

# URINARY TRACT INFECTION IN ACUTE SPINAL CORD INJURY

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## ABSTRACT

*Preservation of renal function and prevention of recurrent urinary tract infections is the ultimate goal of any method of neurogenic bladder management in spinal cord injury patients.*

*Method - The hospital courses of fifty such patients admitted to our Rehabilitation Department from August 1989 to August 1990 were studied according to age, gender, spinal cord injury level, method of bladder drainage on admission and upon discharge, type of urinary tract infections and results of bladder management were documented.*

*Results - Forty-five men and ten women were studied. Mean age of males was forty and females, forty-two. The commonest cause of injury was road traffic accident followed by accidents at work place. Fifty-three percent had cervical cord injuries, thirteen percent thoracolumbar and sixteen percent lumbo sacral injuries. Seventy-eight percent had an indwelling Joley catheter upon admission. Upon discharge eighty-two percent of spinal cord injury patients were able to void with/without tapping and compression. There were a total of one hundred and forty-three urinary tract infections in our study group. All positive urine cultures had  $\geq 100,000$  CFU/ml. The commonest organisms causing urinary tract infection were *Klebsiella pneumoniae*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Proteus mirabilis*.*

*Conclusion - For bacteria to produce disease in the urinary tract, they must gain access and colonise the uroepithelium, induce inflammation and tissue damage. The indwelling catheter provides a direct access to the uroepithelium, making bacteriuria and subsequent infection inevitable. Impaired voiding and sensation in spinal cord injury patients provides an excellent reservoir for the multiplication of bacteria, tissue invasion and recurrent urinary tract infection. Hence current methods of neurogenic bladder management have to focus on attaining a catheter-free status as soon as possible; relevant antibiotic therapy and careful attention to individual urinary tract problems to reduce morbidity and improve on spinal cord injury patient's future. Although spinal cord injury patients are described, the material covered is applicable to any type of neurogenic bladder dysfunction.*

*Keywords: Bacteriuria, Neurogenic Bladder, Spinal Cord Injuries, Urinary Tract Infections*

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## INTRODUCTION

In 1976 Guttmann<sup>(1)</sup> wrote "in spite of all advances made in the treatment of patients with spinal cord injuries (SCI) during the last twenty-five years, ascending infection of the urinary tract resulting in renal deficiency is still the main killer". Adequate bladder drainage is the most effective method of preventing recurrent urinary tract infection<sup>(2)</sup>. Bacterial invasion places the remainder of the tract at risk for further invasion. Under normal conditions sterility of the bladder is maintained by the combined effects of the physical barrier of the urethra, urine flow and various antibacterial enzymes, antibodies and the anti-adherence effects maintained by bladder mucosal cells<sup>(3-5)</sup>. In the neurogenic bladder an indwelling catheter provides direct access to the uroepithelium for bacteria. It also provides a foreign body nidus for bacterial colonization. Impaired sensation and impaired emptying with residual urine in the bladder between voiding, provides an excellent reservoir for the multiplication of bacteria<sup>(6,7)</sup>. Associated with detrusor sphincter dysnergia and vesicourethral reflux the spinal cord injury patient will progressively develop chronic pyelonephritis, nephrosclerosis, irreversible vesicoureteric reflux and early renal failure.

In the general population, diagnostic criteria for a urinary tract infection depends on the presence of symptoms, bacteriuria and sex of the individual. In the spinal cord injury population, however, depending on the level of neurological impairment, symptoms like frequency, urgency, nocturia and dysuria are unreliable and frequently absent<sup>(8)</sup>. Moreover chills and fever may be the only objective symptoms but this occurs late in the course of their urinary tract infection.

Pyuria is one index of urinary tissue inflammation and often found in association with urinary tract infections. We use the pyuria level upon admission and during infection as a guide in our diagnosis of urinary tract infections. We have noted that all our spinal cord injury patients with consistent bacteriuria progressing to urinary tract infections always have a pyuria level of more than 100 white blood cells per high powered field and a study is ongoing to document the pyuria level during infections and its significance in our department.

## METHODS

### Study Sample

The hospital courses of all spinal cord injury patients admitted to our Rehabilitation Department from August 1989 to August 1990 were studied, inclusive of age, gender, spinal cord injury management. Specimen collection of urine was done during a scheduled routine intermittent catheterisation, where after an initial 100cc of urine was allowed to drain, 10cc of mid-stream catheter urine was collected and sent for urinalysis. Urinalysis and urine cultures were done twice weekly and all positive urine cultures had  $\geq 100,000$  CFU/ml. Fifty-five new patient admissions were studied (forty-five men, ten women) at the Department of Rehabilitation Medicine, Tan Tock Seng Hospital from August 1989 - August 1990. (See Tables I - III)

Seventy-six percent of our patients were injured while travelling on the road or at work. The average time lapse from the acute surgical ward to our Rehabilitation department was

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**Table I - Mean Age and Site of Injuries**

Mean Age		
Males	40.4	(15 - 72)
Females	42	(19 - 75)
Spinal Cord Injury on Admission	No. of Patients	Percentage
Cervical Cord Injury	29	53%
Thoracolumbar Injury	17	31%
Lumbosacral Injury	9	16%

**Table II - Neurological Deficit on Admission**

	No. of Patients	Percentage
Tetraplegia/Paresis	17	31%
Central Cord Syndrome	9	16%
Brown Sequard Syndrome	1	2%
Paraplegia/Paresis	21	38%
Cauda Equina Syndrome	4	7%
No Neurological Deficit	3	6%

**Table III - Causes of Injury**

	No. of Patients	Percentage
Road Traffic Accident	22	41%
Work-Related Accident	19	35%
Home Accident	7	13%
Attempted Suicide	5	9%
Assault	1	2%
Leisure, Sports	1	1%

**Table IV - Method of Bladder Drainage**

	No. of Patients	Percentage
<b>Upon Admission</b>		
Foley Catheter	43	78%
Voiding & Intermittent Catheterisation	12	22%
<b>Upon Discharge</b>		
Indwelling Foley Catheter	2	3%
Voiding & Tapping/Compression	45	82%
Clean Intermittent Self Catheterisation	8	15%
<b>Mean Urinary Tract Infection/per patient/per stay</b>		
On Indwelling Catheter - 4 (range: 2 - 6)		
Voiding with/without Intermittent Catheterisation - 1 (range: 0 - 3)		

11 days (range 2-27). Average mean stay in our Department for all our spinal cord injury patients was 100 days, patients with thoracolumbar injuries and neurogenic bladders staying the longest.

Seventy-eight percent of patients upon transfer to our department had an indwelling foleys catheter. The mean duration of bladder training was forty-nine days for cervical cord injuries, fifty days for thoracolumbar injuries and forty-seven days for lumbosacral injuries.

The term **Bladder trained** means a catheter-free status, patient continent and able to consistently maintain a residual volume of  $\leq 100$ ml with/without the aid of tapping and compression.

The mean serum creatinine level done fortnightly was

0.8mg/100 ml of blood (range 0.4-1.1) for all our patients during their hospital day in our department.

For our study and presently in our department, urinary tract infection is **defined** as urinary bacterial counts  $\geq 100,000$  CFU/ml and one or more of the following: malaise, foul smelling urine, genital or suprapubic pain, pyuria level consistently  $> 100$  white blood cells/high powered field, leucocytosis greater than 12,000, temperature  $> 37.8^\circ\text{C}$ .

*Klebsiella pneumoniae* and *Escherichia coli* were the pathogenic organisms in more than 50% of our study population. (See Table V) and the incidence of urinary tract infections was four times more, in those with an indwelling catheter in contrast to those without.

## DISCUSSION

Maintenance of good urinary tract function in patients with

**Table V - Incidence of Bacterial Pathogens from which  $\geq 100,000$  CFU/ml were isolated:**

Species	No. of Infections	Percentage
<i>Klebsiella pneumoniae</i>	52	36%
<i>Escherichia coli</i>	27	19%
<i>Pseudomonas aeruginosa</i>	23	16%
<i>Proteus mirabilis</i>	15	11%
<i>Enterobacter aerogenes</i>	5	4%
<i>Providencia rettgeri</i>	3	2%
<i>Citrobacter freundii</i>	3	2%
<i>Streptococcus Gp D</i>	2	1%
<i>Staph. epidermidis</i>	1	
<i>Acinetobacter calcoaceticus</i>	1	1%
Mixed bacterial growth	11	8%

spinal cord injury continues to be a major concern for clinicians as urinary tract infection has long been recognized as a contributing factor to renal function deterioration in spinal cord injury patients.

The process of bladder training has helped a higher percentage of this patient population to attain a "catheter-free" state upon discharge. Moreover, it has been shown that this process of bladder training by tapping with/without compression and intermittent catheterisation lowers the urinary tract infection rate during the rehabilitation phase and eliminates many of the significant urinary tract complications associated with an indwelling catheter<sup>(9)</sup>.

Simple mechanical washout with emptying to nearly zero residual volumes is lost in virtually all neurogenic bladder patients, thus making eradication of the persistent bacteriuria even with appropriate anti-microbial treatment difficult. The spinal cord injury patients especially with reflex detrusor function, bladder neck dyssnergia and elevated intravesical pressures may cause relative ischaemia to the bladder wall and increase colonization and inflammation of the wall and mucosa<sup>(10,11)</sup>.

All 55 patients in our study population had urinary tract infections requiring 10 to 14 days of antibiotic therapy during the study. Those on indwelling catheter had a significantly increased incidence of urinary tract infection in comparison to those without, an average increase of four times, as seen in our patient population. *Klebsiella pneumoniae* was the most common organism cultured (36%) followed by *Escherichia coli* (19%), *Pseudomonas aeruginosa* (16%) and *Proteus mirabilis* (11%).

Six out of the ten patients who demonstrated abnormal roentgenographic findings were noted to have vesicoureteric

reflux probably as a result of alterations in the morphology of the bladder wall, inflammation of the periurethral tissues and obstructed high pressure voiding.

Four patients in our study population developed septicæmia and required intense haemodynamic support, selective use of intravenous bactericidal antibiotics over a fourteen-day period and transfer to an acute medical ward. All four were on indwelling catheter at the time of their illness, tetraplegic at the time of admission to our department; the offending organisms being *Escherichia coli* (n = 2), *Klebsiella pneumonia* (n = 1) and *Pseudomonas aeruginosa* (n = 1).

Guidelines for treatment in our spinal cord injury patients followed best by reserving therapy for definite urinary tract infections with single agents preferably bactericidal for over a ten to fourteen-day period<sup>(12,13)</sup>. Acidification of the urine by ascorbic acid was done when the offending organism was predominantly *Proteus mirabilis*. The serum creatinine levels of all our patients in this study remained at the mean of 0.8mg/100ml of blood, none of them progressing to chronic renal impairment, during their hospital stay, of an average duration of three months in our department<sup>(14,15)</sup>.

### CONCLUSION

This study confirms Comarr's findings published in the Journal of Urology October 1961 that a "catheter-free state does bear watching among patients with spinal cord injury". He stressed the importance of a carefully regulated bladder emptying regime together with strict residual measurement at regular intervals and a free catheter status to significantly reduce urinary tract infection in spinal cord injury patients. This is what we desire to achieve in our department and it is gratifying to note that the majority of our patients maintained good renal function during the study period and were able to be bladder trained. The average monthly infection rate during the study period was 12% in comparison to 32% in the same working period for the year 1987 and 1988, when indwelling catheters were the main form of bladder drainage in spinal cord injury patients in our department. Hence, intermittent catheterisation with/without tapping and compression is an improvement over

indwelling catheterisation as a method of bladder drainage especially reducing bacteriuria, urinary tract infections and its complications in our study population.

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