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Flexible cystoscopy in spinal cord injury. Review article

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Endoscopy of the urinary tract remains the cornerstone of urological therapy. Over the years, continued refinement of the endoscopic instruments has permitted a progressive increase in the number and methods of their application. The development of the smaller diameter, flexible endoscopes represents the greatest advance in urological endoscopy. Their characteristics permit greater versatility with less traumatic procedures, increasing patient comfort and minimizing iatrogenic injury. Spinal cord injury (SCI) patients are a select group, which require special attention when undergoing endoscopic procedures. Often a contracted bladder or poorly controlled muscle spasms make the SCI patient difficult to endoscope using conventional rigid instruments. Furthermore, autonomic dysreflexia is a significant concern during traumatic urinary tract instrumentation. This communication will discuss the applications of flexible cystoscopy, including novel techniques, which can be useful in SCI patients.

Keywords: spinal cord injuries; cystoscopy; flexible cytoscopes; urodynamics; bladder; urethra.

Introduction

The ability to directly visualize the features of the urinary tract is of paramount importance when urological dysfunction develops. The limitations of urological endoscopy have largely been determined by the instrumentation itself. Initially, incandescent bulbs provided illumination which was barely adequate for visualization. Once cold-source lighting via fiberoptic cords was developed, image conduction using the rod/lens system further enhanced endoscopic capabilities.

With superior ability to illuminate and visualize the internal bodily cavities, the next most significant development came in the form of flexibility. Prior to the advent of flexible endoscopes, rigid instrumentation could often not adequately reach convolutions of the lumenal surfaces. This limitation was compensated for by adjusting the angle of the rigid lens, but was not remedied until flexible imaging bundles allowed for a truly flexible, actively deflectable endoscope.[1]

This new generation of instruments initially met with a poor reception, as illumination and visualizing power were somewhat decreased when compared to traditional rigid instrumentation.[2] The ability to reach convoluted areas of the urinary tract, however, provided a strong impetus for further development. Over the past two decades, continued refinement of flexible urological endoscopes has resulted in the development of increasingly smaller instruments of superior quality, with exceptional illumination, visualization, and working capabilities.[3]

Basic endoscopy

Endoscopic examination of the urethra and bladder is the most elementary urological procedure. It may be included in the evaluation of a patient with urinary tract dysfunction, symptomatology, or hemorrhage. In addition, it is the initial step towards gaining access to the urinary tract for other diagnostic and therapeutic maneuvers, such as

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ureteral stenting and ureteroscopy for stone disease.[4]

Traditionally, basic cystoscopy has been performed using rigid instruments, which require the dorsolithotomy position in order to permit adequate endoscopic inspection. Often those with spinal or hip joint arthritis experience some discomfort with such positioning.

Several lens angle systems (0°, 30°, 70°, 120°) may be required to completely visualize the entire urothelial surface, including the urethra and bladder neck, because of the often convoluted angles of the urinary bladder. Due to the rigid nature of the instrument and the stress it imposes on urogenital tissues, anesthesia is often required in order for the patient to tolerate a thorough examination.

Flexible cystoscope development

Flexible cystoscopy was first introduced by Tsuchida & Sugarawa in 1973.[5] Since that time, the usefulness of the technique has been greatly extended (Table I). Flexible cystoscopy has been used as an adjunct in percutaneous stone extraction,[6] for ureteral catheterization,[7] and retrograde urography.[8] The need to perform cystoscopy may arise intraoperatively when the surgeon least expects it. The use of a rigid cystoscope, necessitating the lithotomy position, may require patient repositioning, reprepping, and redraping, resulting in the loss of valuable time, increasing expense, and increasing the risk of iatrogenic infection. The flexible cystoscope, however, may be utilized without such extensive maneuvers, provided that the urethra is accessible.[9]

Table I Applications of flexible cystoscopy in spinal cord injured patients

Diagnostic
Evaluate for tumor, stones, stents, strictures, and bladder neck obstruction
Endourodynamic
Retrograde urethrogram, cystogram, and pyelogram
Bedside endoscopy of acute and spinal unstable SCI
Therapeutic
Bladder biopsy
Placement and removal of ureteral guidewire and stents
Laser fiber and electrohydraulic fibers for treatment of bladder stone, tumor, and obstruction
Assist in ESWL: retrograde imaging
Deflate jammed Foley catheter balloon
Bedside diagnosis of urinary tract bleeding and assist in difficult ureteral catheter insertion
Ureteral stent insertion for decompression of hydronephrosis

Flexible cystoscopy is a valuable procedure which can be used under many different circumstances. Even retrograde ureteropyelograms can be performed, if necessary, under what may be less than ideal conditions.[8] Male and female patients have been examined in both the prone and supine positions.[10] Flexible instrumentation can be used in the outpatient, office setting, essentially replacing rigid cystoscopy for diagnostic purposes.[11] Clayman has described its versatility during percutaneous procedures.[6]

Flexible endoscopy of the urinary tract has facilitated the diagnosis and treatment of urological disease for both the patient and the physician.[3] Early reports of flexible endoscopy were elementary, and limited to examinations of the bladder.[5] Refinements of techniques and advances in technology have enabled investigators to perform tasks previously reserved for rigid endoscopes.[1–4] The working port permits biopsy, fulguration, laser therapy, the retrieval of foreign bodies and calculi, and ureteral guidewire placement for catheterization or further instrumentation.[12] Several series comparing flexible with rigid endoscopy have universally shown less patient discomfort, decreased anesthetic requirements, and equivalent diagnostic capabilities with flexible cystoscopy.[1,12]

The advent of flexible cystoscopy has permitted a more comfortable routine examination, eliminating the need for the lithotomy position. The flexibility of the shaft of the instrument is less stimulating, therefore sedation is rarely necessary. The actively deflectable tip of the endoscope may be angled up to 220°, permitting a thorough examination without the need for the interchanging of different lenses. Taken

together, these flexible characteristics allow a complete examination of the patient in either the supine, prone, sitting or oblique positions.[4]

Flexible cystoscopy: general considerations

A patient with a spinal cord injury may require endoscopic evaluation for several different reasons. In general, such patients often have muscle spasms and limb contractures, making them difficult to be placed in the lithotomy position. The flexibility of the nonrigid instrumentation permits endoscopy in the supine position in those in whom rigid endoscopy might not otherwise be possible. Indeed, in the case of outpatient, in-office examinations, the endoscopic procedure may be performed while a male patient is seated in his wheelchair, avoiding the need to transfer to an examining table.

Described below are flexible cystoscopy techniques which facilitate endoscopic examination of the lower urinary tract in nearly every situation which we have encountered at the Regional Spinal Cord Injury Center of the Delaware Valley, Thomas Jefferson University, Philadelphia, PA.

Patient preparation

Common to all urological endoscopy, the genitalia should be cleansed with an antiseptic solution and draped in a sterile fashion. In those patients with known or suspected urinary tract infection prior to the cystoscopy, appropriate antibiotic coverage based on urine culture should be instituted. There is generally a one in 50 to one in 100 chance of contracting a urinary tract infection during a sterile technique urinary tract instrumentation. In those with chronic indwelling catheters and in all our patients, a short course of prophylactic antibiotic is administered after the cystoscopy. Our choice of therapy is generally nitrofurantoin, trimethoprim/sulfamethoxasole, or a quinolone antibiotic for 2 days.

The blood pressure should be monitored prior to initiating cystoscopy. Water soluble lubrication should always be used. A general or sedational anesthesia is almost never needed with flexible cystoscopy; topical lidocaine (2% jelly) is our anesthetic of choice. Although the patient with complete suprasacral SCI does not perceive pain with cystoscopy, topical anesthesia is helpful in diminishing noxious stimuli in those susceptible to the development of autonomic dysreflexia (AD). We will detail below particular precautions required for such patients.

Universal precautions should be practiced by all personnel performing and assisting with the procedure. Eye protection and a mask to cover the mouth and nose are essential, as splashing of urine that may be contaminated with blood and semen may transmit the human immunodeficiency and the hepatitis viruses.

Sterile water or saline irrigation improves visibility and allows bladder distention to maximize the surface area to be inspected. Dilute sterile radiographic contrast may be used if a fluoroscopic cystogram is to be combined with flexible endoscopy. This dilute contrast solution does not impair visual acuity.

In patients in whom we anticipate the possibility of intraoperative cystoscopy, we now prepare and drape the urethra in a sterile fashion prior to draping the primary operative site. The urethra is then accessed with an end-hole catheter to provide for easy placement of a wire guide through the device into the bladder. The position of the patient need not be altered. Routine flexible cystoscopy over a guidewire is a reliable, reproducible procedure which can be accomplished with the patient in any standard operative position. Using the flexible cystoscope insertion over a guidewire is an ideal solution to the difficult problem of emergency cystoscopy being required during another operative procedure, especially valuable when the question of injury to a ureter or the bladder arises intraoperatively.[9] At the end of the procedure, documentation of the procedure and findings should be included in the patient's medical record.

Flexible cystoscopy at the bedside

In acute and critically ill spinal cord injured patients, flexible cystoscopy may be per-

formed at the bedside in the intensive care unit. These patients may have an unstable spinal fracture or be medically so unstable that a bedside procedure is preferred over transportation to the operating theater. The most common indications for the procedure are hematuria and the inability to insert a urethral catheter.

Occasionally, the retaining balloon of an indwelling ureteral catheter may not deflate to allow catheter exchange. In such cases, the flexible cystoscope can usually be passed beside the catheter and, using a small guidewire as a lance, the balloon is perforated under direct vision. In addition, a SCI patient with urosepsis, hydronephrosis, and an obstructing ureteral calculus requires immediate drainage with a ureteral catheter. This procedure is performed initially by performing flexible cystoscopy and locating the ureteral orifices on the floor of the bladder. A guidewire is then inserted through the endoscope, cannulating the desired ureter. An open-ended ureteral catheter may then be placed over the guidewire, and the guidewire removed. Urinary drainage from the previously obstructed system may not only be sent for bacterial culture and sensitivity analysis, but also continually monitored as the ureteral catheter empties into a urimeter.

Flexible cystoscopy in the wheelchair

In certain cases, routine cystoscopy is required for a thorough urological evaluation, such as that for hematuria. Especially in quadriplegic and overweight men, it is technically easier to perform the procedure while the patient remains in his wheelchair. Avoiding patient transfer minimizes spasticity and eliminates the need for ancillary staff to aid in proper positioning on an examination table. Wheelchair flexible cystoscopy is restricted to the male SCI patients.

Using this technique, the patient is lifted up slightly off the wheelchair and his pants are pulled down to around his knees. The indwelling ureteral or condom catheter is removed and a waterproof sheet is placed under the penis so that no urine or irrigation fluid can saturate the patient. Two per cent lidocaine gel is instilled in the urethra in order to decrease pain and blunt the stimulus for the development of autonomic dysreflexia.

The flexible cystoscope should be held in the dominant hand with the thumb resting on the deflecting lever. The urologist should kneel on one side of the patient rather than directly in front of the wheelchair for two reasons. Primarily, the examiner will avoid injury from any inadvertent severe lower extremity spasms common in the spinal cord injury population. Secondarily, kneeling to one side is less awkward for the patient and also more comfortable for the endoscopist. Kneeling on the right side of the patient with the examiner's head turned toward the patient allows not only for safety, but also good orientation to the genitourinary system, during the examination.[13]

To insert the flexible cystoscope in the male patient, the examiner should grasp the penis with the fourth and fifth fingers of the nondominant hand, holding the penis upright and slightly extended. The remaining three digits are used to guide the instrument into the urethra. Once in the bulbous urethra, the tip of the instrument should be deflected upward in order to bridge the external sphincter. Asking the patient to breathe deeply helps reduce some of the intrinsic sphincter tone, aiding in passage of the cystoscope. It is imperative to advance the instrument only with an adequate view of the ureteral lumen in order to avoid trauma which could precipitate bleeding or dysreflexia. Complete visualization of the bladder and urethra is almost always possible in the sitting position.

Endourodynamics

At our urodynamic laboratory we evaluate large numbers of spinal cord injured patients, many of whom have urological indications for both cystoscopy and urodynamics. The first combined flexible cystoscopy and urodynamic evaluation was reported in 1986 by Loughlin and associates.[14] Occasionally the inability to insert a urodynamic catheter at the time of a scheduled urodynamic study prompts flexible cystoscopy, which not only permits diagnosis of the

urodynamic study to be performed through the endoscope itself.[13,15]

Flexible cystoscopy can be combined with urodynamics in order to complete the two tests in one clinic visit, increasing efficiency. The flexible cystoscope is inserted into the bladder under visual guidance using minimal irrigation. Residual urine is measured through the working port with an aspiration syringe. The working port is then connected to a 'Y' connector which is connected to both a pressure transducer and the cystometrogram (CMG) infusant. A 25% sterile radiographic contrast solution as the CMG infusant allows for video-urodynamics. A blood transfusion pressure bag is used to infuse at a constant rate of 50 ml/min through the small caliber of the working port; the CMG is zeroed after having started the infusion.[13] Periodic observation is made with fluoroscopy to assess position, bladder configuration, vesicoureteral reflux, and urinary incontinence. Most patients have no difficulty voiding around the flexible cystoscope. If a problem with voiding is encountered while the instrument is in place, we simply fill the bladder, remove the cystoscope, and fluoroscopically assess the bladder neck, prostate and external sphincter, determining the presence and degree of incontinence. Alternatively, fiberoptic microtransducer applications for combined cystoscopy and urodynamics have recently demonstrated evaluations equivalent to the traditional, external transducer method as described above.[16]

Avoiding autonomic dysreflexia during flexible cystoscopy

Autonomic dysreflexia is a potentially life threatening exaggerated sympathetic nervous system response to afferent visceral stimulation after a spinal injury to the T6 level or higher. Bladder or bowel distention usually triggers the autonomic dysreflexia response. Symptoms include diaphoresis and flushing above the level of the injury, headache, nausea, and sudden, severe hypertension accompanied by a reflex bradycardia. The result of such an AD episode may be severe enough to induce myocardial ischemia, intracerebral hemorrhage, or even death. The risk of autonomic dysreflexia must be taken very seriously during any urological instrumentation.[17]

Patients with lesions of T7 and higher are susceptible to the effects or noxious stimuli below the level of their lesion. They may develop severe hypertension as a result of AD induced by rigid cystoscopy, whereas a flexible cystoscopic examination may incur little or no such excess of sympathetic discharge.

Physicians caring for spinal cord injury patients must be familiar with the clinical presentation and treatment of autonomic dysreflexia. Patients whose injury is at or above T6 level should undergo blood pressure monitoring during the endoscopic procedure. Lidocaine 2% gel, a topical local anesthetic and lubricant, is routinely used prior to flexible cystoscopy. It helps to decrease the afferent impulses which may trigger the AD response. Overdistention of the bladder with irrigant may also initiate the development of AD, and must be avoided. Utilizing these two simple practices, AD can be minimized, if not prevented altogether, during flexible cystoscopy. Should the AD response occur, nifedipine (Procardia) 10 mg sublingually, chlorpormazine (Thorazine) 1 mg IV, or phentolamine (Regitine) 5 mg IV may be used to abort the autonomic dysreflexia episode. Chronically, those predisposed to the development of autonomic dysreflexia can receive prophylaxis with alpha-adrenergic blockade.[17,18]

When conducting a complete urodynamic study in SCI patients, the potential for autonomic dysreflexia should be considered. If a patient demonstrates involuntary detrusor contractions accompanied by detrusor-external sphincter dyssynergia, the evaluation should be terminated as the diagnosis has been made; further filling may serve only to induce blood pressure elevation secondary to AD. If during bladder filling or manipulation the patient complains of dysreflexia symptoms and the blood pressure becomes elevated, the procedure should be terminated immediately. The purpose of a urodynamic study is not to distend the bladder to its maximal capacity;

it is to reproduce a patient's symptoms and make a clinically useful diagnosis.

Flexible cystoscopy during stone treatment

Patients with SCI may be at higher risk of developing upper urinary tract calculi because of infection or hypercalciuria from inactivity. Double pigtail ureteral stents are often placed prior to extracorporeal shock waves lithotripsy (ESWL) of such calculi to enhance the passage of stone fragments, minimize the risk of steinstrasse, and prevent acute ureteral obstruction. Rigid cystoscopy has routinely been employed for such stent placement. With the advent of lithotriptors requiring minimal anesthesia, the cystoscopic stent insertion has become the more stimulating of the two interventional procedures requiring anesthetics. Flexible cystoscopy provides access to the bladder which is well tolerated, further minimizing anesthetic dosages, and is effective for the placement of ureteral stents.[7]

The SCI patients arrive at the lithotripsy suite on standard hospital stretchers. Intravenous access is established by the anesthesiologist and a small dose of intravenous sedation is given. Both the flexible cystoscopy and the stent placement are performed under sedation with the patient in the supine position. Once access to the bladder has been gained, the entire urothelium is inspected. The ureteral orifice of choice is then intubated with a standard 0.038 inch floppy-tipped Teflon coated guidewire. The wire is passed to the level of the renal pelvis (22–27 cm) where resistance is encountered. Over this wire, a double pigtail ureteral stent is passed under direct vision through the flexible cystoscope. The diameter of the working channel permits a standard 6 Fr ureteral stent to be set into position. The patient may then be moved directly from the stretcher onto the lithotripsy table.

Flexible cystoscopy of the reconstructed urinary tract and bladder cancer screening

Spinal cord injury patients are known to have an increased risk of bladder carcinoma.[19–21] Patients with chronically indwelling urethral or suprapubic catheters are especially at risk for the development of urothelial neoplasia.[22] In addition, the urological literature has documented the development of malignancy developing at areas of ureterointestinal anastomosis. Most reports have been generated from patients with a ureterosigmoidostomy after 10 years. The use of intestinal segments in urinary tract reconstruction is increasing, however, and whether malignant transformation will occur in those patients with intestinal augmentation cystoplasty, cutaneous ileoneocystostomy, and continent intestinal urinary reservoirs has yet to be demonstrated. We recommend that patients with any of these reconstructions, where small or large bowel is constantly exposed to urine, as well as those with chronic urinary drainage catheters, should be endoscopically evaluated on a yearly basis to rule out malignant transformation. Furthermore, we recommend annual cystoscopy in SCI patients managed with an indwelling urethral or suprapubic catheter after a period of 5 years.

Patients with urinary diversion may develop urinary calculi, hematuria, polypoid lesions, or obstruction of urinary flow. In these cases, endoscopic inspection should be performed promptly to diagnose and treat the condition. The flexible cystoscope is well suited to the reconstructed urinary tract. Such a system is often much more convoluted than a native system, therefore rigid instrumentation may not permit a thorough evaluation. The flexible deflectable cystourethroscope offers the ability to navigate through the irregular passageway of an ileal conduit, closely examine all irregular contours, and admit instruments for diagnostic and therapeutic maneuvers such as stone manipulation, biopsy, and ureteral catheterization.

Discussion

Urological dysfunction is almost universal in the SCI population, often requiring multiple endoscopic evaluations for various reasons. Flexible cystoscopy offers ease for the clinician and safety to the patient.[4] The flexible cystoscope offers four main advantages for

those urodynamic laboratories caring for a large number of spinal cord injured patients.

Primarily, flexible cystoscopy reduces the stimulus for the development of autonomic dysreflexia, which is a particularly worrisome problem for the urologist during lower urinary tract manipulation of patients with spinal injury above the level of T6.[16] In our experience, the flexibility and reduced caliber of the flexible cystoscope have dramatically decreased the incidence and severity of autonomic dysreflexia during examination when compared to rigid endoscopy.

A second advantage to flexible cystoscopy is that it can be performed in a variety of positions.[6,9,10] This is especially important in the spinal cord injured population, where putting a patient with spasticity and contractures in the dorsal lithotomy position can be difficult, if not impossible, and can cause iatrogenic injury. The flexible cystoscope, because of its maneuverability, enables the urologist to limit the amount of patient manipulation, even allowing the examination of a male patient in a wheelchair. For female patients, the need for lower extremity elevation is eliminated; they may remain supine as the frog-legged position provides adequate urethral exposure.[10] Patients who arrive by stretcher need not be moved to an adjustable table in order to provide adequate exposure and patient positioning, thus decreasing the chance of injury for both patient and clinician.

A third advantage of flexible cystoscopy is that it not only permits visualization of the urinary tract (Figs 1, 2), but also enables the clinician to perform a cystometrogram through the working port of the instrument.[14] The cystometrogram performed via the flexible cystoscope gives accurate, reliable, reproducible results, comparable to those obtained using a standard 10-Fr urodynamic catheter.[15] Detrusor contractions are not caused by the presence of the flexible cystoscope during bladder filling. Combining endourodynamics with fluoroscopy of the bladder and urethra enables a thorough endo-video-urodynamic evaluation.

A fourth advantage is that the flexible cystoscope can immediately diagnose the etiology of a difficult urethral catheterization. Occasionally, the urodynamics catheter cannot be passed through the urethra because of excessive resistance. In this instance the flexible cystoscope can be both diagnostic and therapeutic. The most common causes in our patients of difficult catheterization are urethral strictures and false passages. Utilizing the working channel of the endoscope, a guidewire can be

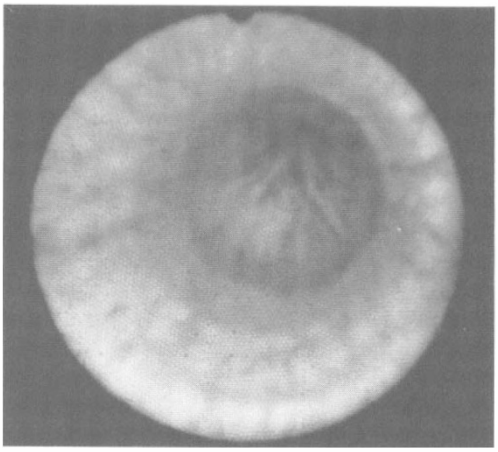

Figure 1 Photograph of the external urinary sphincter seen with the flexible cystoscope. The 'grainy' appearance represents the bundling of individual optical fibers.

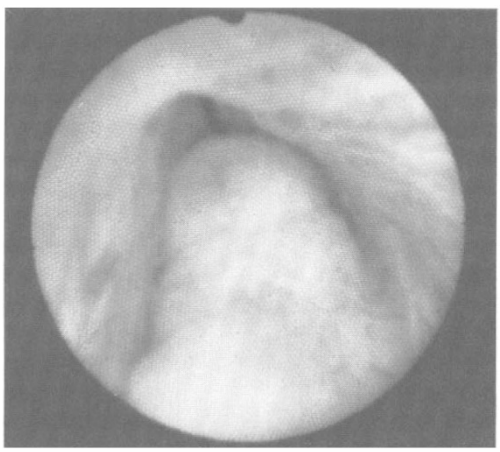

Figure 2 Photograph of the verumontaneum, an important landmark in the distal prostatic urethra at the 6 o'clock position. The ejaculatory ducts drain at the verumontaneum.

placed through the irregular area. The obstruction is then bypassed by sliding a catheter over the wire guide, and the urodynamics procedure may be performed.

Our complications with flexible cystoscopy have been limited to a few urinary tract infections which responded promptly to antibiotics. Flexible instrumentation, even in those patients receiving anticoagulation with heparin or coumadin, has not resulted in urinary tract hemorrhage. Furthermore, ureteral false passage or stricture formation has not developed as a result of flexible cystoscopy.

The historical disadvantage of flexible cystoscopy has been a lack of visual clarity, thus compromising the examination.[5] We have found that the newer generation of flexible cystoscopes provides superior optical quality, enabling a complete evaluation of the urethra and bladder.

Future developments

Continued development has produced a tremendous improvement in the quality and applicability of flexible, deflectable endoscopic equipment and technology. Equipment manufacturers are perpetually generating instruments with improved visibility, smaller outer diameters, and larger working channels, further increasing the potential for diagnostic and therapeutic procedures.

The flexible cystoscopy may also be applied elsewhere in the genitourinary tract which has not been previously visualized. In two male SCI patients who developed infection and erosion of implanted penile prosthesis on one side of the penis, we were able to look directly into the penile corporal cavernosum and determined a communication and infection of the contralateral prosthesis. We have also used a 22 gauge fiberoptic scope to look directly into the ejaculatory duct and seminal vesical on a experimental basis.

Future applications of the flexible instruments have great potential. Pressure sensors may be built into flexible cystoscopes, enabling direct endourodynamics. A miniature video camera may be mounted directly to the front of the scope thereby increasing visual clarity and eliminating the bulky optical fibers. Small laser fibers may be developed which pass through the instruments, and can be used to treat bladder outlet obstruction from bladder neck dysfunction, prostatic hyperplasia, and external sphincter dyssynergia. Bladder calculi and tumors may all potentially be treated with the aid of the flexible endoscope on a regular basis. With the ever decreasing size of the endoscopes, it is possible that complete upper and lower urinary tract examination and treatment may be done simultaneously with greater ease and even lower anesthetic requirements. In short, the flexible, actively deflectable cystoscope has made, and will continue to make, significant contributions to the diagnosis and treatment of urological pathology.

Conclusion

Flexible cystoscopy is a safe and useful tool in spinal cord injured patients in the urodynamics laboratory. It permits complete diagnostic visualization, and limited procedural intervention. Overall, the procedure is convenient and well tolerated by patients, and can be done in men while in the wheelchair. We depend on the accessibility of a flexible cystoscope in the urodynamics laboratory and feel that this has improved our urological care of spinal cord injured patients.

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