervical, cardinal, and sacrouterine ligaments). Hysterectomy (especially vaginal) is one of the main factors in urethral and bladder prolapse if the supporting structures are not carefully reapproximated and reconstructed after surgery. Moreover, during coughing and straining, the pelvic floor contracts in a reflex fashion, producing an increase in the closing pressure of the urethra, greater than the change in pressures occurring in the bladder or other abdominal viscera. Childbirth and surgery of the pelvic floor (hysterectomy or abdominoperineal resection) may change the pelvic support, inducing prolapse, but also eliminate this important reflex mechanism of defense in the female urethra against the sudden changes in intraabdominal pressure. The continence mechanisms of the female urethra are extremely complex and still not completely understood.

The next group of chapters deal with diagnosis of lower urinary tract dysfunction in the female. The chapter on signs and symptoms of female incontinence stresses the importance of a careful clinical assessment. Patients with a clinical history of frequency, urgency, nocturia, and concomitant stress incontinence are often found in further studies to be hyperreflexic in 80 to 90 per cent of cases. On the other hand, patients with stress urinary incontinence only (without frequency, nocturia, or urgency) are rarely hyperreflexic. The objective demonstration of urinary stress incontinence by the Marshall test or the modifications is probably the most important of all tests in the study of a patient with urinary stress incontinence. If a patient without residual urine tolerates 200 ml of fluid in the bladder and during cough or strain loses urine only at the time of cough (not after it), she probably suffers from surgically correctable stress urinary incontinence. (Occasionally, cough can elicit bladder contractions and produce "stress incontinence" that is due to unstable bladder and is not true sphincter incompetence.)

We must differentiate between the symptom of stress incontinence and the condition of stress incontinence. The symptom of stress incontinence is usually defined as involuntary loss of urine from the urethra during stress. But, as mentioned earlier, urinary retention with large residuals, an unstable urethra, and stress hyperreflexia as well may produce the symptom of stress incontinence. The condition of stress incontinence is defined as involuntary loss of urine occurring after stress in a patient with sphincteric incompetence. There should be no residual urine, no evidence of unstable urethra, and no change in the true detrusor pressures during stress.

The chapter on cystometry (urodynamic testing) discusses this cystometry and the pathophysiology of bladder function during filling and voiding. It is not rare to find bladder hyperreflexia in the female patient without urinary symptoms. It is thought that 10 to 15 per cent of asymptomatic women can have bladder hyperreflexia. It is also not uncommon to find a pattern of voiding without change in bladder pressures in women, especially those suffering from stress incontinence. Sphincter incompetence produces an inability to record a change in bladder pressures despite the fact that the bladder is contracting. In order to demonstrate whether the patient is having bladder contractions, the urethra must be occluded during voiding by voluntary pelvic floor activity or an inflated balloon in the bladder neck.

The chapter on urethral pressure profile in female lower urinary tract dysfunction lists the factors involved in the urethral closing mechanism and provides an overview of the different available methods of profilometry. Urethral pressure profile is probably the most overused and overinterpreted test in the evaluation of the female urethra. There are two types of profilometry methods that must be sharply differentiated: the static and the dynamic. Static profilometry performed with a single channel pressure recording very rarely correlates with the clinical condition and is incapable of differentiating among continence, incontinence, or retention. On the other hand, dynamic profilometry performed with a dual-channel recording catheter allows simultaneous recording of bladder and urethral pressures and of pressure gradients of urethra and bladder during cough or strain. This type of recording can distinguish the patient with sphincteric competence (in which the gradients are maintained) from the patient with sphincteric incompetence, in which the urethra is unable to maintain a gradient of pressure above bladder pressures. Dynamic profilometry also permits detection of cases of stress hyperreflexia.

Gas and water cystourethoscopy are the two methods of observing the anatomic changes in the lower urinary tract; both are discussed in the chapter on endoscopy. Without entering into a discussion of the advantages and disadvantages of each, it is the belief of the authors that endoscopy should include a careful observation of bladder, bladder neck, and urethral changes. In addition to checking the bladder interior in routine fashion, abnormalities of the mucosa that occur during filling (fine trabeculation) and during decompression (glomerulation and bleeding) should be sought. In order to examine bladder neck and diagnose urethral abnormalities correctly, an urethroscope and not a regular cystoscope should be used. At the beak of the water cystoscope the distance between the optical lens and the water entry may be more than 1 cm. For that reason, the urethra is not fully distended during observation. Use of the gas endoscope or the water urethroscope obviates this problem by having the lens and the fluid entrance at the same level. The presence of such urethral pathology as inflammation, diverticula, atrophy, deformity, and hypermobility during stress should be checked. Changes of the bladder neck during filling and stress should be studied; they are particularly important during bladder neck suspension surgery.

Urinary flow measurements provide a noninvasive tool in the assessment of the female lower urinary tract. A great discrepancy is found between the findings of urethral stenosis in women as defined by mechanical calibration and the more objective functional results of urinary flow. Urethral stenosis in the female is a rare condition. Urinary flow can be used as a single study or in combination with pressure studies. A noninvasive flow study should always be performed before a pressure flow study. Catheter insertion can distort the

voiding ability of the patient and conclusions can be drawn only by comparing the results of invasive and noninvasive studies.

Radiologic studies are useful in the diagnostic evaluation of the female urinary tract. As seen in the chapter on upper tract obstruction, radiology plays a crucial role in the evaluation of ureteric obstruction. Not so crucial, but still valid, radiologic studies are used for assessment of lower tract dysfunction. Video/pressure/flow studies are discussed in the chapters on cystometry and unstable bladder. Radiologic evaluation may be used as another independent test, especially when the sophisticated equipment required for combined video/pressure/flow studies is not available. These studies are presented because, although far from ideal, they provide us with objective information on some aspects of the lower urinary tract. Voiding cystourethrograms under fluoroscopy provide us with a way to study the anatomy of the female objectively while the patient is standing and straining. There is no correlation between anatomy and continence, but the majority of patients with urinary stress incontinence due to sphincter incompetence also have an anatomic abnormality. The majority of bladder neck suspension failures are due to the lack of support of the bladder neck in a high, immobile retropubic position. Radiologic studies can assess this problem objectively. When radiologic studies are done independently to assess urinary incontinence, the demonstration of stress incontinence under fluoroscopy is extremely important, but other testing can show that stress hyperreflexia is present. With careful interpretation, radiologic studies of the lower tract can provide valid information for those unable to avail themselves of the more sophisticated video/pressure/flow studies.

The subject of urinary incontinence in the female constitutes the largest part of this book. Unstable bladder may be due to sensory instability (early sensations) or to motor instability. We should define motor instability as the inability to inhibit bladder contractions voluntarily during bladder filling, change in position, stress, or other bladder challenges. Motor instability may result from true uninhibited bladder contractions (bladder hyperreflexia) or as poor bladder compliance. Compliance is the ability of the bladder to change in volume with minimal change in pressure. Poor compliance, as seen in interstitial cystitis, radiation injury to the bladder, or chronic catheterization, is the inability of the bladder to adapt to the change in volume. Filling of the bladder with fluid will produce an increase in pressure proportional to the volume of the fluid given. The mechanism of bladder hyperreflexia differs. The contraction of the bladder and the rise in pressure are triggered by the fluid administered but they are not proportional to the amount of fluid.

The varieties of degrees, types, and causes of urinary incontinence in the female have created a similar number of solutions to the problem of incontinence. Pharmacologic therapy is one of the nonsurgical treatments of the problem. Drugs may be used to increase the storage capability of the bladder or to improve emptying. To improve continence, some of the drugs are directed toward the bladder (cholinolytics) or toward increasing urethral resistance (alpha-stimulatory drugs, such as ephedrine, phenylpropanolamine, and so forth). Drugs to promote emptying can act on the bladder (cholinergic) or diminish urethral resistance, as in the case of alpha blockers (phenoxybenzamine). Another nonsurgical modality used with increasing success in controlling urinary incontinence in women is behavior modification, especially in the control of the unstable bladder.

Electrical stimulation is a growing field in the research and treatment of

lower urinary tract dysfunction in the female. It can be directed toward improving continence or to improving emptying. Although bladder stimulators are rarely needed because of the excellent results achieved by intermittent catheterization, the field of electrical stimulation to improve continence is looked upon as another alternative in the nonsurgical treatment of urinary incontinence. This stimulation can be directed toward increasing urethral resistance or diminishing bladder contraction. At this stage, electrical stimulators have been very rarely used in the United States.

Vaginal prolapse may be found in women after multiple deliveries and hysterectomy. However, only a small portion of females with cystocele or urethral prolapse suffer from clinically important stress incontinence.

The vaginal approach is indeed excellent in surgery for repair of prolapse. It is not unusual to find the patient presenting with stress incontinence occurring after a cystocele repair who had been perfectly continent before the procedure. In these cases we find a dependent and hypermobile bladder neck and urethra that were not treated at the time of surgery. The fact that vaginal prolapse is present in the majority of patients with stress incontinence should lead us to correct all the problems at one time (rectocele, enterocele, cystocele) rather than treating only the incontinence. An abdominal bladder neck suspension operation in a patient with severe cystocele and rectocele can cure the continence but aggravate the prolapse and require further surgery. The treatment of stress incontinence in women should be done, therefore, in this context of pelvic floor relaxation.

The long-term cure of clinically significant stress incontinence with the classic type of Kelly repair has not been encouraging, the success rate being 30 to 50 per cent. Since the description by Marshall and co-workers of their procedure for the correction of female stress incontinence, abdominal bladder neck suspensions have given and continue to give excellent results in more than 90 per cent of cases of female stress incontinence. And, as occurred in many other surgical procedures, modifications to improve the results soon appeared. The principles of the colposuspension developed by Burch and Tanagho are similar to those of the original pin-up procedure of Marshall, elevating the bladder neck and urethra to a high, fixed intraabdominal position. The difference is mainly that in positioning the suspending sutures lateral to the urethra (in the vaginal wall), the urethra is free in the retropubic space and no obstruction can occur. Also, by this approach, cystocele can be corrected. The Lapides modification concentrates the suspension sutures only at the level of the bladder neck, simplifying much of the original Marshall-Marchetti procedure.

Since the 1959 report of Pereyra on the vaginal approach and use of needles to transfer the suspending sutures from the vagina to the abdomen, a great number of modifications have been introduced. The slow acceptance of the procedure derived from the early complications—bladder perforation, severe bleeding, infections, and so forth. With the introduction of improved techniques, the use of the cystoscope (by Stamey), and better patient selection, the "needle suspensions" are gaining increased acceptance and use. The results are similar to those of the abdominal approach (90 per cent). The main advantage of this approach is that the abdomen does not need to be opened, the operation is easy to perform, minimal complications are encountered, and a shorter postoperative stay is required. If further vaginal prolapse is to be corrected, as so often is the case, this can be taken care of at the same time. Multiple surgeries and scarring of the bladder neck and urethra lead to severe

sphincteric incompetence, which is not responsive to the regular bladder neck suspension. Sometimes, despite good positioning and fixation of the bladder neck, the patient continues to be incontinent. Damage has occurred to the intrinsic mechanism of urethral continence and a simple resuspension will not change the situation. Some of the options are urethrolysis, urethral reconstruction, and so forth. For these cases the injection of periurethral teflon seems to be an excellent additional option. The material is inert and injected through the cystoscope, providing an inner layer of submucosa that will improve continence. At this stage, this agent is not approved in the United States for use in the urethra, except under experimental conditions. Also, for selected cases of severe incontinence that fail under conventional surgical and nonsurgical procedures, the insertion of an artificial sphincter should be considered.

There is increased interest in the surgical treatment of bladder hyperrreflexia. In selected cases in which drugs and other programs of therapy fail, surgery is a consideration. The use of neural blocks (incision of sacral roots, percutaneous rhizotomy, subarachnoid blocks) was reported with relative success. Newer procedures, such as bladder denervation, bladder transections, and enlargement cystoplasty, are being assessed, with encouraging preliminary responses, but it is too soon for long-term follow-up results.

The process of aging involves profound changes in the neural control of micturition and also in the quality of the tissues responsible for support of the bladder neck and urethra, as well as impairment in the closing mechanisms. Little research has been conducted with modern urodynamic techniques on the incidence, etiology, and response to treatment of incontinence in the elderly.

One of the most important therapies in the specialty of urology, which completely changed our approach to urinary retention, is the institution of self-intermittent catheterization. By using this nonsterile clean technique, urinary diversions are now rarely performed for lower urinary tract dysfunction. Our goal in a majority of cases of neurogenic dysfunction is to obtain retention and start self-intermittent catheterization. Urinary retention in the female is much better tolerated than incontinence. Self-catheterization is used in the immediate postoperative therapy of urinary retention. More than 50 per cent of the patients are expected to develop bacteriuria, which usually is asymptomatic and does not require therapy.

The location of the urethra, bladder, and ureters in the pelvis, in close proximity to the other pelvic structures, makes the lower urinary tract very vulnerable to trauma. The trauma is usually iatrogenic, occurring during hysterectomy, vaginal repair, tubal and ovarian surgery, rectal surgery, and so forth. The importance of early recognition should be stressed. During surgery, repair is easy, and with appropriate drainage no complications will ensue. Problems occur when the trauma is not recognized and fistula results.

Two approaches are presently used in the treatment of bladder and urethral fistula. The abdominal approach includes excision of the fistulous tract, wide opening and mobilization of the bladder, and occasionally interposing of omentum. The vaginal approach is our preferred way to treat fistula of bladder or urethra. These principles include early recognition and treatment (as soon as conservative measures fail), wide flap mobilization, no excision of the fistulous tract, and advancement of the vaginal flap to avoid crossing of suture lines. The vaginal approach is much better tolerated by the patients and obtains an equal or better result than the abdominal approach.

The ureter is a hormone-dependent structure that crosses the female pelvis in a tortuous path, runs in close proximity to the uterus and ovaries, and is often subject to injury. The injury can lead to fistula or to ureteric obstruction. The most common obstruction involves the right ureter and is seen during pregnancy. Probably a combination of pressures and hormone influence (progesterone) produces the hydroureter of pregnancy. With the advantage of endourological techniques, many of these conditions can now be managed without open surgery.

Because excellent monographs are available, the subject of urinary tract infection in the female was not included in this book; however, one of the conditions that can lead to recurrent urinary tract infections is presented. Urethral diverticula can be very difficult to diagnose and do not always present with the classic findings of a tender mass and infection. Careful urethroscopy and voiding cystourethrography need to be performed in cases of recurrent urinary infection.

Urethral syndrome, defined as frequency, urgency, and pain on micturition, is like a waste basket into which a large number of unrelated conditions is deposited. The same symptoms can be present with lower tract stones, urethral diverticula, neuropathic bladder dysfunction, carcinoma in situ, psychological stress, endometriosis, pelvic inflammatory disease, rectal conditions, and so forth. Failure to respond to conservative therapies may require in-depth evaluation to rule out a curable condition. For the idiopathic type of urethral syndrome we do not use urethral dilatation or internal urethrotomy. We obtain equally satisfactory results with behavior modification, placebo, medications, and similar treatments. The one condition that is manifested by this syndrome of frequency, urgency, and pain which we elected to discuss is interstitial cystitis. The etiology is still not totally clear, but diagnosis and management have been changing over recent years. The changes of the bladder wall under anesthesia after bladder dilatation, with bleeding of the mucosa and small bladder capacity, are the bases of the diagnosis. The biopsy usually shows nonspecific changes. Dimethylsulfoxide (DMSO) is found very effective in 30 to 60 per cent of the cases until a cause can be established. Interstitial cystitis will require surgery in very selected cases not responsive to any medical therapy. The use of bladder denervation procedures and transections is undergoing clinical trials, and fewer cystoplasties will be needed for this disabling condition.

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