Urological Problems in Transverse Myelitis
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difference towards the hope and dream of making a cure for transverse myelitis a reality.

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Introduction

Transverse Myelitis is a rare disease affecting 4.6 per million of the population per year. It has many causes and/or associations including multiple sclerosis, parainfection (especially following upper respiratory infection), spinal cord ischemia; in many patients the cause is unknown. Its course is variable with approximately half of the patients in the multiple sclerosis and parainfectious group able to walk and empty their bladders on discharge from hospital. The remainder, especially the ischemic group, have variable recovery. Some individuals, from any group, who initially recover may relapse.

Pathology of Bladder Dysfunction

Control of the bladder and urethral sphincter takes place in the mid brain and cerebral cortex. Damage to the tracts in the spinal cord in Transverse Myelitis interrupts the normal sensory messages ascending, and the motor messages descending, to the nerves that directly drive the bladder which lie in the sacral segments (S2, 3 & 4).

In the acute phase, especially if the Transverse Myelitis is complete and all the fibers are interrupted, the bladder is totally paralyzed and fills without the individual being aware of it. As the spinal cord recovers there is a parallel recovery of bladder function which may be complete. Later on, if there is no recovery of spinal cord function, the bladder reflex usually returns. However, instead of the control being in the brain it is in the sacral segments due to rerouting or short-circuiting of the impulses from the sensory directly to the motor nerves of the bladder. Although the bladder may start to empty, its function is erratic and uncontrolled and emptying is incomplete.

Urinary Symptoms in Transverse Myelitis

With the onset of acute Transverse Myelitis, the patient’s bladder has little or no sensation and fills with urine. If the bladder is allowed to become very distended, urine will start to dribble continuously, and this is called retention with overflow incontinence. Some form of catheterization program, either indwelling (Foley) or intermittent, is started to prevent the bladder muscle over-stretching.

Later on, as the spinal cord recovers function, patients will begin to be aware of bladder filling and be able to urinate although emptying may not initially be complete. With regard to symptoms, patients will usually have frequency of urination and urgency with perhaps some urge incontinence before they can get to the bathroom. Once in the bathroom, urination may be delayed (hesitancy), the stream may be interrupted, and emptying incomplete. This incomplete emptying of the bladder is due to a combination of a reduced contraction and discoordination of the urethral sphincter muscle. Over several weeks or months further recovery of function may occur as the spinal cord recovers.

In patients who have no recovery of spinal cord function, the new reflex in the sacral segments will start to produce some bladder emptying. However, in this situation the patient has no sensation and leaks urine without being aware of it (reflex incontinence). Emptying is usually

Figure 1 Nerve Supply to the Bladder and Urinary Sphincters

Transverse Myelitis affects the spinal cord in the suprasacral region between the two horizontal lines in the diagram. The mid-brain and sacral centers (stippled) are disconnected from one another.

more incomplete than those with recovery of spinal cord function due to worse coordination of the urethral sphincter. The secondary effects, such as high bladder pressure, urinary tract infections, and eventually kidney damage, are worse in patients who make little recovery.

**Natural History**

The recovery of bladder control and emptying in Transverse Myelitis parallels the recovery of function in the legs. Early and full recovery of the spinal cord dysfunction will usually lead to complete bladder and sphincter recovery. Why the spinal cord in some individuals recovers and in others it does not is beyond the scope of this article. Although it is difficult to determine from the literature how many patients have permanent problems, at least 20 percent of patients have some residual bladder and urethral symptoms, and most of these also have some impairment in the lower limb function. In patients with residual problems, the symptoms and the lower urinary tract manifestations may change as they age. In men the growth of the prostate may cause obstruction to the outflow of urine. In women pelvic floor descent and stress incontinence may occur especially in those who have had vaginal deliveries. In both men and women, if the bladder pressure is high and infections frequent, the bladder muscle and often the upper tracts will undergo pathological changes that further affect the lower tract and kidney functions. Long-term surveillance is therefore recommended in patients with residual bladder symptoms following Transverse Myelitis.

**Evaluation of Urinary Tract Symptoms**

Soon after the onset of the acute illness the patients will often be managed with a catheter. Urine analysis and culture are performed once or twice a week. Base line kidney function is assessed with a serum creatinine and a creatinine clearance. Those patients making a quick recovery need no further evaluation. In others that have some residual problems at the time of discharge, a renal ultrasound is usually done. Other kidney evaluations with computed tomography, intravenous pyelography, or renal isotope scan may be recommended if there is any evidence on ultrasound, or clinically, of upper tract problems such as stones, dilation, or prior abnormality due to congenital or acquired disease.

Evaluation of the lower tract is also deferred in those patients making early recovery. In those that are not recovering, a cystometrogram is performed. Here, the bladder is filled via a catheter while bladder pressure is monitored. This will determine the bladder sensation, the bladder size and elasticity (compliance), and whether there is overactivity of the bladder reflex. A full videourodynamic study includes the filling study (cystometrogram) and the bladder-emptying phase. X-rays are also combined so that, not only can the bladder wall outline and the presence or absence of urethral reflex be determined, but also the function of the urethral sphincters be assessed.

**Treatment**

Initial treatment in the acute phase usually consists of continuous bladder drainage with an indwelling Foley catheter. When the fluid balance status has stabilized, intermittent catheterization is begun by the nursing staff. Later on patients learn self-catheterization depending on their age and motivation. In men, as the majority have thoracic or lumbar lesions, there should be few physical impediments to self-catheterization. In women, although they also have thoracic and lumbar lesions, the spasticity of the lower limbs and the need for many to lie down to catheterize, may limit their ability to continue with this program after leaving the hospital. It is important for patients to empty their bladders on time so that the muscle is not over stretched. In an average sized adult 500 to 600 ml should be the maximum volume retained in the bladder.

In the first few weeks, depending on the degree of spinal cord recovery, the bladder sensation and the ability to void may return. Good prognostic factors are the ability to walk before 20 days from the start of the illness and a history of retention only rather than retention plus overflow incontinence. The later probably leads to over stretching of the muscle which delays recovery. Early catheterization at the onset of the acute illness is essential.

If recovery of the spinal cord function is very incomplete or absent, the bladder reflex will usually occur in an uncontrolled fashion leading to reflex incontinence at small bladder volumes. Treatment with medication that suppresses bladder contractions, Ditropan (oxybutynin), and Detrol (tolterodine), are the commonest agents used. If these fail to suppress the bladder reflex and the patient wants to continue with self-catheterization, surgery to enlarge the bladder and lower the pressure (augmentation) can be considered. This involves taking a twenty-five to thirty centimeter segment, usually from the small bowel, and sewing it into the opened bladder as a patch. In women who find catheterization via the urethra difficult, an artificial urethra can be constructed from the bowel and placed on the abdominal
wall so that they can catheterize sitting in their wheelchairs.

An alternative in men who can wear an external (condom) catheter is a procedure to keep the sphincters open either by cutting them (sphincterotomy) or by using a stainless steel stent. The stent gets incorporated into the urethral wall as a permanent implant. The bladder automatically empties down the urethra into the condom as the sphincters can no longer obstruct the flow of urine.

A new treatment has recently been introduced into the United States for complete spinal cord injury patients. It can be used in both males and females and would be suitable for many individuals with complete Transverse Myelitis. The bladder is made to contract by stimulating the sacral motor nerve roots at S2, 3 and 4. This is done via a totally implanted set of electrodes on the nerves connected to a receiver under the skin of the abdomen. An external controller and a transmitter drives the implant to cause bladder evacuation. At the time of implantation, the sensory roots at S2, 3 and 4 have to be cut to abolish the reflex bladder contractions which has the disadvantage of abolishing reflex bowel activity in both sexes and reflex penile erections in men. However, both of these may be restored in the majority of patients using stimulation with different characteristics to those that cause bladder emptying.

Finally, in some patients, the only practical method of bladder drainage is using an indwelling catheter either via the urethra or in the suprapubic area. Bladder complications such as stones, infections, and possible bladder cancer are more common with this method of management.

**Complications of Neurogenic Bladder in Transverse Myelitis**

**Urinary Tract Infections**

Whatever the method of management used, urinary tract infections are a risk but are most common with an indwelling catheter and least with sacral root stimulation. Management of these is controversial but generally treatment is not recommended unless there are significant symptoms. These would obviously include fever, flank pain, malaise, increased frequency of bladder contractions with incontinence, blood in the urine, and very cloudy urine with a strong odor.
Some patients have more non-specific symptoms such as increased spasticity. Mild cloudiness and odor may clear on increased fluid intake and more frequent catheterization. Treatment with antibiotics should be short term otherwise organisms resistant to oral antibiotics may start to appear. Long term or prophylactic antibiotics are not recommended for the same reason. The presence of bacteria in the urine without symptoms is not a reason to treat with antibiotics.

**Urinary Stones**

The risk of kidney and bladder stones is increased in any acutely paralyzed individual if recovery does not occur within two to three months. Decalcification of the skeleton results from disuse of the muscles and bones, and the extra calcium is excreted in the urine, which may lead to metabolic kidney and bladder stones. Later on, urinary tract infection itself may cause stone formation. For treatment, bladder stones are broken up and removed under anesthesia using instruments through the urethra. For kidney stones, externally generated and focused shock waves (ESWL) can be successful for stones less than 2 to 3 cm maximum diameter. For larger stones, instruments introduced via the ureter using energy from a Holmium laser can be used. More effective is an approach via the skin of the flank directly into the kidney using a telescope and various forms of energy to break up and remove the stone fragments. Chemical dissolution of the stones in the bladder may be successful if they are very small (3 to 4 mm.), but generally non-surgical methods are unsuccessful.

**Urethral Problems**

In men, repeated self catheterization of the urethra four to six times a day can lead to damage of the urethral lining and it is estimated that 15% of individuals develop some urethral problems after 10 to 15 years on this program. Most of these can be treated successfully and catheterizations continued. Occasionally, if their problem is so severe, the urethra may have to be abandoned. In this situation, either an indwelling or suprapubic catheter, or a catheterizable suprapubic artificial urethra will have to be considered.

In women, strictures are less common but in some, particularly those who have had an indwelling Foley catheter for many years, the urethra enlarges and urine leaks around the catheter. Here, the bladder neck has to be closed and some form of suprapubic catheterization, either permanent or intermittent, used.

**Research**

There are several areas of research using chemical and biological agents to affect the nerves in the bladder and the muscles of the urethra. Recently, the sensory nerves responsible for the overactivity of the bladder reflex have been identified. Chemical agents related to the chili pepper (Capsaicin) and a similar manufactured substance (Resiniferatoxin) are under trial. Introduction of these into the bladder can abolish the reflex for several months and may be an alternative to the oral medications, some of which have troublesome side effects, and are certainly less risky than the major surgery of bladder augmentation. Botulinus toxin has also been used to try and paralyze the urethral sphincter by injection. As an alternative to the urethral stent, it has not yet been shown to be very effective or durable in producing paralysis and further agents are awaited.

In the surgical field, an alternative to dividing the sacral sensory roots when implanting the stimulator are being sought. Various electrode configurations and stimulation parameters are being tried to achieve bladder emptying without stimulating the whole reflex via the sensory nerves. If this can be achieved, the main objection that many patients have - the dividing of intact nerves - will be eliminated.

Finally, my task as a urologist is to treat the symptoms and side effects of the organs (bladder and sphincters) that are abnormal because of a spinal cord disease. Clearly a cure for the neurological problem in the spinal cord would be the ultimate goal and make today’s urological treatments obsolete.

**Chronic Pain in TM Patients**

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Many patients with TM report symptoms of chronic pain. In our experience at the Johns Hopkins Transverse Myelopathy Center, approximately 2/3 of patients report severe pain at some time in the acute or convalescent stage. In approximately 40% of patients, pain continues as a major feature in the convalescent stage. Each patient describes the pain differently, but many phrases are commonly used to