THE MEDICAL AND ECONOMIC FATE OF TWENTY-NINE INDUSTRIAL SPINAL CORD INJURED PATIENTS

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A DETAILED analysis of 29 spinal cord industrial injured patients has been made. The mechanism of injury, types of treatment, complications and economic costs have been studied. Other groups of such patients have been studied in the past, but often the economic cost has not been presented in detail.

MATERIAL

Twenty-nine industrial injured paraplegics and tetraplegics have been treated in the Province of British Columbia from 1957 to 1963. They were all young males with an average age at the time of injury of 36.5 years. Two-thirds of the cases were married at the time of injury. The occupations reflect the type of industries peculiar to British Columbia (Table I).

In the industrial spinal cord injured patient the pathogenic factor causing the injury is major trauma and is not due to factors intrinsic to the spinal cord itself, such as tumour pathology, etc. (Table II).

Two-thirds of the cases were paraplegic and one-third were tetraplegic. The pathological anatomy consisted of fractures in 14 cases, fracture dislocations in another 14 cases, and a central cord syndrome with no associated fractures or dislocations in one case. The anatomical level of injury is seen in Table III.

The severity of trauma often produces associated injuries. Sixteen cases (55 per cent) had fractures in sites other than the spine. Twenty-four of the 29 cases had some form of early spine surgery (Table IV). Eighteen of these 24 cases, namely 75 per cent, had surgery to the spine within one month of injury and the remaining six cases had surgery to the spine within eight months of injury.

All 29 cases had one or more surgical procedures performed on them sometime after the onset of the spinal injury (Table V).

Fifteen cases had some form of orthotic device to the lower extremity. Four were below knee braces, seven above knee and four were body braces.

Nine of these 29 cases were said to have some form of ambulation. Only three of these nine lesions were proximal to the L3 level (Table VI). It should be stated that ambulation was a vague term and often meant putting braces on and walking only a few feet.

There were 113 complications occurring in these 29 cases for an average incidence of four complications per patient (Table VII). The pressure sores developed within a few days of onset of injury to within a few months from onset of injury in 50 per cent of cases (Table VIII). One case died within three years after injury secondary to multiple complications and personal neglect. This patient had recurrent bleeding from within and multiple infected pressure sores.

The cost to manage the 29 cases were divided into two parts. The first part was the sum of money set aside as lost earnings for each patient and was related

TABLE I

Occupation of the 29 industrial spinal cord injured patients in British Columbia

Logger	13 (45%)
Truck driver	4
Miner	2
Miscellaneous	10
Total	29

TABLE II

Cause of injury to the industrial spinal cord injured patient

Fall from a height	7
Struck by a tree	11
Struck by a car	8
Miscellaneous	3
Total	29

TABLE III

The anatomical level of spinal cord injury

Cervical	5 (17%)
Thoracic	16 (55%)
Lumbar	8 (28%)

TABLE IV

Type of early surgery to the spine

Laminectomy	11 (38%)
Laminectomy and fusion	8 (28%)
Fusion	5 (17%)
Total	24

TABLE V

Other operative procedures on the spinal cord injured patient

	Cases	Procedures
Neurosurgical and orthopaedic procedures	15	21
General surgery	4	7
Plastic surgery	4	17
Urological surgery	15	31
Cystostomy	21	84
Ileo-loop bladder	2	2
Dilatation of the urethra	2	6
Other G.U. surgery	11	11
Miscellaneous surgery	2	2

TABLE VI

Site of lesion in ambulatory patients

Site of lesion	Number of cases
Cervical central cord lesion	1
T12 lesion	2
L3 lesion	2
L4 lesion	2
L5 lesion	2
Total	9

TABLE VII

Early and late complications in 29 spinal cord injured patients

	Number of cases	Total number of times
A. <i>General complications:</i>		
Burns	2	2
Pressure sores	17	33
Dermatitis	2	2
Phlebitis	3	3
Pulmonary embolus	1	1
Delayed wound healing	3	3
Miscellaneous	5	6
B. <i>Musculoskeletal complications:</i>		
Fractures	7	7
Myositis ossificans	1	1
Kyphosis	3	3
Contractures	3	3
C. <i>Urological complications:</i>		
Hydronephrosis	8	8
Kidney or bladder infection	6	6
Urethral fistula	4	4
Calculi	12	15
Epididymitis	6	6
Urethral diverticulum	2	2
Hydrocele	1	1
D. <i>Psychiatric cases:</i>	4	4
Total	90	110

TABLE VIII

Onset of pressure sores

Number of cases	Time after injury
1	1 day
1	4 days
1	2 months
1	3 months
2	6 months
11	Greater than 6 months

to the monthly earnings the patient received at the time of injury multiplied by his life-expectancy years. These 29 cases had an average of \$64,000 set aside for them which represented their salary over their life expectancy for a total of approximately \$2,000,000. The second part of the cost was the amount of money that has been spent over the years to maintain health in these 29 patients (Table IX). For the life expectancy of these 29 spinal cord injured patients, about \$2,000,000 will be spent to maintain satisfactory health. The major expenses will be: hospitalisation (63 per cent); nursing care (18 per cent); medical care (6.6 per cent); and surgical supplies (6.5 per cent).

TABLE IX

Distribution of money to maintain health in 29 spinal cord injury patients from 1957 to 1969

Distribution to	Amount in dollars	Percentage of total	Cost per patient per year in dollars
Hospitals	431,873	63.00	1,587.77
Nursing care	123,756	18.06	455.00
Doctors	45,023	6.57	165.53
Surgical supplies	44,712	6.52	164.38
Druggist	22,553	3.29	82.92
Transportation	14,922	2.18	54.86
X-ray	1,674	0.24	6.15
Physiotherapy	370	0.05	1.36
Subsistence	293	0.04	1.08
Dental	159	0.02	0.58
Total	685,335	100.00	2,519.63

DISCUSSION

The incidence of spinal cord injured patients in the world is variable, but is reported to be 12 to 15 new patients per year per million of population in western countries (Lougheed *et al.*, 1970).

A recent study (Peerless & Schweigel, 1971) has shown that the present facilities and philosophy of management needlessly prolongs the initial hospitalisation of the individual with a spinal injury and in many instances the final level of social and occupational rehabilitation is insufficient to permit the patient to return to a useful role in society. Symington wrote (Symington & Fordyce, 1965): 'It is sometimes said that patients with spinal injuries are too sick to be moved to major centres. Actually they are too sick to be safely managed in smaller hospitals.'

As such, it is proposed that an acute spinal cord injury unit would ensure maximum recovery of such patients. Most acute spinal cord injury units attempt to admit such patients as early as possible after injury (Guttmann, 1963). Key and Retief (1970) admits 72 per cent of such patients within 48 hours of injury. If the patient is within 200 miles of his unit, he is transported by ambulance, and if greater than this distance, by chartered airplane accompanied by a physiotherapist. Other authors (Cheshire, 1969) also attempt to admit such patients as early as possible after injury.

Over 82 per cent of spinal cord injured patients are secondary to trauma, and the remainder are associated with other pathology (Lougheed *et al.*, 1970). Because

trauma plays such a major role in the pathogenesis of this problem, the patients are often very young, as seen in this study and others (Lougheed *et al.*, 1970). The ratio of paraplegics to quadraplegics is usually 2 : 1 (Key & Retief, 1970; Lougheed *et al.*, 1970).

The question of whether early or late surgery to the spinal column is necessary, is difficult to answer. Most cases within this study had early laminectomy and fusion, but it is difficult to say whether the patient improved after surgery. The Stoke Mandeville Hospital (Frankel *et al.*, 1969) reported on only four unstable spines in 600 fractured spines after 12 weeks of non-operative treatment. Chesire (Chesire, 1969) had 12 patients with instability of the spine 12 weeks after spinal fracture out of 212 spinal cord injuries.

The complication rate increases proportionally to the delay of admission to an acute spinal centre. Cibeira (1970) in analysing 365 paraplegics admitted to his centre, found that only 13 per cent were admitted within one month of injury and 65 per cent of this total had pressure sores and 100 per cent had urinary tract infections. Proper staffing and apparatus such as the Egerton-Stoke Mandeville Turning Bed (Guttmann, 1965, 1967; Frankel *et al.*, 1969) or the Roto-Rest Bed (Keane, 1970), can decrease the incidence of bed sores to zero and can secondarily decrease the cost of patient's care. (The cost of the bed is only one-half the cost of caring for one bed sore.)

The cost of maintaining the health in the spinal cord injured is primarily due to hospital costs (63 per cent) as seen in Table IX. By decreasing complications, hospital stay is decreased and so is the cost of patient care. Rancho Los Amigos Hospital (Personal Communication) has been able to discharge most of their patients within three to four months of admission. These patients are discharged fully rehabilitated and are, as such, suitable for job training.

Proper facilities are mandatory to decrease the incidence of renal complications. Jousse *et al.* (1968) showed that the commonest cause of death in paraplegics is renal failure (36 per cent). Guttmann and Frankel (1966) are the proponents of intermittent catheterisation. Dollfus & Mole (1969) used Guttmann's technique and found that of 16 patients admitted within 24 hours of injury, more than 80 per cent had sterile urines three months later.

TABLE X

Ratio of staff to patients for a 25-bed spinal cord injury unit

	Rancho Los Amigos Hospital	Bors	Key
Number of nurses and aides	25	23	18
Physiotherapist and Occupational Therapist	5	2	4
Physician	—	1:20	—
Psychologist	—	1:40	—
Social Worker	—	3:40	—
		<hr/> 28½	

The ratio of staff to patients varies from unit to unit. Bors (1967), Key and Retief (1970), and Rancho Los Amigos Hospital (Personal Communication) give estimates on this ratio (Table X). These figures vary depending on what ancillary beds, et cetera, are available.

SUMMARY

The care of the spinal cord injured patient has improved since the Second World War. This is especially true where acute spinal injury centres exist. In such centres, the general care of the patient is emphasised to enable the patient to return to society with maximum return of function. This study supports the concept of such an acute spinal cord injury unit.

RÉSUMÉ

Le traitement des malades avec une atteinte médullaire s'est amélioré depuis la deuxième guerre mondiale. Ceci est surtout vrai là où existent des Centres Spécialisés. Dans ces Centres, le but principal est de permettre au malade de retourner dans la société avec un retour maximum des fonctions. Cette étude supporte l'idée de l'établissement d'un tel Centre.

ZUSAMMENFASSUNG

Die Fürsorge des spinal Verletzten hat seit dem 2. Weltkrieg Fortschritte gemacht, insbesondere wo akute Spinale Zentren existieren. In diesen Zentren wird die Allgemein-fürsorge betont, um den Patienten zur Gemeinschaft mit dem Maximum von Funktion zurückzukehren. Diese Studie unterstützt die Konzeption der akuten Spinalzentren.

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