Urological Care of the Paralyzed Patient*

ROBERT H. HACKLER, M.D.

Urologist, McGuire Veterans Administration Hospital, Richmond, Virginia, and Assistant Professor of Urology, Department of Surgery, Medical College of Virginia, Health Sciences Division of Virginia Commonwealth University, Richmond, Virginia

The paraplegic injured during World War I had only a 10% chance of surviving the first year. Only 20% of the American paraplegics could even be evacuated. A great majority of the deaths were caused by urinary tract sepsis. Starting in the mid and late 1940's, however, with the discovery of broad spectrum antibiotics, many of the early complications were eliminated and the survival rate greatly improved. Since 1946, over 2,000 patients have been admitted to the McGuire Veterans Administration Hospital. This spinal cord injury service receives approximately 400–500 admissions per year with about 70 being new patients.

Mortality. The general mortality figures dealing with longer surviving time point to the greatly improved overall care. We recently reported the mortality figures on 170 World War II paraplegics followed for 25 years and 100 Korean War paraplegics followed for 20 years (2). The overall survival was 40% and 74%, respectively. However, the survival rate greatly increased if the patient had a good neurogenic bladder (Table 1). The distinction between a good neurogenic bladder and a poor bladder will be discussed subsequently. Also, of those living at 25 and 20 years, respectively, the incidence of pyelonephritis and caliectasis was significantly higher in the patient with a poor bladder.

The main cause of death remains renal failure. The poor bladder group had a much higher incidence of renal deaths; whereas, most of the good bladder patients succumbed from non-renal causes. The great majority of the nonrenal deaths were of cardiovascular origin. It was interesting that if the kidneys were essentially normal after 12–15 years of cord injury life, whether the patient had a good or poor neurogenic bladder, he would succumb just as often from nonrenal causes.

Definitions. A good neurogenic bladder will fulfill these criteria:

1) A bladder with sufficient capacity to act as a reservoir, and this with consistency.
2) Residual urine, less than one-third of the bladder capacity or less than 100 cc.
3) Establishment of urethral voiding, although defective control dictates the use of an external appliance.
4) No permanent vesicoureteral reflux.

If these objectives cannot be accomplished, then the bladder must be treated with continuous Foley catheter drainage. The patient is then classified as having a poor or unbalanced bladder. There seems to be no question that the poor bladder patient saddled with long-term catheter drainage with its problems of constant urethral and bladder infections, increased incidence of small, contracted, spastic bladders leading to vesicoureteral reflux, hydronephrosis, chronic pyelonephritis, and amyloidosis has a very poor prognosis. Most of these patients will eventually succumb to renal failure.

We use a simple classification for neurogenic bladder when dealing with spinal cord injury (Table 2). If the spinal cord injury is above the sacral reflex arc (S-2, S-3, S-4), then the lesion is of an upper motor neuron type. Most upper motor neuron lesions will develop a good reflex contraction. A small percentage never develop a detrusor contraction, however, and must remain on intraurethral catheter drainage. These patients are classified as having a poor nonreflex bladder. The true lower motor neuron lesions, because of the disruption of the sacral reflex arc, will also have a nonreflex bladder. Many of the patients can remain catheter-

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free, however, because of their ability to credé as well as increase their intra-abdominal pressure.

Acute Spinal Shock Phase. During spinal shock, the bladder is atonic and must be decompressed either by continual catheter drainage or by intermittent catheterization. Suprapubic diversion, whether by suprapubic cystostomy or cutaneous vesicostomy, should not be instituted, for there is a high incidence of developing a small, contracted, spastic bladder. If urethral complications occur, then diversion may be implemented by way of the perineal route. A #16 Foley catheter is used for continuous drainage, and the bladder is irrigated twice daily with an antiseptic solution. The Foley is taped over the lower abdomen to prevent any lower tract complications. If urethral sepsis develops, a three-way multi-hole Bunts catheter is used in order that the urethra itself can be irrigated with Clorpactin® or other antiseptic solutions.

The results of intermittent catheterization, as recently reported in the literature, have been impressive (3). At our paraplegic center, we have been unable to institute this program due to lack of personnel. There are approximately 30 patients in spinal shock at all times, and this would require about 150 catheterizations daily under strict aseptic techniques.

Chronic Phase of Spinal Cord Injury. Approximately 65% of our patients spontaneously developed a good reflex neurogenic bladder following spinal shock. A small percentage of these patients will have bladder decompensation manifested by high residual urine. Excessive spasticity of the external sphincter causes the detrusor contraction to be ineffective, and thereby the patient continues to maintain a high residual. It has been demonstrated in many reports that the site of greatest urethral resistance is in the prostatomembranous urethra (7). We have just recently reported the results of external sphincterotomy in 150 patients (8). The best results were achieved when the cystometrogram demonstrated a reflex bladder and the sphinctermetrogram demonstrated a hypertonic, spastic external sphincter. Following external sphincterotomy in the reflex bladder group, there was an average decrease in retrograde urethral pressures of 19 mm of mercury. The results of 110 patients with a reflex bladder were impressive in that the success rate was 86%. Theoretically, if we consider these results and the fact the 65% will become catheter free spontaneously, then approximately 90% of all upper motor neuron lesions will have a reflex bladder and should develop a catheter-free state. This figure will never be reached due to lower tract complications, small penis, allergy to the condom external appliance, and the fact that some of these patients like the convenience of continuous intraurethral drainage. Naturally, the patients with a nonreflex bladder must remain on Foley catheter. Recently, in some patients with external sphincterotomy, we have been resecting the anterior part of the lateral lobes of the prostate (5). Several of our external sphincterotomy failures were corrected by this maneuver.

TABLE 1

PERCENT SURVIVAL

	Overall	Good Bladder	Poor Bladder
World War II (25 yrs.) 170 patients	40%	50%	20%
Korean War (20 yrs.) 100 patients	74%	83%	60%

Complications. The most common causes of renal failure in the cord injury patients are:

1) Pyelonephritis
2) Renal amyloidosis
3) Hydronephrosis without vesicoureteral reflux
4) Permanent vesicoureteral reflux

Pyelonephritis. Pyelonephritis of some degree is present in most paraplegics. Uncomplicated pyelonephritis (not associated with vesicoureteral reflux, hydronephrosis, or amyloidosis) resulting in renal insufficiency has been a rare occurrence in over 2,000 paraplegics we have treated at McGuire VA Hospital.

Amyloidosis. Amyloidosis is a common cause of death in the paraplegic who survives for a sig-

TABLE 2

SIMPLE CLASSIFICATION OF CORD INJURY NEUROGENIC BLADDER

I. Upper Motor Neuron
  A. Reflex Bladder
    1. Good bladder (balanced)
    2. Poor bladder (unbalanced)
  B. Nonreflex Bladder
    Poor bladder
II. Lower Motor Neuron
  A. Nonreflex Bladder (autonomous)
    Poor bladder
III. Mixed Lesion

TABLE 3

IVP GRADING

Grade
0—Normal
1—Minimal Caliectasis
2—Mild-to-Moderate Caliectasis, Minimal Dilatation of the Ureter and Pelvis
3—Moderate-to-Marked Caliectasis, Moderate Dilatation of the Ureter and Pelvis
4—Severe Hydronephrosis and Hydroureter

nificant period of time. In an autopsy study at our hospital (1) it was significant that of 26 patients with proven amyloidosis, 18 of these deaths were due directly to renal failure. In addition, 16 of these 18 patients had 2+ or greater proteinuria. Prolonged suppurative disease—as seen with chronic decubitus ulcer disease and/or osteomyelitis—is the most likely major underlying factor. Continual urethral sepsis probably should be included in the overall problem.

Hydronephrosis and Hydroureter without Vesicoureteral Reflux. Hydronephrosis and hydroureter without vesicoureteral reflux are encountered in a small percentage of paraplegics. The etiology of this upper tract deterioration is the result of high residual urine or excessive spasticity of the bladder. This increase in spasticity is often due to severe cystitis and/or the development of eggshell calculi. Treatment consists of removing the calculi as well as clearing up the bladder infection.

Some paraplegics develop a small, contracted, spastic bladder due to erratic persistent impulses from the distal stump of the spinal cord. This hypertrophy of the detrusor muscle in the area of the intramural ureter produces obstruction to the ureters. This obstruction is evidenced on intravenous pyelograms, but there is no obvious blockage at the ureterovesical junction, for large size ureteral catheters or bulbs will easily pass this area. If there is no improvement in the condition of the upper tracts with good bladder hygiene, then therapy must be directed toward interrupting the nerve impulses from the spinal cord. The results of selective sacral rhizotomy are impressive, if the bladder has not become irreversibly contracted due to loss of elastic tissue and replacement by collagen. This must be determined prior to the rhizotomy by performing cystometrograms before and after spinal anesthesia. There should be at least a 100% increase in bladder capacity following spinal anesthesia. For best results, the anterior and posterior roots of S-2, S-3, S-4 must be sectioned. Many of these spastic bladders are converted into more easily managed flaccid autonomous bladders. Misak, Bunts and others (6) reported on 28 patients undergoing selective rhizotomy, and 25 of these acquired a good autonomous bladder with good voiding potential. It was interesting that 23 of these patients actually became catheter-free. The best results were obtained in the cord injury patient who could use his upper extremities and abdominal muscles. The procedure also decreases the spasticity of the external urinary sphincter.

High residual urine can produce rather marked hyronephrosis and hydroureters. These patients usually have done well for years, voiding into an external urinary appliance, and therefore are classified as having a good reflex bladder. After this decompensation, long-term drainage may be needed for bladder tone to return. If the sphinctermetrogram reveals high intraurethral pressure, external sphincterotomy is indicated. If high residual urine is persistent, the patient must remain on permanent urethral catheter drainage.

The upper urinary tract in the paraplegic shows marked lability, and in many cases, is reversible. It must be determined that the deterioration of the upper urinary tracts cannot be reversed before some type of urinary diversion such as an ileal conduit is considered.

Vesicoureteral Reflux. In the paraplegics dying from renal failure at our hospital, irreversible reflux was present in over 60%. Reflux is considered to be irreversible if present on three consecutive cystograms or if persistent on three consecutive six-month checkups. The incidence of reflux remains about 15% after the patient has had 5–10 years of paraplegic life. Permanent vesicoureteral reflux is definitely detrimental to the kidneys in the paraplegic. It is usually the high pressure type and associated with chronic cystitis (4).

We place the patient in one of four groups based on the condition of the kidneys and bladder for the purpose of management. Table 3 illustrates how we grade the pyelogram.

Group A—Good Reflex Bladder, Grade 0-1 Urograms. Permanent reflux rarely develops in a good reflex bladder. After it has been determined that the patient does not carry significant residual urine and that the reflux is indeed permanent, vesicoureteroplasty is indicated. Vesicoureteroplasty is only indicated in a good reflex bladder. Dr. Rich-

ard Reece is currently evaluting the results of this procedure. In our hands, a successful vesicoureteroplasty is obtained in 70–80% of the cases if the reflux is unilateral. The results are worse if a bilateral reimplant is performed, because in about 50% of the cases, one side will fail. We do not perform repeat vesicoureteroplasties for the results are poor.

Group B—Poor Reflex Bladder, Grade 0-1 Urograms. The whole purpose here is to try to convert the poor bladder into a good reflex bladder, in other words, to make the patient catheter free. The reason for the poor bladder status may be high residual urine secondary to excessive external sphincter spasticity. As discussed earlier, external sphincterotomy may help rehabilitate this bladder. If successful, the external sphincterotomy has placed the patient now in Group A, and a vesicoureteroplasty could be entertained.

The largest number of paraplegics with permanent reflux have a small, contracted, spastic bladder. Naturally, this would be high pressure reflux. Nerve interruption procedures should be considered in this situation after bladder infections and/or calculi have been eliminated as the cause of the hypertonicity. As stated previously, we prefer sacral rhizotomy. If after a sacral rhizotomy the patient develops a good autonomous bladder, thereby being maintained on external appliance drainage, then a vesicoureteroplasty may be performed. A modification of the *Hutch* I vesicoureteroplasty has yielded the best results in our hospital.

The patient may have a good reflex neurogenic bladder, but due to persistent vesicoureteral reflux, catheter drainage must be continued. This problem would be alleviated if the vesicoureteroplasty was successful. However, in some cases of bilateral vesicoureteroplasty, one side would fail. Since repeat vesicoureteroplasty is uniformly unsuccessful in the paraplegic, we have turned to performing transureterourеterostomy. There have been 11 transureterourеterostomies at our hospital performed over the last several years and the results have been excellent. Of the 11 cases, only one kidney deteriorated, and this was due to a technical error in that the anastomosis into the recipient ureter was inadequate. All of these ureters were essentially of normal caliber, and there was no deterioration postoperatively. It is safe, however, to transfer a dilated ureter to a normal size ureter.

Group C—Grade 2-3 Urograms. Up to this point the discussion has centered on how to prevent any deterioration of kidney function. Most patients with a good reflex neurogenic bladder and with careful follow-up should not develop this deterioration. Faced with persistent and/or progressing deterioration of the upper tracts, and failure of bladder hygiene and sacral rhizotomy to alleviate this problem, an ileal conduit must be considered. As one can tell from the previous discussion, we are conservative in recommending this procedure, but there is a definite indication for its use. We have performed about 25 conduits and are generally impressed with the results. The renal units will uniformly improve after ileal diversion if ureteral peristalsis is adequate and renal function is not too impaired. In reviewing some of our cases, it is evident that renal insufficiency could not have been expected to improve by conduit diversion because of poor ureteral peristalsis.

Group D—Grade 4 Urograms. Marked hydronephrosis must be treated with immediate loop nephrostomies (9). These cases are uniformly uremic and usually acidotic. The ureters are dilated and tortuous. We feel that the loop nephrostomy is a definite surgical advancement over the routine Cabet type nephrostomy in the paraplegic. It is technically simple and there are no leakage problems. The catheters are easily maintained, which is important because some of these nephrostomies are permanent.

Each patient is periodically evaluated to determine if there has been enough return of kidney function and ureteral function so that the patient may be reconverted to an ileal conduit. In some cases, the creatinine clearance improves but the ureteral function remains inadequate. Cineureterograms show poor peristalsis, and in many cases retroperistalsis. We do have two patients with enough improvement in creatinine clearance and ureteral peristalsis that ileal diversion will be undertaken.

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