

## INTERMITTENT CATHETERISATION: FOLLOW-UP STUDIES\*

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*Abstract.* One hundred twenty-six male spinal cord injury patients whose acute bladder management included indwelling urethral catheters were converted to an intermittent catheterisation programme and most of them subsequently achieved a catheter-free state. A higher prevalence of pyelocaliectasis was observed in these patients compared to previous reports of similar changes in patients upon whom intermittent catheterisation was initiated immediately after injury. Right side predominance of pyelocaliectasis was demonstrated but requires further study. The extent of neurological deficit (complete or incomplete lesions) does not appear to influence the development of pyelocaliectasis. These findings support our contention that intensive urological follow-up is necessary for all spinal cord injury patients even though a catheter-free state has been achieved through use of intermittent catheterisation.

**Key words:** Intermittent catheterisation.

INTERMITTENT catheterisation has gained increasing acceptance as the most appropriate bladder management technique in spinal cord injury patients. Since the value of intermittent catheterisation was first described by Guttman and Frankel (1966), others have also advocated intermittent catheterisation for bladder drainage during the immediate post-injury period (Walsh, 1968; Pearman & England, 1973). The present system of acute spinal cord injury care in the United States has made it difficult to establish immediate intermittent catheterisation: however, recent reports from the United States have also recommended intermittent catheterisation for patients in whom indwelling catheters have been used for varying periods of time following injury (Firlit *et al.*, 1975; Lindan & Bellomy, 1975; Perkas, 1975). There is general agreement that a majority of patients can become catheter-free through an intermittent catheterisation programme. Likewise, it is agreed that the incidence of early complications such as penoscrotal abscess and fistula, epididymitis, bladder and/or renal calculi, vesico-ureteral reflux, and pyelonephritis is reduced with intermittent catheterisation (Guttman & Frankel, 1966).

An intermittent catheterisation programme is commonly described as successful if the patient is catheter-free, has a low residual urine volume and a negative urine culture at the time of hospital discharge. However, such general criteria have caused some clinicians to question the long-term effects of this method of bladder management due to a paucity of long-term follow-up data. Reports of insidious hydronephrosis among catheter-free patients are becoming more frequent (Pelosof *et al.*, 1973; Rosen *et al.*, 1975). These findings have prompted us to review and analyse some of the results of our intermittent catheterisation programme which started in 1970 as a prospective study.

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### Materials

Three hundred and fifty male spinal cord injury patients have participated in an intermittent catheterisation programme. Before admission to the Spain Rehabilitation Center, an indwelling urethral catheter had been used for acute bladder management for varying lengths of time. A subset of 126 patients has now had annual follow-up evaluations with excretory urograms for at least 2 years, ranging from 2 to 6 years, and is the subject of this report. Ninety-one (72 per cent) patients in this series experienced complete neurological deficit below the level of injury while the remaining 35 patients (28 per cent) had an incomplete neurological deficit.

### Methods

Our intermittent catheterisation procedure was described in detail in a previous report (Stover *et al.*, 1973). In summary the procedure was performed by technicians who had been trained and were proficient in a sterile, gloved, non-touch technique using a disposable catheterisation tray<sup>1</sup> which included a No. 14 French plastic catheter. Residual volumes of less than 150 ml after voiding were arbitrarily established as acceptable to continue on external condom drainage. Appropriate antibiotic therapy was administered as determined necessary by urine cultures and sensitivities to achieve a sterile urine prior to discharge.

After plain film X-rays of the abdomen, cystograms were performed on most patients by retrograde filling of the bladder through a Foley catheter, temporarily inserted for the procedure. Following cystography, excretory urography was done according to the technique described by Emmett and Witten (1971). Preparation for excretory urography included a liquid diet the day before the examination with nothing by mouth after midnight. A Fleet's enema was given the night before and the morning of the procedure. For excretory urography, 100 ml of iodinated contrast agent was injected intravenously, and external ureteral compression applied. Several tomographic cuts were made of the renal areas at 2 to 3 minutes post-injection and small films of the renal area were made at 5 and 10 minutes. After the 10-minute film, the compression was released and a large abdominal film made. Post-voiding films were obtained on those patients able to void. A radiologist monitored the examination, and necessary alterations in the filming procedure were made to demonstrate any detected abnormalities.

For this report, pyelocaliectasis is designated as the determinant of upper tract (renal) abnormality. Caliectasis had to be present to be considered abnormal. Dilatation of the renal pelvis or ureter without caliectasis was suspect of impending difficulty, but not reported as abnormal. Pyelocaliectasis was graded in all patients as follows: absent, grade 0; mild, grade 1; moderate, grade 2; severe, grade 3; non-functional or removed kidney, grade 4. In the case of minimal change, grade agreement by at least two of the three interpreters was required for reporting.

### Results

Thirty-eight (30 per cent) of these 126 patients followed 2 to 6 years after injury were observed to have some degree of pyelocaliectasis on the most recent excretory urogram (Table I).

<sup>1</sup> Curity Pre-Connected Closed System Cath. Tray 'A' Code No. 3193, The Kendall Company, Hospital Products Division, Boston, Massachusetts, 02110.

TABLE I

Incidence of pyelocaliectasis on excretory urography in 126 spinal cord injured patients 2 or more years post-injury

Pyelocaliectasis	No. of patients	% of patients
Present	38	30
Absent	88	70
Total	126	100

Pyelocaliectasis was present on excretory urography in 12 (34 per cent) patients with incomplete spinal cord lesions and in 26 (29 per cent) patients with complete neurological lesions, suggesting that both categories are at equal risk of developing pyelocaliectasis (Table II).

Each renal unit was assessed for the presence of radiographic abnormalities (Table III). Right side changes predominated. In patients with complete injuries, pyelocaliectasis was noted bilaterally in 12 patients, unilateral right side in 11 patients and unilateral left side in two patients. Patients with incomplete injuries demonstrated a similar distribution: bilateral, 6; unilateral right side, 5; unilateral left side, 1.

TABLE II

Incidence of pyelocaliectasis in incomplete and complete spinal cord injury patients

Pyelocaliectasis	Incomplete		Complete	
	No. of patients	% of patients	No. of patients	% of patients
Present	12	34	26	29
Absent	23	66	65	71
Total	35	100	91	100

TABLE III

Pyelocaliectasis according to side of involvement

	Right	Bilateral	Left
Complete injury	11	12	2
Incomplete injury	5	6	1

TABLE IV

Grade\* of pyelocaliectasis according to side of involvement

Grade	Right	Left	Total
1	22	11	33
2	8	7	15
3	3	3	6
4	1	0	1
Total	34	21	55

\* Grade 0, normal; grade 1, mild pyelocaliectasis; grade 2, moderate pyelocaliectasis; grade 3, severe pyelocaliectasis; grade 4, non-functional or removed kidney.

Grading each renal unit on a 0-4 scale (Table IV) suggested the more severe degrees of pyelocaliectasis were seen almost equally on the right and left sides, the less severe being predominantly on the right side. Mild (grade 1) changes were seen on the right side in 22 renal units and on the left in 11 renal units. Moderate (grade 2) changes were present in eight right and seven left renal units. Severe (grade 3) changes occurred three times on each side while grade 4 changes were present in only one renal unit on the right side.

Cystograms were performed in 102 of 126 patients in this study at the time of their last annual examination (Table V). Eleven patients (10 per cent) demonstrated vesico-ureteral reflux. Six of the patients with vesico-ureteral reflux had normal excretory urograms, while five patients had some degree of pyelocaliectasis.

In this series of 126 patients, 92 patients (73 per cent) were catheter-free at the time of hospital discharge. One year post-injury, 97 patients (77 per cent) were catheter-free. Bladder management at the time of the last excretory urogram was as follows: 93 patients (74 per cent), catheter-free with external condom drainage; 13 patients (10 per cent), indwelling urethral catheters; 11 patients (9 per cent), uretero-iliostomies; 4 patients (3 per cent), suprapubic cystotomies; and 5 patients (4 per cent) regained adequate bladder control. Eight patients had had external sphincterotomies and/or bladder neck resections.

TABLE V

No. of patients with reflux. Cystograms performed on 102 of 126 patients at time of most recent follow-up excretory urogram examination

	No Reflux	Right Reflux	Left Reflux	Bilateral Reflux
Normal excretory urograms	67	1	3	2
Pyelocaliectasis	24	2	0	3

### Discussion

Undoubtedly, many of the complications of indwelling urethral catheters can be avoided by early intermittent catheterisation and maintenance of the catheter-free state. Less is known, however, about the long-term effects of a catheter-free state on renal function. Guttmann and Frankel (1966) reported 7.4 per cent of their patients developed hydronephrosis during their follow-up studies. Gibbon and co-workers (1969) reported a 10 per cent prevalence rate of hydronephrosis. In comparison, earlier reports in patients managed mainly with indwelling urethral catheters indicated hydronephrosis occurred in 20 to 43 per cent of spinal cord injured patients (Comarr, 1954; Damanski & Gibbon, 1956; Talbot *et al.*, 1959; Ascoli, 1968). According to Donnelly *et al.* (1972), 22 per cent of World War II paraplegics with good bladders and 55 per cent with poor bladders developed caliectasis. However, only 10 per cent of Vietnam paraplegics with good bladders and 20 per cent with poor bladders had caliectasis 5 years post-injury. A good neurogenic bladder was defined as one which had no reflux, did not require an indwelling catheter, and had a residual urine of less than one-third capacity. More recently Price *et al.* (1975) reported 22 per cent calyceal blunting and 22 per cent with decreased renal function in spinal cord injured patients during an 8-year follow-up study where the majority of patients were managed with an indwelling urethral catheter. Their data did not demonstrate any correlation between renal functional deterioration and method of bladder drainage.

The difference in the prevalence of hydronephrosis between patients treated with immediate intermittent catheterisation and those maintained on indwelling catheters has led to the acceptance of intermittent catheterisation as the preferred method of bladder management. It was assumed the above results obtained with immediate intermittent catheterisation could be duplicated in patients who were treated initially with indwelling urethral catheters and intermittent catheterisation was used subsequently to achieve a catheter-free state. Success of this method of management was based on hospital discharge data rather than proof that upper urinary tracts were preserved for long periods of time, with prevention of renal morbidity and mortality.

Some evidence suggests there may be deleterious long-term effects associated with a catheter-free state. Butler *et al.*, (1971) showed that raised intravesical pressure caused diminished ureteral peristalsis and dilatation of the ureters and pelvicalyceal system in a small group of patients. They concluded continuous urethral catheter drainage probably offered greater protection to the upper urinary tracts. Boyarsky *et al.* (1971) have shown the flow of urine into the bladder gradually ceases when the intravesical pressure reaches 37-50 cm of water. Clinical evidence of this phenomenon was suggested by two recent reports (Pelosof *et al.*, 1973; Rosen *et al.*, 1975) of the development of silent hydronephrosis in patients treated by intermittent catheterisation. Two patients in this study also developed insidious pyelocaliectasis. Clinical signs and symptoms were absent and the urine remained sterile. These observations raise the question of the effect of chronic increased intravesical pressure in neurogenic bladder patients who empty the bladder incompletely.

Vesico-ureteral reflux is often thought to be associated with renal deterioration (Hutch & Bunts, 1951; Donnelly *et al.*, 1972). In the current study, vesico-ureteral reflux was just as often associated with a normal excretory urogram as it was with pyelocaliectasis. Further follow-up of these patients will be required to determine the significance of this finding.

The predilection of the right kidney to develop early changes of pyelocaliectasis needs further clarification. In 1954, Comarr studied the X-rays of both kidneys in 315 patients. In patients with complete injuries he found changes in 32 per cent of the right kidneys and 25 per cent of the left kidneys. Patients with incomplete injuries had changes in 29 per cent and 23 per cent for the right and left kidneys, respectively. Damanski and Gibbon (1956) noted reflux occurring more often on the right than the left side. Price (1976) studied the bacteriology of the upper urinary tract at the time of uretero-ileostomy and found positive cultures more frequently on the right side. In the present study, reflux was not more common on the right side at the time of cystography, but in those patients with right-sided reflux, the degree of pyelocaliectasis was more severe than that observed with left reflux. It is recognised that the gravid uterus causes right-sided ureteral dilatation more often than left (Fainstat, 1963). Whether our observed right-side predominance has any morphologic or physiologic basis in spinal cord injury remains unknown. Patients in this study had external ureteral compression applied over the sacral promontory at the time of excretory urography. It is possible this technique along with increased doses of iodinated contrast agent demonstrate earlier renal changes than previous methods of excretory urography. The natural history of early minimal pyelocaliectasis must be followed for longer periods of time to determine its significance.

Most investigators have held that incomplete spinal cord injured patients have fewer complications than those with complete lesions. However, in Comarr's study (1954) there was very little difference in patients with complete or incomplete lesions. The patient with an incomplete spinal cord injury has a greater likelihood of maintaining a sterile urine, but intravesical pressure can be quite variable. Our observation that the prevalence of pyelocaliectasis is as frequent and the degree of pyelocaliectasis is as great in incomplete as complete injuries is disturbing and again raises the question of infection versus increased intravesical pressure in the development of upper tract changes.

Published results of the success of intermittent catheterisation at the time of hospital discharge in patients who were initially treated for variable periods of time with indwelling urethral catheters may be leading to a false sense of security for patients who are catheter-free. It is increasingly apparent these patients demand extremely careful follow-up, including regular radiographic studies, urodynamic evaluation and possible surgical intervention to guarantee the anticipated success of a catheter-free state both in prevention of acute complications as well as long-term preservation of renal function.

Our findings raise several questions about intermittent catheterisation as currently practiced in most spinal cord injury centres in the United States. (1) Are the benefits of immediate post-injury catheterisation applicable for long-term bladder management in patients who have had indwelling catheters for varying periods of time after injury and in whom a chronic urinary tract infection is usually established? (2) Should we be making a greater effort toward immediate intermittent catheterisation post-injury? (3) What are the independent or combined roles of chronically increased intravesical pressure and infection on the development of renal changes?

### Conclusion

Intermittent catheterisation as carried out at the Spain Rehabilitation Center, which is similar to intermittent catheterisation programmes in most spinal cord injury centres of the United States, has led to a higher prevalence of pyelocaliectasis

than observed in centres which establish intermittent catheterisation immediately after injury. Right-sided predominance of pyelocaliectasis was observed and requires further study. The equal risk of pyelocaliectasis among incomplete and complete spinal cord injury patients reaffirms the necessity for intensive follow-up in patients who may have partial bladder sensation and control and are symptom-free.

### RÉSUMÉ

Cent vingt-six mâles avec la blessure de la moelle épinière dont le traitement aigu de la vessie a compris la sonde à demeure urétrale sont converti à une programme pour la cathétérisme intermittent et subsequemment sont devenus libre de la sonde. Une prévalence plus grande de la pyélocaliectasie été remarqué dans ces malades en comparaison des communications précédants des changements semblable dans les malades sur qui la cathétérisme intermittent été commencé immédiatement après la blessure. La prédomination à droit de la pyélocaliectasie été démontré mais il faut l'étudier plus. L'étendu du déficit neurologique (les lésions complets ou incomplets) ne semble pas à influencé le développement de la pyélocaliectasie. Ces conclusions soutiennent notre contention que la poursuite urologique intensif est nécessaire pour tout les patients avec la blessure de la moelle épinière même que l'état libre de la sonde a été achevé par la usage de la cathétérisme intermittent.

### ZUSAMMENFASSUNG

126 männliche Patienten mit Rückenmarksverletzungen, die mit Dauerkathetern behandelt waren, wurden in ein Programm übernommen, bei dem intermittierende Katheterisierung durchgeführt wurde. Die Patienten erreichten nach und nach ein katheterfreies stadium. In diesen Patienten wurde eine höhere Frequenz von Nierenbeckencalictasie beobachtet als bei in der Literatur beschriebenen Patienten mit ähnlichen Veränderungen, die vom Zeitpunkt der Verletzung an nur intermittierend katheterisiert wurden. Die Nierenbeckencalictasie trat häufiger auf der rechten Seite auf, dies muss allerdings noch durch weitere Untersuchungen belegt werden. Das Ausmass der neurologischen Ausfälle (vollständige oder unvollständige Läsionen) scheint keinen Einfluss auf die Entwicklung von Nierenbeckencalictasie zu haben. Die beschriebenen Befunde unterstützen unsere Anschauung, dass eine intensive urologische Kontrolle bei allen Patienten mit Rückenmarksverletzungen notwendig ist, obwohl ein Katheterfreies Stadium durch intermittierende Katheterisierung erreicht werden kann.

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### General Discussion

DR PERKASH (*Chairman*). This paper gives a tremendous insight into what has happened in the past 10 years. I think that one of the messages which Sam has tried to bring in is that probably we have to look more down in the urodynamics what's going on rather than looking at the effects of what has gone wrong in the urodynamics. Dr Frankel would like to make a comment.

DR H. FRANKEL (*G.B.*). Mr Chairman, Sir Ludwig and I first presented our results on intermittent catheterisation on several hundred patients in the equivalent meeting of the Society in Tokyo in 1964 and I want to make it clear that our results then and our method now is used entirely for acute lesions for the primary management of the patient. If we receive a patient with an indwelling catheter 4 to 6 weeks after injury we do not use intermittent catheterisation. We feel that the battle is over and possibly lost at that stage. The entire rationale of the method is for the *prevention* of infection and for the rapid establishment of reflex voiding. At that time, our good results were met with amusement or incredulity. For reasons that I can't explain over the years it became very fashionable, everybody wanted to do intermittent catheterisation, even those who did not have the acute patients. I can see no reason for subjecting a late patient to three or four times a day catheterisation myself and we don't do it, but I do endorse your remarks and we do need an accurate continuous follow-up of all patients however, whatever method of initial treatment they've had. I think that intermittent catheterisation is marginally superior as an early method to anything else but I don't claim that it gives the patient an immunity from further complications in the future.

DR G. BEDBROOK (*Australia*). My question Mr Chairman is twofold: first of all were the changes that you described only noted in the group who on discharge were non-sterile and secondly what are the numbers of urinary tract infections that these patients are sustaining per year? Unless you know the urinary tract infections that these people are



sustaining per year then of course you don't really know what's happening to those kidneys.

DR STOVER. To answer the first question, many of our patients were discharged sterile so these are both patients that were discharged sterile and those that remained infected at the time of discharge. We have a very high incidence of re-infection in our patients after they got home. I cannot give you the exact numbers and time of re-infection or urinary tract infections but I might ask you whether you are talking about clinical infection or urinary tract culture, positive cultures. We only maintain about 20 per cent of our patients over a prolonged period of time sterile in complete injuries. This goes up to about 50 to 60 per cent in incomplete injuries so that we have many patients with re-infection.

DR GLEN REYNOLDS (*U.S.A.*). Dr Stover, in your total series what percentage of the patients were female and of those female patients what percentage were catheter free and what was the renal morbidity in those that were catheter free with those of the same form of indwelling catheter drainage as measured against the total series?

DR STOVER. I stated that all of these patients were male patients so I have no female patients.

DR G. REYNOLDS. Somehow I missed that, I'm sorry.

DR PERKASH. I think that one of the remarks made by Dr Bedbrook is very pertinent. We have to have some kind of a common understanding of presenting or collecting data in our own institutions. It would be very very pertinent to follow Dr Pearman's significant bacterial accounts in all groups of patients. What I have shown today which is I think the same thing, but find out 6 months or 1 year later how many infections are present so that people can really compare. It quite often happens that one may see one last culture in the follow-up and think the patient is uninfected but that's not the thing which holds true for paraplegia which Sam agrees, and Sam has really pointed out that it's a very small minority of patients which are infection free under the present situation.

DR STOVER. I have much of that data on infection. One of the problems in any of this work is that you get so many variables that you end up with no results if you're not careful. That's why I elected in this paper to look at pyelocaliectasis itself.