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Clinical Case of the Month

Recurrent bilateral renal calculi in a tetraplegic patient

S Vaidyanathan[1], BM Soni[1], Fin Biering-Sorensen[2], Per Bagi[2], AH Wallberg[3], J Vidal[4], A Borau[4], G Singh[1], P Sett[1] and KR Krishnan[1]

[1]Regional Spinal Injuries Centre, Southport, UK; [2]Centre for Spinal Cord Injured, The Neuroscience Centre, Rigshospitalet, Copenhagen University Hospital, 25 Havnevej, DK-3100, Hornbaek, Denmark; [3]Spinal Injuries Unit, Rehabcentrum Lund-Orup, Lund University Hospital, 221 85 Lund, Sweden and [4]Institut Guttmann, C/Garcilaso 57, 08027, Barcelona, Spain

An 18-year-old male developed C-5 complete tetraplegia following a motor-cycle accident in May 1975. The neuropathic bladder was managed by an indwelling urethral catheter. He developed recurrent episodes of urinary infection with Proteus species. In September 1975, an X-ray of the abdomen revealed small calculi in both the kidneys. In July 1976, he underwent transurethral resection of the bladder neck and division of the external urethral sphincter; subsequently, he was put on a penile sheath drainage. He continued to suffer from repeated episodes of urinary tract infection with Proteus, Providencia, and Pseudomonas species, and he was treated with antibiotics. In 1980, intravenous urography (IVU) showed two large stones in the left kidney with marked caliectasis. The IVU performed in 1984 showed an increase in the size of the calculi in the left kidney which was grossly hydronephrotic. There were clusters of small calculi in the right kidney. The left renal calculi were treated by percutaneous lithotripsy in two sessions. In 1988, an X-ray of the abdomen revealed staghorn calculus in the right kidney and recurrence of stones in the left kidney. The staghorn calculus in the right kidney was treated by percutaneous nephrostolithotomy in two sessions. In 1991, he was admitted with acute urinary infection. IVU showed a stone in the pelviureteric junction with no excretion of contrast in the left kidney. Percutaenous nephrostomy drainage was established followed by left percutaneous nephrostolithotomy. In 1992, he was found to retain large amount of urine in the bladder; subsequently, his mother was taught to perform regular intermittent catheterisations. In 1995, he was admitted with acute urine infection. Abdominal X-ray revealed recurrence of large stones in both kidneys. With multiple sessions of Extracorporeal Shockwave Lithotripsy (ESWL), about 80% clearance was achieved on the left side. Right staghorn renal stone awaits treatment. This case shows that recurrent urinary infection in spinal cord injury patients is a predisposing factor for renal lithiasis. These patients require annual urological evaluation. Urinary tract calculi, if detected, should be dealt with promptly to prevent renal damage due to urinary obstruction and urosepsis. Renal calculi can be treated effectively and safetly by ESWL in spinal cord injury patients, thus avoiding the need for an invasive procedure. It is essential to achieve low-pressure, adequate emptying of the urinary bladder in patients with spinal cord injury in order to prevent recurrent urinary infection and its sequelae. Social issues involved in the care of a tetraplegic patient play a vital role in the implementation of ideal medical treatment and need to be addressed promptly to avoid any compromise in the quality of medical care.

Keywords: tetraplegia; urinary infection; kidney stones; spinal cord injury; extracorporeal shockwave lithotripsy (ESWL)

Introduction

Patients with spinal cord injury are at increased risk for developing urolithiasis. During the preceding 5 years, renal lithiasis was dealt with in 13 tetraplegic patients (9 male, 4 female) in the Spinal Injuries Centre, Southport. Extracorporeal shock wave lithotripsy (ESWL) was used successfully as the monotherapy in eight tetraplegic subjects (4 male, 4 female); percutaneous nephrolithotripsy (PCNL) was performed in only one patient; a 56-year-old male tetraplegic patient with a calculus in the proximal third of the left

Correspondence: S Vaidynathan, Regional Spinal Injuries Centre, District General Hospital, Town Lane, Southport, Merseyside PR8 6PN, UK

ureter, underwent ureteroscopic laser lithotripsy; one tetraplegic patient with recurrent, bilateral renal calculi underwent ESWL for the left kidney stone; he is awaiting treatment for the right renal calculus. Complications associated with renal calculi were the contributory factors for the demise of two tetraplegic patients. Urinary sepsis, renal insufficiency, respiratory failure and intra-cerebral haemorrhage accounted for the demise of a 41-year-old male tetraplegic patient following surgical removal of a large, impacted stone at the pelviureteric junction.[1] Another 41-year old male C-4 tetraplegic patient with left renal and ureteric calculi developed pyonephrosis with perinephric abscess, and died of respiratory failure before any procedure could be performed. Based on this clinical experience in the management of tetraplegic patients with upper urinary calculi, it appears that (1) nephrolithiasis in the majority of tetraplegic patients may be treated by ESWL alone; (2) renal and ureteric calculi, if left untreated, may produce urinary obstruction and life-threatening urosepsis.

As patients with cervical spinal cord injury have profound changes in the physiology of the cardiovascular and respiratory systems, tetraplegic patients with kidney stones form a distinct group in contrast to able-bodied individuals with renal calculi; therefore, the policy of treatment of renal calculi in patients with intact neuraxis may not be applicable *in toto* to the tetraplegic patients with compromised pulmonary function. The clinical details of a tetraplegic patient with recurrent, bilateral renal calculi are presented here with the aims (i) to generate a discussion on prevention and treatment of renal calculi in tetraplegic patients, and (ii) to formulate a consensus on the pragmatic approach for management of renal lithiasis in tetraplegic patients.

Case presentation

This male patient, born in 1957, sustained complete tetraplegia below C-5 in May 1975 in a motor-cycle accident. Initially his bladder was managed by an indwelling urethral catheter. As trial of micturition was unsuccessful he was put on indwelling urethral catheter drainage. Microbiology of urine showed Proteus species. In September 1975, intravenous urography (IVU) revealed small calculi in both the kidneys; the renal pelvis and the ureters were undilated (Figure 1). During October and November 1975, microbiology of urine revealed Proteus rettgeri resistant to all antibiotics. In December 1975, Pseudomonas pyocyaneus was grown from the urine. He received courses of carbenicillin and then gentamicin. In May 1976, Pseudomonas aeruginosa and citrobacter species were grown from the urine. Circumcision was performed on 21 May 1976 under lignocaine ring block. In June 1976, he developed acute urine infection and received a course of gentamicin. The X-ray abdomen taken on 22 June 1976 showed no radio opaque stone in the urinary tract. The IVI series showed good excretion of contrast

Figure 1 The 30 min film of the IVU series performed on 24 September 1975 showed good excretion of contrast by both the kidneys with undilated pelvis and ureters

by both the kidneys; the right kidney showed mild caliectasis. In July 1976, he underwent transurethral resection of the bladder neck and division of the external urethral sphincter. He was established on penile sheath drainage in August 1976. In September 1976, he developed acute urine infection and was treated with amoxycillin. The residual urine was only 30 ml.

In November 1976, he developed another episode of acute urine infection and was administered Cephradine. Subsequently urine microbiology revealed heavy growth of Pseudomonas aeruginosa. In December 1976, urine culture yielded heavy growth of Proteus Morganii. In April 1977, urine microbiology revealed Proteus species, Providence species, and Pseudomonas aeruginosa. In May 1977, he developed acute urine infection and was treated with gentamicin 80 mg twice a day intramuscularly for a week. he was then advised to take hexamine hippurate 1 gram twice a day, and vitamin C 500 mg four times a day indefinitely. In June 1977, urine culture showed Acinatobacter anitratus. In September 1980, urine microbiology revealed Acinatobacter anitratus, Pseudomonas species, and Proteus morganii. The IVU series showed two large stones in the left kidney with marked caliectasis. In September 1981, urine microbiology

revealed Providentia species and Proteus rettgari. He was prescribed Co-trimoxazole two tablets twice a day for 10 days. In 1983, urine culture was positive for Proteus morganii. X-ray abdomen showed an increase in the size of the left renal calculi as compared to the X-rays of 1980. In September 1984, urine culture yielded Pseudomonas aeruginosa. IVU showed large laminated calculi in the left kidney and clusters of small calculi in the right kidney. The left kidney was grossly hydronephrotic with considerable reduction of the cortex. The calyces of the right kidney were slightly dilated.

On 30 August 1985, percutaneous lithotripsy of stones in the lower pole and renal pelvis of the left kidney was performed. On 13 September 1985, further lithotripsy of left renal calculi was done. In June 1988, he developed acute urine infection. Urethral stricture was diagnosed and urethral bougies were passed. Cystourethrogram showed open bladder neck; diverticulated bladder; no vesicoureteric reflux. Ascending urethrogram was normal. X-ray of abdomen revealed large staghorn calculus in the right kidney and collection of large stones in the left kidney (Figure 2). In January 1989, right percutaneous nephrostolithotomy was performed; partial debulking of the staghorn calculus was accomplished. In January 1991, right percutaneous nephrostolithotomy was performed with good clearance of the staghorn calculus. On 28 February 1991, he was admitted with high temperature, shivering, and vomiting for 4 days. IVU showed a stone in the pelvi-ureteric junction with no function in left kidney. Percutaneous nephrostomy drainage was established. He received imipenem with cilastatin. Subsequently IVU was performed; this showed faint opacification of left pelvicalyceal system. In May 1991, left percutaneous nephrostolithotomy was performed achieving satisfactory clearance of the stones from the renal pelvis and the calyces. In June 1991, he was admitted with acute urinary infection; he was given Claforan intravenously. In September 1991, he was admitted again with urinary infection. X-ray abdomen revealed small residual stones in both kidneys (Figure 3). In August 1992, he was found to hold large amount of urine in the bladder (1300 ml) while on penile sheath drainage. Subsequently, his mother was taught to perform regular intermittent catheterisation. In June 1995, he was admitted with acute urine infection, and received intravenous antibiotics. Ab-

Figure 2 The X-ray of abdomen taken on 11-11-1988 shows recurrence of stones in the left kidney after percutaneous lithotripsy. There is formation of staghorn calculus in the right kidney

Figure 3 The X-ray abdomen taken on 09-09-1991 shows almost complete clearance of the stones in both the kidneys by percutaneous lithotripsy

dominal X-ray revealed large stones in both kidneys. In 1997, IVU showed an increase in the size of the right kidney stone (Figure 4). ESWL of left kidney stones was begun. With multiple sessions of lithotripsy, about 80% clearance was achieved on the left side. Right staghorn renal stone awaits treatment. In January 1988, MAG 3 isotope renogram was performed; this showed relative function of 63% by the right kidney and 37% by the left kidney.

This patient did not require anaesthesia for ESWL. The total sum of shock waves delivered to the left kidney varied considerably, eg from 1607 to 4100 shock waves at each session. For example, on 17 October 1997, three electrodes were used for the ESWL; 1000 shock waves were delivered to each upper and lower poles; 2000 shock waves were delivered to the pelvic stone; and high power was employed. During this double treatment session, which lasted from 1353 h to 1510 h, he developed autonomic dysreflexia twice as manifested by an increase in blood pressure from 103/66 mg Hg to 150/106 mm Hg at 1411 h, and from 121/62 mm Hg to 139/92 mm Hg at 1452 h. Each of these dysreflexic episodes was treated by administration of nifedipine 10 mg sublingually. On 28 November 1997, the total sum of shock waves delivered to the left kidney stone was 3007; the lithotripsy session lasted from 1512 to 1631 h. He developed one episode of autonomic dysreflexia as manifested by an increase in blood pressure to 140/89 mm Hg at 1526 h. Sublingual administration of 10 mg of nifedipine resulted in lowering of the blood pressure to 93/58 mm Hg. He also developed transient increase in spasms of legs during the lithotripsy. The lithotripsy-induced increase in muscle spasms was controlled adequately by intravenous administration of diazepam emulsion in a dose of 5 mg at 1555 h, and 5 mg of diazepam emulsion was again administered intravenously at 1606 h. He tolerated these double treatment sessions of lithotripsy very well. He developed mild, self-limiting, episode of haematuria lasting for a short period of 12 to 24 h, after each lithotripsy session; this did not require any treatment apart from antibiotics and intravenous fluids.

Figure 4 The X-ray abdomen taken on 12.09.1997 shows gall stones, staghorn calculus in the right kidney, and multiple renal calculi in the left kidney with the ureteric stent in place

Summary of investigations

The chest X-ray taken on 03/06/1997 revealed clear lungs. Blood urea, creatinine, glucose, sodium, potassium, chloride, calcium, phosphate, alkaline phosphatase, and haemoglobin were within the reference range. The 24 h urine oxalate, urate, calcium, and phosphate were normal.

Comments by Dr Per Bagi and Dr Fin Biering-Sørensen

It is always easy to suggest alternative investigations and treatments, which may not have been available 20 years ago. Therefore, we like to look at this case in the light of the present days possibilities. This patient presented with urine infection due to Proteus species, a well known stone-associated organism, 1 month after the spinal cord injury, and bilateral renal calculi were detected at the X-ray taken four months post-injury. Even though these calculi may not be infection-associated, we would expect that intermittent catheterisation soon after injury could have diminished this risk of infection and future calculus formation.[2,3] Likewise, intermittent catheterisation may achieve sterile urine, even though the presence of stones tends to maintain urinary infection. A urodynamic examination in the initial stage is often helpful in characterising the function of the lower urinary tract and assist in planning appropriate bladder management.[4,5]

The initially detected renal calculi seem to have disappeared after 9 months, and no control was performed until 4 years later, when large calculi were diagnosed on the left side, which were however left untreated. Not until 5 years later were the large calculi removed by means of PCNL in two sessions. Looking back on the case, more frequent urinary tract assessments could have been performed, making earlier stone removal possible. This might also have made the use of ESWL possible, if available. ESWL is probably not the treatment of choice for large renal

calculi,[6] and PCNL should be preferred in such instances. However, ESWL may be used for larger calculi in selected cases.[7]

The pathogenesis of the recurrent stones in the present patient is probably infectious, and none of the laboratory values indicate otherwise. However, no stone analysis was reported. Prevention of recurring calculi could probably be facilitated if the urine could be kept sterile. Long-term prophylactic low-dose antibiotics may be helpful in recurring urinary tract infections,[8] although this as well as the use of antiseptics is debateable.[2,9] An increase in fluid intake is also to be recommended.[10]

In the long term management of spinal cord injured patients, prevention and early treatment of renal calculi is desirable, and regular urological follow-up is therefore, mandatory. It has not been proven how often such examinations should be performed, but many centres have control investigations carried out at least every second year. To be able to diagnose stones, these follow-ups should include plain X-ray or ultrasound examination. In addition, renal function should be followed by renography, apart from standard blood and urine tests. In selected cases, renal clearance and intravenous pyelography should be considered.

Comments by Dr AH Wallberg

In this case a better method of bladder emptying other than an indwelling catheter and later penile sheath drainage could have been used right from the early period after the spinal cord injury. Clean intermittent catheterisation (CIC) would have probably decreased the chances of urinary infection. In my Centre, intermittent catheterisation performed by the nursing staff, is started 1 week after the acute cervical cord trauma. We prescribe prophylactic antibiotics in patients who develop recurrent urinary tract infections without any indentifiable predisposing factor.

The kidney stones which were detected by abdominal X-ray should have been removed at an early stage, and completely if possible in order to reduce further stone formation and the consequent risk of a persistent infectious focus. Urease-producing bacteria (Proteus, Klebsiella, some Pseudomonas species, most of the Staphylococcus) can give rise to struvite stones. It has been reported that 8% of spinal cord injured patients will develop struvite stones.[11] The incidence is highest in patients with complete lesion and in those with upper motor neuron lesions of the urinary bladder. Bladder dysfunction plays an important role in the aetiology of urolithiasis in patients with spinal cord injury. Long-term immobilisation, an important factor to be considered in those patients undergoing conservative treatment of the fracture of cervical spine, may produce hypercalciuria and consequently, renal lithiasis. It is also important to exclude other reasons for stone formation in spinal cord injury patients such as hypercalciuria, hyperparathyroidism, hyperuricosuria, hypocitraturia, renal tubular acidosis, medullary sponge kidney, etc. In patients with renal lithiasis, a complete stone work-up (urine microbiology, blood and urine biochemistry, stone analysis) may be indicated.

PCNL and ESWL may be used in combination to achieve complete clearance of renal calculi. Residual stones may act as the nidus for urinary infection and for further formation of urolithiasis. Considering fluid and diet intake, it is important to maintain a high urine output, but this has to be balanced against the frequency of catheterisation to avoid urine leak or over-distension of the urinary bladder. Protein intake ought to be controlled; a varied and low-fat diet is recommended. It has been reported that beer-drinkers seem to have less risk for kidney stones, even though there was no relationship between the amount consumed and the risk of stones. In the same report, it was also noticed that consumers of antacids seemed to have a lower risk for stone formation.[12]

Problems with kidney stones are small at our unit in Sweden. During the last 5 years, 101 tetraplegic patients (newly injured as well as follow-up patients) have passed through our unit. No patient had any kidney stones. Therefore, we have no experience of ESWL treatment; on reflection, it is remarkable that the frequency is so low here.

Comments by Dr J Vidal and Dr A Borau

This patient had an unfortunate development of bilateral renal lithiasis associated with recurrent urinary infections. Intermittent catheterisation would have been the preferred method of bladder drainage right from the outset of the initial spinal shock phase. The effectiveness of the intermittent urethral catheterisation has been widely demonstrated as the preferred technique in the acute post injury period, and as a good method of urine drainage in the long term. In contrast, the indwelling urethral catheter is associated with a high level of urine infections, urethral complications and bladder stones development. The first micturition trial performed on a patient in June of 1975 resulted in retention of 1200 ml of urine and consequently, acute urine infection. We perform urodynamics in our Centre before trial of micturition in a newly injured tetraplegic patient to find out whether the patient has developed detrusor reflex activity. The occurrence of kidney stones within 5 months of spinal cord injury in this patient, can be attributed to urine infection, and/or vesico-ureteral reflux, rather than to hypercalciuria. The hypercalciuria begins about 10 days after paralysis, reaches a maximum at 10 weeks and persists for at least 6 months. The peak incidence of stone formation occurs between 1.5 to 3 years after the spinal cord injury and has been related to the period of hypercalciuria, triggered perhaps by an episode of dehydration or infection with a urease-producing organism.[13] It is

interesting to note that within a month of spinal cord injury, this patient had developed urinary infection with the urealytic and lithogenic bacteria, Proteus.

During the first 5 years after the initial bilateral renal calculi diagnosis, there had been no other treatment except the application of appropriate antibacterial drugs. It was 10 years after renal lithiasis before lithotripsy was performed. Understandably, PCNL and ESWL were not used until the years 1979-80 and 1980 respectively, in reference to the general lithiasis. We treat renal lithiasis in patients with spinal cord injury promptly either by PCNL or by ESWL, or by a combination of both. It should be remembered that patients with spinal cord injuries have increased risk of urolithiasis, and the most commonly used treatment is the ESWL.[14,15] This patient had developed renal lithiasis during the era when ESWL was not readily available for treatment of renal lithiasis. Nowadays, it is impossible to contemplate a similar situation. It is possible to act promptly and aggressively against the lithiasis, and at the same time avoid complications such as persistent infection and renal damage. With the advent of new technologies such as the sacral anterior root stimulator for micturition control, we hope that the incidence of urolithiasis, renal insufficiency, and urine infections will be reduced, and the patients with spinal cord injuries will have a better quality of life.[3,16–19]

Discussion

This case illustrates the desirability of intermittent catheterisation regime instead of an indwelling catheter drainage in order to prevent recurrent urinary infection and consequent formation of renal lithiasis. The potential complications of an indwelling catheter are myriad and include recurrent urinary infection, and urinary lithiasis; even a fatality due to rupture of the urinary bladder because of a blocked catheter was reported in a paraplegic patient.[20] It is generally agreed that all attempts should be made to avoid long-term indwelling urinary catheter drainage in patients with spinal cord injury because of the well-recognised complications.

However, there is evidence to show that the indwelling urethral catheter does not increase the risk of renal lithiasis in patients with spinal cord injury, and long-term bladder drainage by an indwelling catheter does not compromise renal function. Kohli and Lamid (1986)[21] studied the risk factors for renal stone formation in patients with spinal cord injury by analyzing the medical records of 893 patients who had been followed up by the Milwaukee Veterans Administration Centre from 1970 to 1984. These authors found no relationship between kidney stone formation and methods of urinary drainage. Dewire and associates (1992)[22] studied 57 consecutive patients with tetraplegia followed for at least 10 years, 32 of them managed on indwelling catheters and 25 catheter free. Overall, the incidences of renal and bladder calculi, pyelonephritis, gross haematuria, penile/urethral erosion, urosepsis, urethral stricture, epididymitis, and pyonephrosis were not significantly different in the catheterised and non-catheterised groups. The Kaplan-Meir analysis of the most recent excretory urogram demonstrated that the incidence of renal deterioration was also equivalent in the catheterised and non-catheterised groups. These authors concluded that the decision to manage tetraplegic patients with or without an indwelling catheter should not be based on relative risk of complications or renal deterioration, but should reflect patient comfort, convenience, and quality of life. Padmini Sekar and associates (1997)[23] compared the long-term renal function after spinal cord injury in patients with indwelling urethral catheter, condom, Crede manoeuvre, normal voiding, intermittent catheterisation and suprapubic cystostomy, by measuring total and individual kidney effective renal plasma flow. Renal function was adequately preserved in the great majority and did not appear to be influenced to any great extent by method of bladder management. Perhaps, we may be naive and too simplistic if we attribute recurrent urinary infections in tetraplegic patients solely to the presence of an indwelling urethral catheter. Other host factors such as urothelial proliferation, maturation, apoptosis, vesical mucosal innervation, secretory Immunoglobulin A, and cell adhesion molecules may play a vital and interactive role in the pathogenesis of urinary infection in patients with neuropathic bladder due to spinal cord injury.[24]

Nevertheless, this case raises certain medical and social issues concerning the care of patients with cervical spinal cord injury. The consensus on the urological aspects of the medical care of tetraplegic patients may be summarised as follows:

(1) The neuropathic bladder in a tetraplegic patient should be managed ideally by intermittent catheterisation performed with sterile, single-use, Lofric catheters which are less likely to cause urethral trauma,[25] and this regime should be instituted as soon as possible after the general condition of the patient has become stable. High fluid intake has been recommended to minimise the chances of urinary lithiasis. However, if intermittent catheterisation is practised in a tetraplegic patient and he/she drinks large amounts of fluids, more frequent catheterisation is indicated to prevent urine leak between catheterisations, and to avoid over-distension of the urinary bladder.[26]
(2) The ideal long-term care of the neuropathic bladder in a tetraplegic patient should avoid the use of an indwelling urinary catheter. The treatment plan should be selected on an individual basis after discussion with the patient, his/her partner, and carer(s). The options avaiable at present are: (1) intermittent catheterisation performed by the patient, his/her partner, or by the

carer(s) with adjuvant pharmacotherapy when indicated; (2) penile sheath drainage with the use of a selective alpha$_1$-adrenergic blocking agent; (3) transurethral sphincterotomy; (4) sacral anterior root stimulator; (5) bladder reconstructive surgery in selected cases. In a few tetraplegic patients, suprapubic cystostomy may be the only viable option; but such patients with a permanent catheter require careful follow-up.

(3) Recurrent urinary infection warrants detailed investigations and treatment of the predisposing factor(s), eg a large amount of residual urine in the bladder, low compliant bladder, urinary stone(s), vesicoureteric reflux, indwelling urinary catheter, etc.

(4) Tetraplegic patients require regular evaluation of the urinary tract, prefereably at 12-monthly intervals. Patients with recurrent or bilateral urinary calculi should be investigated for a possible systemic etiological factor for urolithiasis eg hypercalciuria, hypocitraturia, hyperuricosuria, renal tubular acidosis, and hyperoxaluria.[27]

(5) The urinary tract stone(s) requires prompt removal preferably by the least invasive method. This principle is in accordance with the general philosophy of management of tetraplegic patients in whom a non-operative method of treatment is preferred to an invasive procedure for any medical ailment, be it renal stone, or extraperitoneal rupture of the urinary bladder.[28]

(6) ESWL remains the preferred treatment for renal calculus in a tetraplegic patient. The presence of infected stones, prior operative procedures, and medical complexity of the patients with spinal cord injury make complications more frequent after percutaneous nephrolithotomy. Culkin *et al* (1986)[29] reported major complications in 4 of 23 patients who underwent PCNL (Respiratory arrest: 1; perirenal abscess that required open surgical drainage: 2; hydrothorax that required chest tube drainage: 1). The minor complications consisted of fever (64.3%), dislodged nephrotomy tubes (21.4% of the operated kidneys), and retained stones in 17.4% of the operated kidneys. If tetraplegic patients undergo urological evaluation every 12–18 months, or earlier if they develop acute symptomatic urinary infection, or autonomic dysreflexia, it is likely that the urinary stone will be detected without delay. Under these circumstances, the renal calculus, if present, will not be very large in size, and therefore, ESWL can be employed to advantage as the monotherapy.

(7) As patients with spinal cord injury represent a unique group, further collaborative research between different spinal injury centres is desirable to identify the risk factors for (i) urinary infection and (ii) urolithiasis in this special set of patients. With the recent advances in technology for stone disintegration, the ideal treatment methods for urolithiasis in tetraplegic patients need to be established on the evidence of controlled clinical trials.

Social issues play an important role in the care of a tetraplegic patient, and these are quite often more complex to deal with than the medical issues of a spinal cord injury patient. Sub-optimal care from the point of view of the social milieu of a tetraplegic patient often contribute to the development of urinary tract disorders inclusive of urolithiasis. The multifarious social issues often delay the implementation of an ideal medical treatment, eg carrying out the intermittent catheterisation programme in the community. The magnitude of these social issues vary from country to country. Social issues which are relevant to the evolution of urinary tract disorders in a tetraplegic patient include:

(1) Shortage of hospital beds, facilities, medical and nursing manpower in spinal injury centres for providing appropriate and timely treatment to a chronic tetraplegic patient.

(2) Inadequate care package at the time of discharge of a newly injured tetraplegic patient for implementing the recommended urological care plan, eg intermittent catheterisation by trained carers.

(3) Psychological and emotional issues surrounding the urological treatment programme in tetraplegic subjects. For example, the mother of a male tetraplegic patient who acts as his carer may not be able to perform intermittent catheterisation although she may be providing excellent quality of care otherwise.

(4) Inadequate support from community health care professionals in terms of both manpower and facilities for providing the recommended urological treatment plan in the patient's home environment, or in a nursing home.

Solution for these social issues are likely to be found when the spinal cord injury physicians actively liaise with other health care professionals, social service officers, hospital and community volunteers, professionals in the field of legal medicine and insurance industries. Awareness needs to be raised in society at large, that patients with spinal cord injury require specialised care by a team of dedicated health professionals with expertise in spinal cord injury medicine, both in the community set-up, and in purpose-built spinal injury centres. The Spinal Injuries Centres are accruing more new patients; the survival of tetraplegic patients is improving. Therefore, it becomes mandatory to invest in the creation of additional manpower and facilities for providing satisfactory follow-up care to the patients with spinal cord injury. Nevertheless, as physicians caring for patients with spinal cord injury, it is important that we are not carried away by an isolated medical problem,

be it renal stone, or post-traumatic syrinx. We should always adopt a holistic approach towards management of patients with spinal cord injury, so that these patients with profound disabilities are fully reintegrated in their community, and are able to enjoy their remaining life with dignity.

Comments by Mr Krishnan

Three events had clearly determined the trend in this patient:

(1) There had been development of renal lithiasis quite early after initial admission.
(2) The urologist had repeatedly decided against surgical intervention.
(3) The patient had somehow been lost in the surveillance network for almost 4 years.

The elemental incongruity had been the lack of a 'safety net', which was not clearly operating. As a result a comprehensive enquiry of an important clinical incident did not happen and appropriate questions were not asked. Such an omission was not confined to clinical management, as the patient who was noted to have early renal lithiasis, was curiously 'lost' in the review programme for lengthy periods.

The working culture that prevails within a centre determines the clinical habit and therefore the outcome. As the sole specialist in the centre, it had been the accepted practice for me to discuss every incident of importance in the urinary tract or the skin with the appropriate specialist. This had clearly not happened, and the decision not to proceed to definitive surgical intervention has to remain a matter for speculation.

Poor initiative to ensure clinical continuity by the centre staff had come to light, and a system of more effective surveillance had been established. Appointment of a Case Manager with the brief to visit patients at home, on demand or electively, for the clinicians to be available for domiciliary visits (routinely in selected cases), and actively encouraging disabled people living at home to contact staff in the centre, represented an important turning point.

The therapeutic team including a clinical psychologist would now establish a partnership between hospital staff, the patient, and the family, and ensure that a vulnerable patient is not lost in the review programme.

Some disabled people living at home may not be assertive in seeking timely evaluation, advice or treatment. An effective corporate approach in a centre should compensate for such a lack of informed participation by a disabled person in planning and delivery of specialised health care.

Such a system still has serious difficulties, particularly when major extension of provision of specialised services are offered without appropriate and adequate manpower and financial infrastructure. Survival even after very high spinal cord injury is steadily improving, and ability to be vigilant and efficiently competent will become increasingly difficult unless there is comparable financial investment to enable continuity of comprehensive care.

Finally, I want to congratulate the leading author (SV) for his choice of the case and his decision to bring out the issues involved with realism and intellectual honesty.

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