Holistic Management of Traumatic Spinal Cord Injury Resulting from a Fracture of T-9 Vertebra

Witsanu Kumthornthip, M.D.*
Surin Thanapipatsiri, M.D.**
Sirirat Kooptiwoot, M.D.***
Pradit Prateepavanich, M.D.*

Abstract : **Traumatic spinal cord injury (SCI) is an disastrous condition resulting in not only disability and handicap to the victims but also profound psychological damage. We report a case of complete spinal cord injury resulting from a fracture of T-9 vertebra in a car accident. Emergency management is needed to prevent further damage to the neural tissue, as well as to treat a life threatening condition. Surgical treatment to maintain spinal alignment and stability provides early mobilization to prevent the complications caused by the immobilization syndrome. A holistic approach to management is fundamental to the rehabilitation program. Although physical impairment and disability are permanent, psychosocial management focused on cognitive and behavioral modification together with home modification plays an important role in reducing disability and handicap and allowing a patient to return to his home and previous social function with the best quality of life as possible.**

เรื่องย่อ : **การดูแลรักษาแบบองค์รวมในผู้ป่วยบาดเจ็บไขสันหลัง เนื่องจากอุบัติเหตุกระดูกสันหลังระดับทรวงอกที่ 9 หัก**

วิษณุ กัมทรทิพย์ พ.บ.*, สุรินทร์ ธนพิพัฒนศิริ พ.บ., ศิริรัตน์ คุปติวุฒิ พ.บ.***, ประดิษฐ์ ประทีปะวณิช พ.บ.***

**ภาควิชาเวชศาสตร์ฟื้นฟู, **ภาควิชาศัลยศาสตร์ออร์โธปิดิคส์และกายภาพบำบัด, ***ภาควิชาจิตเวชศาสตร์, คณะแพทยศาสตร์ศิริราชพยาบาล, มหาวิทยาลัยมหิดล, กรุงเทพมหานคร 10700.*

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บาดเจ็บไขสันหลังเป็นภาวะที่ทำให้ผู้ป่วยพิการทุพพลภาพ บางครั้งอาจทำให้พิการถาวรตลอดชีวิต ซึ่งกระทบกระเทือนจิตใจผู้ป่วย รายงานผู้ป่วยบาดเจ็บไขสันหลัง จากกระดูกสันหลังระดับทรวงอกที่ 9 หัก เนื่องจากอุบัติเหตุรถยนต์พลิกคว่ำ 1 ราย การดูแลในช่วงวิกฤติสามารถช่วยชีวิตผู้ป่วย และป้องกันการบาดเจ็บต่อประสาทไขสันหลังแบบถาวร การผ่าตัดช่วยในการจัดกระดูกให้เข้าที่ และยึดกระดูกไว้ให้มั่นคงแข็งแรง เพื่อการฟื้นฟูสภาพผู้ป่วยต่อไป ซึ่งในช่วงแรกของการฟื้นฟูจะเน้นการป้องกันภาวะแทรกซ้อนที่เกิดจากการนอนนาน (immobilization syndrome) และทำให้ผู้ป่วยมีความสามารถสูงสุดตามศักยภาพที่ควรจะทำได้ในที่สุด การดูแลผู้ป่วยแบบองค์รวมทั้งทางด้านร่างกาย จิตใจ และสังคม ทำให้ผู้ป่วยสามารถกลับเข้าสู่สังคมได้อย่างมีความสุข และมีคุณภาพชีวิตที่ดีขึ้น

**Department of Rehabilitation Medicine, **Department of Orthopedic Surgery, ***Department of Psychiatry, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.*
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INTRODUCTION

Spinal cord injury (SCI) is a traumatic insult to the spinal cord leading to alteration of normal motor, sensory, and autonomic function. Scientific and technological advances in recent decades, in terms of surgical techniques, emergency and critical care, and management of specific problems have significantly improved the survival rate and life expectancy for the person with SCI. The impact of SCI influences individuals and their family in almost all aspects for a lifetime. Optimal management of SCI requires an interdisciplinary team to save life, to prevent complications, to reduce disability and handicap, to maximize their function and eventually to improve their quality of life. The team members include the patient, family, orthopedist, neurosurgeon, physiatrist, nurse, physiotherapist, occupational therapist, psychiatrist or psychologist, orthotist and prosthetist. These individuals must be competent and familiar with each other, and they must work within a system that promotes effective interaction to achieve these goals.

CASE REPORT

A 26-year-old gentleman sustained a car accident while he was sitting in a rear seat without a seat belt six hours before he was referred to Siriraj Hospital. Immediately after injury, he had severe pain in his midback, in both shoulders and chest wall. He was unable to move his legs and lost sensation below the umbilicus. Initial physical examination revealed BP 100/50mmHg, P 60/min, and he was fully conscious. Anterior and lateral compression of the chest wall produced pain. Breath sounds were slightly diminished bilaterally. There were no obvious signs of intra-abdominal injury. Musculoskeletal and neurological examination demonstrated that 1) both shoulders were tender and painful on movement, 2) the lower thoracic spine was markedly swollen and tender, 3) both legs had grade 0/5 power and were weak and flaccid, 4) all modalities of sensation were lost from the umbilicus to the perianal region, 5) deep tendon reflexes in both legs were absent, 6) the anal sphincter was loose without voluntary contraction, and 7) the bulbocavernosus reflex was positive. Radiological studies of chest and thoracic spine showed fracture of the right 6th and left 7th ribs with a bilateral hemothorax, a fracture of the distal end of the right clavicle, a fracture of the neck of the left scapula, and an unstable burst fracture (burst-rotation) of T-9 vertebra (Figure 1-2). Computerized tomography of the thoracic spine demonstrated a burst fracture of T-9 vertebra with bony fragments retropulsed into the spinal canal (Figure 3). The diagnoses listed according to severity were 1) bilateral hemothorax and rib fractures, 2) unstable burst fracture of T-9 vertebra with complete spinal cord injury and neurogenic shock, 3) closed fracture of the distal end of the right clavicle, and 4) closed fracture of the neck of the left scapula.

The life threatening conditions i.e. the hemothorax and neurogenic shock were treated promptly. Intercostal chest tubes were inserted bilaterally. Crystalloid fluid was infused intravenously to raise the blood pressure and venesection was performed for CVP monitoring. A Foley's catheter was inserted to monitor urine output and to ensure urinary drainage. Routine preoperative studies including CBC, urinalysis, serum electrolytes and blood group matching were performed.

The unstable fracture of the T-9 vertebra was initially managed by careful transfer of the patient with a rigid backboard and a log-rolling maneuver in order to prevent further injury to the spinal cord. Intravenous high-dose steroids (methylprednisolone) were given at a dose of 30 mg/kg in the first hour and 5.4 mg/kg/hr for the next 23 hours.

The patient's family were told the diagnoses and the treatment plan was discussed. The patient was scheduled for internal fixation of the spinal column after his vital signs were stable. Open reduction of the fractured T-9 vertebra was performed by a posterior approach. Pedicle screws were placed in T-6, T-7, T-8, T-10, and T-11 vertebrae as an internal fixation device to provide stability for early ambulation and rehabilitation (Figure 4-5). Following completion of definitive treatment of life threatening conditions and spinal injury, physiatric and psychological assessment were carried out.

A few days postoperatively, the patient was silent and wanted to know his prognosis. Although the orthopedic surgeon had informed his family that

he was not going to walk independently in the future, all of the family did not want him to know this bad news because he might not accept it. Thus a psychiatric consultation was arranged to evaluate and prepare him for receiving bad news. Unfortunately, he already knew the bad news accidentally from his father and was shocked, sad and angry. Meanwhile a physiatrist was asked to see this patient for rehabilitation management.

Rehabilitation problems in this case included paraplegia, potential complications such as pneumonia, pressure sores, joint contractures, neurogenic bowel and bladder, and activities of daily living and ambulation problems. A Jewette brace was applied to relieve pain and to encourage early ambulation and rehabilitation. Breathing exercises for chest expansion were introduced. Proper positioning, range of motion exercises, and tilt table standing were prescribed in the early phase to prevent pressure sores and joint contractures. Thereafter, strengthening exercises of the upper extremities were encouraged to prepare for transfer, wheelchair ambulation and self-care. Bladder management was discussed with the patient and his caregiver and intermittent catheterization was suggested. Baseline investigations of the genitourinary system were done, including urinalysis, urine culture, intravenous pyelonephrogram (IVP), voiding cystourethrogram (VCU), cystometry and a urodynamic study. The results were unremarkable except a hyperactive bladder and detrusor-sphincter dysynergia. Intermittent catheterization was introduced together with an antispasmodic agent after removing the catheter. The patient regulated his oral fluid intake to about 2 liters a day, performed self-catheterization by himself appropriately during the daytime and used diapers at night. Urine volume was 200-300 ml with occasional leakage. Bowel management was introduced when the patient began to sit upright without back pain, including a high fiber diet, a regular bowel pattern, bowel massage, laxatives, digital stimulation and bisacodyl rectal suppositories.

With a good support from his family and friends and a warm relationship with all the physicians and medical team, he fortunately coped with this painful situation in a short period of time. At discharge he could perform activities of daily living independently, transfer between the bed and wheelchair without assistance, stand at a parallel bar with knee splints, and manage his bowel and bladder care properly. Eventually, he accepted his longstanding and permanent disability. As a wheelchair ambulator, he could cope with his disability at home by appropriate wheelchair design, home modification and he returned to work after discharge.

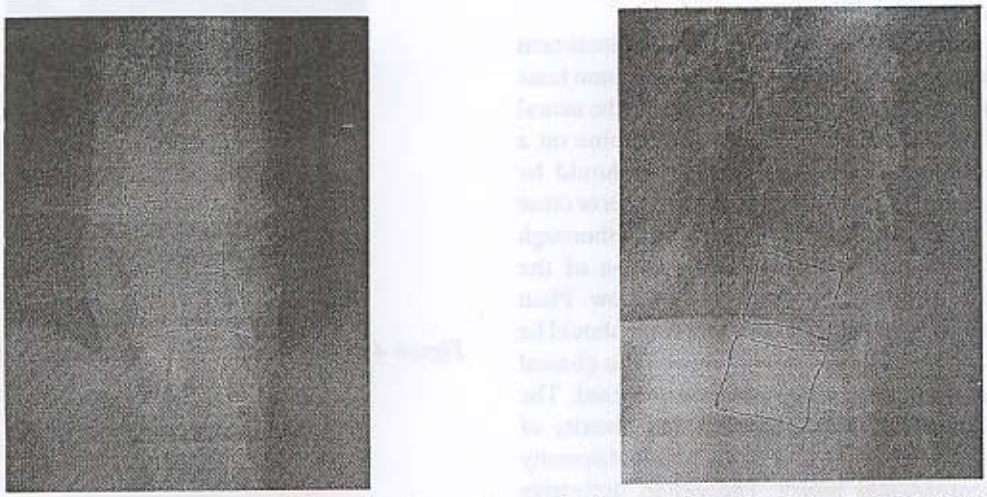

Figure 1-2. Radiological study of thoracic spine, anteroposterior and lateral views, showed unstable burst fracture of T-9 vertebra.

Figure 3. CT T-9 vertebra demonstrated burst fracture with bony fragments retropulsed into spinal canal.

DISCUSSION

The approach to a spinal injured patient should be executed systematically. Initial history taking and physical examination should focus on the life threatening conditions that should be treated promptly. The airway should be cleared, especially in unconscious patients. Adequate breathing and oxygenation should be ensured. Major external and internal bleeding should be controlled. Circulation should be maintained by means of fluid or blood replacement and medication as needed.[1]

During the initial assessment and treatment of life threatening conditions, the spinal column must be immobilized to prevent further injury to the neural tissues. The patient should be placed supine on a rigid backboard. The head and trunk should be fastened to the backboard with adhesive tapes or other appropriate fastening devices. Careful and thorough history taking and physical examination of the musculoskeletal injuries should then follow. Plain films of the affected part i.e. thoracic spine should be obtained in both AP and lateral views. The clinical and radiological data should then be analyzed. The diagnosis must include 1) location and severity of the spinal column injury and 2) the type and severity of the neurological injury. Thereafter, definitive treatment of both spinal cord injury and spinal column injury is planned.

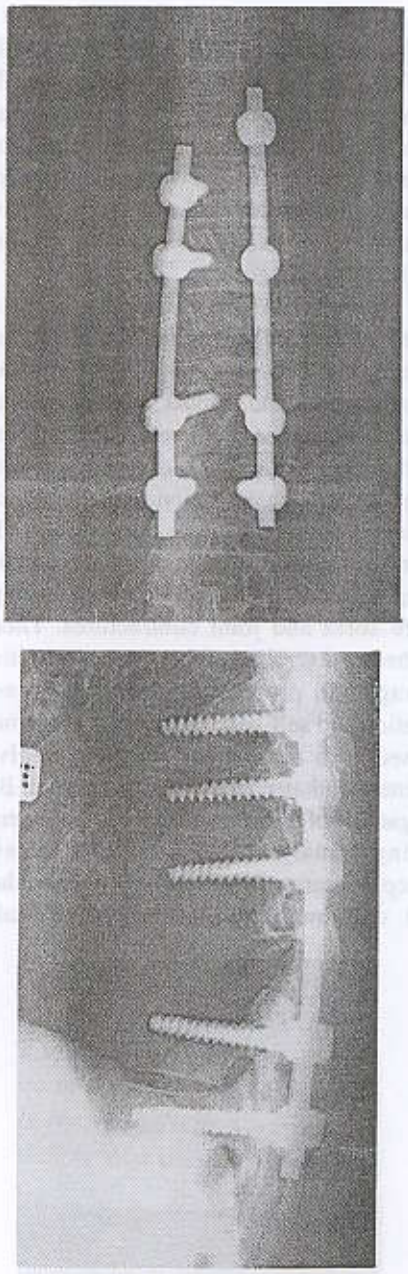

Figure 4-5. Internal fixation with pedicle screws in T-6, T-7, T-8, T-10, and T-11 vertebrae.

Specific treatment of spinal cord injury includes a) intravenous steroid administration using methylprednisolone 5.4 mg/kg/hr for the next 23 hours to prevent secondary chemical injury to the spinal cord and improve neurological recovery[2], b) decompression of the spinal cord if it is an incomplete cord lesion by means of immediate closed reduction of any dislocation, open reduction of a grossly displaced fracture/dislocation, and removal of displaced bony fragments or disc compressing the spinal cord, c) stabilization of the spinal column to prevent further mechanical injury to the spinal cord.

Spinal column injury should be stabilized by either external immobilization or internal fixation. The stability of spinal column should be evaluated. A stable fracture of the T-L spine can be treated with appropriate external immobilization such as a body jacket cast, Jewette brace or Taylor brace. However, an unstable fracture should be stabilized with an appropriate internal fixation device in order to facilitate early ambulation, rehabilitation, and prevent further mechanical injury to the spinal cord from fracture movement. Surgery should be performed as soon as possible.

The vertebral column injury in this patient is an unstable burst fracture of T-9 that is clearly demonstrated on the plain radiographs (Figure 1-2). On physical examination, the spinal reflex i.e. the bulbocavernosus reflex has already returned without any voluntary motor function and sensory function below the level of injury. Therefore, the neurological injury is complete spinal cord injury, which will not recover.

The goals of treatment of an unstable fracture of the spine with complete spinal injury are a) to provide stability to the spinal column by means of internal fixation rather than external immobilization alone, b) to facilitate early rehabilitation, c) to optimize the functional ability and d) to prevent immediate and late complications. Thus early spinal stabilization using pedicle screw fixation of the thoracic spine is selected and early rehabilitation is executed.

Rehabilitation in SCI is a role model for a multidisciplinary approach and needs holistic and comprehensive care including physical, psychological and social aspects. Rehabilitation goals of management in traumatic SCI are to prevent complications such as pressure sores, joint contractures, pneumonia, and postural hypotension, to manage specific problems such as neurogenic bowel and bladder, to maximize function, to reduce disability and handicap, to support their psychosocial functioning and to improve their quality of life. The role of physiatric evaluation in traumatic SCI is to determine the functional level and its severity, to set functional goals, and to give a prognosis. Complete SCI, in the American Spinal Injury Association (ASIA) classification A has a poor prognosis for recovery. Ninety percent of patients admitted with SCI, ASIA class A remained A. Functional goals for SCI, at a functional level of T-9 are independence in self-care, bed mobility and wheelchair mobility[3]. The aim of ambulation is for physiological standing using an orthosis such as the knee-ankle-foot orthosis (KAFO). In the initial phase of rehabilitation, an external spinal stabilization device is beneficial, even for postoperative stabilization. It may relieve pain and allow an upright position and the patient to be mobile out of bed, preventing the immobilization syndrome. A thoraco-lumbo-sacral-orthosis (TLSO) is beneficial to help control thoracolumbar movement. A Jewette brace is preferable to the Taylor brace in case of fracture of the anterior part of vertebral body because it limits flexion more than extension (Figure 6-7). A rehabilitation program includes breathing exercises, passive range of motion exercises of the lower limbs, active exercises of the upper limbs, upright position, and mobility in the bed. This case had the potential for superimposed chest complications such as pneumonia because he had fractured ribs with a bilateral hemothorax, a fracture of the distal end of the right clavicle and neck of the left scapula and immobility. Pressure sores are also a problem related to paraplegia and immobility. Thus a positioning program, with pressure relief techniques, a special cushion and bed were recommended to prevent pressure sores. After he was successfully in the upright position, strengthening and endurance exercises of the upper extremities were emphasized for activities of daily living including transfer from the bed to the wheelchair. Wheelchair was also designed to take into account his disability.

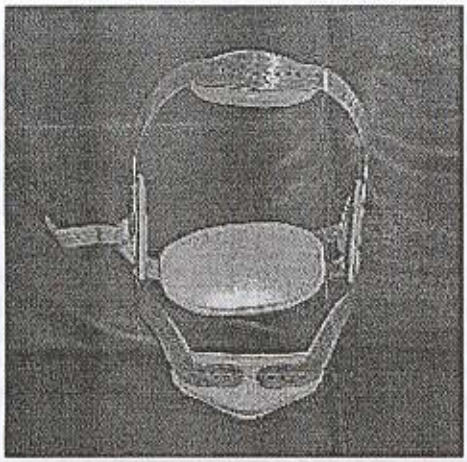

Figure 6. Jewette Brace

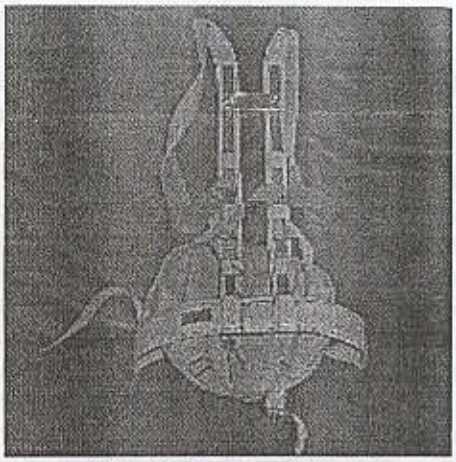

Figure 7. Taylor Brace.

Management of the neurogenic bladder is an important problem in this case. During the period of spinal shock, a Foley's catheter is retained to prevent overdistention of the bladder. Later, he developed a hyperactive bladder with detrusor-sphincter dysynergia, which is the most common problem found in SCI, (found in 96% of patients with suprasacral lesions).[4] The goals of neurogenic bladder management are to prevent upper and lower tract complications such as urinary tract infection, vesicoureteral reflux, hydronephrosis and renal failure and to develop a bladder management program allowing the patient to reintegrate into the community. A self-voiding program producing the smallest postvoiding residual volume (PVR), continence, and that is socially accepted is the goal. A bladder management program was discussed with the patient and his family and intermittent catheterization (IC) with an antispasmodic agent, oxybutynin, was decided on. General baseline investigations for those with a neurogenic bladder prior to an IC program include urinalysis, urine culture, intravenous pyelonephrogram (IVP), voiding cystourethrogram (VCU), and urodynamics. They must be done to exclude urinary tract infection, renal stones, anatomical abnormalities and renal insufficiency. If these complications are found, an IC program is not suitable.[5] This patient had no such contraindications. Moreover he had good cognition, good motivation, good trunk balance and good eye-hand coordination. A sterile IC technique is preferred in a hospital setting and a clean technique for an outpatient setting. Guttman has reported 476 SCI patients using a sterile IC technique with 11 years follow-up, only 7.4% developed hydronephrosis, 4.4% had vesicourethral reflux, 1.7% developed kidney stones, and 0.6% developed bladder stones.[6] Lapides has reported the effectiveness of clean intermittent catheterization (CIC).[7] Maynard and Grass reported 80% of patients on CIC followed for 60 months continued on IC, suggesting a low morbidity and high patient acceptance.[8]

In neurogenic bowel dysfunction management, time, place, consistency, and trigger are important factors. A baseline history is needed to determine a bowel training program. The time should be compatible with the patient's routine prior to injury i.e. once daily or every other day. Timing bowel care with meals i.e. within half an hour of a meal, helps to take advantage of the gastrocolic reflex. Also the appropriate time to start training is important, normally when the patient can sit upright with good trunk balance, no postural hypotension and no back pain. Use of gravity by sitting upright may be necessary. Privacy for toileting is needed for a bowel movement. A high fiber diet and occasional laxatives prevent constipation. Bowel massage, digital stimulation, and bisacodyl rectal suppositories

usually play important roles in the management of bowel evacuation.[5] A successful bowel movement program with these methods was eventually achieved with occasional accidents.

Psychologically, this patient was assessed by a psychiatrist once after the operation to prepare him for bad news and followed up again six month later. He, at 26 years old, had graduated with a Master's degree in engineering from the USA, and was working as a consultant in a private company in Bangkok with a prosperous future and he had planned to get married in the near future. Unfortunately, he had an accident with a complete spinal cord lesion at the T-9 level. The psychiatric consultation - liaison service was notified three days after his operation because he was silent and wanted to know about his prognosis. The orthopedic surgeon had already told his relatives about his prognosis but they did not want him to know about this because they thought that he might not accept this bad news. A psychiatrist went to assess his mental status and found that he was alert, orientated, and cooperative, with no major psychiatric disorder and prepared the patient for receiving this bad news from his physician. The most suitable person, to break bad news to a patient, is the patient's physician, not the psychiatrist. Accidentally, this patient heard the bad news from his father two weeks after the operation and was shocked, very sad and angry for a few days. His family and physician helped him to cope with this situation with psychological support.

A spinal cord injury usually has two major illness phases, which are an acute phase, with loss of organ function, and a chronic phase, with disability. Both of the patient and his family members must cope with these stresses.[9] He has coped with this quite well since the acute phase until now, 6 months later. He had good physical health before the accident, had a good premorbid personality and was socially well-adjusted. His family and physicians, both the surgeon and the physiatrist, have supported him and have encouraged him in his physical rehabilitation as well as social rehabilitation. He thinks that this illness has given him a good opportunity to be close to his mother again. He has forgiven his friend, who drove the car at the time of the accident by thinking that it was an accident, not recklessness, and still has a good relationship with him.

His family has also coped with his illness well. All his family members have given him emotional support as well as supporting each other. His family have had a good past experience with spinal surgery especially with his orthopedic surgeon. His younger sister underwent an operation for a spinal tumor two years ago with excellent results, and is now working and walking well. They also have trusted, respected and have had good communication with his physicians, both the surgeon and the physiatrist. Good communication may not only reduce potential problems, but also may actually help patients to cope better. Techniques of support range from concrete assistance to extended counseling. Social support depends on an acceptable image of the patient, not one that invariably "pathologizes", by giving the patient the courage to cope.[10] The physicians have also given emotional support to him and his family. They have no financial problems. His mother, who is a housewife, has become his primary caregiver and his youngest sister, who is studying at a public university, has become his secondary caregiver. So they can help each other to do his care and can also have some rest. They need not relinquish their jobs and their income to take care of him. The extent of a patient's disabilities has major implications for role allocations in the family. In order to care for a pervasively disabled person, either the family must purchase services or family members must provide services themselves. In most cultures, the wife or mother in the family is often the individual singled out to do this task.[11] If there is only one caregiver in the family, this caregiver will be burdened and may have some mental health problem.[11] His family has responded to the illness very well. They have arranged and established a new room on the first floor of their home for him, where he can stay most conveniently and comfortably. His friends have visited him nearly every weekend and held a party at his home. Sometimes he has gone out to join his friend's weddings with a lot of friends waiting for him at the front of the celebration, which made him feel good. His friends have also helped him by bringing several work projects for him to work on at home.

A spinal cord injury usually involves young adults, sexuality is important to spinal-cord-injured patients. Sexual education is best accomplished by a team approach including a psychologist or psychiatrist (or both) and a urologist familiar with spinal cord injury.[9] His girlfriend has come to visit regularly and has given him emotional support. He and his mother have discussed with her and let her feel free to make decision about marriage. They don't want to force her to get married to the patient. We plan to consult a urologist to help in his management as well.

In summary, this case is a good example of chronic disabling disease in which holistic and comprehensive rehabilitation management of the biological, psychological, and social aspects is so critical for the care of the patient. Although physical impairment and disability remain permanent, his positive attitude helps the patient survive in society with happiness and a good quality of life. Fortunately, because this patient is optimistic, resourceful, flexible, and composed, has maintained a high level of morale, and has good coping skills, he eventually mastered the problems in this potentially disastrous situation. Also good social support from his medical staffs, family and friends has been an important factor in this.

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Comment

Assistant Professor Pradit Prateepavanich
Chairman, Department of Rehabilitation Medicine

The management of spinal cord injury is the role model of a holistic approach to patient management. Management guidelines illustrate a multidisciplinary approach from the acute to the chronic phase. The long-term goal of rehabilitation is to return the patient to his home and social life with the best possible quality of life. The keystone of rehabilitation in meeting this goal is cognitive and behavioral modification. We have to modify the cognitive error of the patient himself, his family, and society from thinking that the individual is handicapped as a non-functioning (burden) individual to a physically challenged (productive) one. Together the need is to modify their behavior from chronic sick role (dependent) behavior that may arise from long-term hospitalization to a return home functioning within society with independent behavior. The success of the holistic management in this case is a good example of a multidisciplinary team approach as the main objective of our interdepartmental conference.