SURVIVAL FOLLOWING TRAUMATIC TETRAPLEGIA

By G. RAVICHANDRAN, B.Sc., F.R.C.S. Ed. and J. R. SILVER, M.B., B.S.,
F.R.C.P. Lond. & Ed.

*National Spinal Injuries Centre, Stoke Mandeville Hospital, Aylesbury, Bucks.,
England.*

Abstract. A review of 166 consecutive male, traumatic tetraplegic patients over the past 11 years was made. The incidence of acute death and the rate of death of patients who have survived the first year after injury were studied. Respiratory infection appears to be the commonest cause of death amongst tetraplegic patients. There were no deaths among those tetraplegics who have survived at least six years after injury.

Key words: Cervical spine injury; Acute mortality; Long term mortality.

MODERN care of the paralysed has led us to a progressive decrease in the mortality over the years (Breithaupt *et al.*, 1961; Jousse *et al.*, 1968; Hardy, 1976). Between 1864 and 1903 the acute mortality of tetraplegic patients was about 85 per cent. Riches (1944) and Guttmann (1946) independently reported a mortality rate of 80 per cent for tetraplegic patients who were injured in the First World War. Breithaupt (1961) reported in his original article that the death rate for complete tetraplegics was twelve times that of the normal population. In a more recent report the same author (Geisler *et al.*, 1977) puts this mortality at around eleven times the normal death rate of the population.

A study was undertaken at the National Spinal Injuries Centre to ascertain the acute death rate among tetraplegic patients treated during the past years. For the purposes of this study, acute death is defined as death that occurred within the first three months after injury. These figures were compared with similar previously published reports (Hardy, 1976; Silver *et al.*, 1968). In addition, certain interesting observations could be made, based on this study, on the long term mortality of tetraplegic patients.

Materials and Methods

Medical records of all consecutive, male patients with spinal cord injury admitted to the care of one consultant at the National Spinal Injuries Centre, over a period of 11 years ending in March 1981, were reviewed. Out of 373 admissions there were 166 tetraplegic patients and the remainder were paraplegics. Every tetraplegic patient known to be alive was sent a letter requesting the patient to attend the Centre for review. Those who did not respond were further pursued by telephone calls or through their general practitioner. The whereabouts of 143 patients out of 166 patients

Address for correspondence: G. Ravichandran, F.R.C.S., National Spinal Injuries Centre, Stoke Mandeville Hospital, Aylesbury, Bucks.

could be thus ascertained. If a patient was known to have died following this search, the cause of death, where possible, was ascertained from the records of the general practitioners. One hundred and twenty-three patients were known to be alive during the last year. Twenty-three were lost to follow up either because they had moved away without giving a forwarding address, or had emigrated.

Results

Of 166 acute tetraplegic admissions during the past 11 years, there were four deaths that occurred within three months of the paralysis (Table I). Of the remaining 162 patients, the whereabouts of 139 patients within the last year could be ascertained with certainty. Among these, 16 people were known to have died during the past 10 years. Table II summarises the causes of death of these 16 patients, eight of whom were over 45 years old at the time of spinal cord injury. During the same period nine paraplegic patients were known to have died, three of whom committed suicide, and two others died within three months of injury.

TABLE I
Cause of acute death in four tetraplegic patients among 166 admissions

	Age	Level of cord lesion	Complete/Incomplete	Cause of death	Survival Period
1.	26	C6/7	Complete	Respiratory arrest	3 days
2.	64	C5	Incomplete	Respiratory infection	3 weeks
3.	73	C6/7	Incomplete	Respiratory infection	4 weeks
4.	73	C6	Complete	Pulmonary embolus. Gastric bleed	12 days

TABLE II
Cause of death occurring after 3 months following the spinal injury

Renal	1
Carcinoma stomach with bleeding	1
Myocardial infarction	1
Broncho pneumonia	3
Suicide	3
Unknown	7
Total	16

Discussion

Apart from the reports referred to earlier, the acute mortality attributed to tetraplegia is not well established. In an earlier report (Hardy, 1977), over 40 per cent of patients over the age of 45 with complete tetraplegia died, whereas the corresponding figure in our series is around 6 per cent (Table III). This represents a very considerable improvement in the acute mortality. The youngest patient in study was 16 years old and the oldest was 73 years old. Thirty-two patients were over 45 at the time of spinal cord injury.

TABLE III
Acute mortality in tetraplegic patients. Actual death/total number in group (as percentage)

	Complete		Incomplete	
	Over 45 yrs	Under 45 yrs	Over 45 yrs	Under 45 yrs
Hardy 1977	12/29 (41.3)	19/88 (21.6)	12/125 (9.6)	0/88 (0.0)
Silver <i>et al.</i> 1968		17/45 (37.7)		9/96 (9.3)
Ravichandran <i>et al.</i> 1981	1/15 (6.6)	1/93 (1.07)	2/17 (11.7)	0/41 (0.0)

Silver (1971) reported an acute mortality rate of 18 per cent for tetraplegics before routine anticoagulant therapy was started. In the same report, following anticoagulant therapy and elective tracheostomy and ventilation in tetraplegic patients with a vital capacity of less than 400 mls, the mortality rate fell to 4.5 per cent. In the present series, the four acute deaths out of 166 tetraplegic patients, represents an overall mortality rate of 2.4 per cent. Except for one patient who died of pulmonary embolism, all other acute deaths were due to respiratory complications. In our series three patients presented during the acute stage with severe respiratory insufficiency and they required positive pressure ventilation. These three critically ill patients survived because of the specialised ventilatory care that could be provided in the Intensive Care Unit. We believe that judicious use of the facilities of I.C.U. will lead to further reduction in the acute mortality associated with tetraplegia.

It is difficult to draw statistically meaningful conclusions on the long-term survival of tetraplegics from a series such as this where the maximum survival is only 10 years. A comparison of the previously published reports with our own shows a reduction in the long-term mortality (Table IV). However, it must be pointed out that with a short follow up such as ours, and with a loss of follow up of 23 patients, the figures do not necessarily represent the actual long-term mortality. Geisler *et al.* (1977) reported that a complete tetraplegic person is eleven times more likely to die than someone in the normal population in the long term. The most common

TABLE IV

Long term mortality of tetraplegic patients. Actual death/total number in the group (as percentage)

Complete		Incomplete		Author	Follow up
Over 45 years	Under 45 years	Over 45 years	Under 45 years		
14/29 (58)	15/88 (17)	53/125 (42)	6/88 (6.8)	Hardy 1976	Up to 25 years
	10/45 (22)		20/96 (20.8)	Silver <i>et al.</i> 1968	Up to 13 years
3/12 (25)	7/79 (8.8)	5/13 (38)	1/35 (2.8)	Ravichan- dran <i>et al.</i> 1981	Up to 10 years

cause of death in this series was cardiovascular disease for patients with complete and incomplete tetraplegia. They also reported that suicide is four to six times more common among these patients. In our own series three of 16 long term deaths were due to suicide among incomplete tetraplegic patients (Table II). Earlier reports have noted renal complications as a major cause of death in the long term. Only one patient in our series died as a direct result of renal failure. The cause of death could not be ascertained in seven patients since their deaths were reported by either friends or relatives.

The increased risk that a tetraplegic suffers during the acute phase is well recognised. Even among those who were discharged, death seemed to be more common during the first 5 years after the paralysis. It is interesting to note that tetraplegic patients who have survived the first 5 years from the onset of paralysis appear to be physically and emotionally stable (Fig. 1). Since the number of tetraplegics studied and the period of follow up altered over the entire period under review, an attempt has been made in Fig. 1 to show the actual situation in a graphical way. The graph was drawn on the assumption that all accidents happened on the same day. Thus, the sample of those who survived the first year is much larger than those who have survived longer. There were no deaths among tetraplegics who survived 6 years or more in this series. Because the sample is small and the maximum follow up only 10 years, a comparison of the actual deaths with the expected mortality rates for the population of England and Wales is likely to be misleading. Fig. 1, shows that 12 out of 15 patients with a maximum follow up of 10 years are alive and well.

Post Script

Since writing this article three more patients who were initially treated in the Intensive Therapy Unit for ventilatory failure have died. These were patients about the age of 50 with a lesion at C4/5 neurological level. These patients died soon after discharge. The survival of these patients depended largely on the care that could be provided in specialised centres. Thus the acute mortality rate could be erroneous if tetraplegic patients

FIG. 1

Long term mortality: out of a total of 166 traumatic tetraplegic patients in this series 23 were lost to follow up and four died within three months after injury (acute deaths). The graph is drawn on the assumption that the remaining 139 patients were injured at the same time, to show the survival of tetraplegic patients. Thus out of 15 patients who were injured 11 years ago, 12 are still alive. Similarly 16 patients had died during the first 6 years after injury, five of whom died in the sixth year in a sample of 61 patients, leaving 45 survivors. NB. Post Script not included.

died in peripheral hospitals before reaching the spinal injuries centre. By the same token long term mortality appears to depend on the extent to which after care can be provided to these patients.

SUMMARY

In a review of 166 male tetraplegic patients admitted over an eleven year period, there were four acute deaths. Three of the four were over the age of 60 at the time of injury. Of the remaining 162 patients, the whereabouts of 143 patients could be ascertained. Twenty-three were lost to follow up. Sixteen patients died during the period of follow up. There

were no deaths among those tetraplegics who survived for at least 5 years after the injury. Respiratory infections were the commonest cause of death among tetraplegic patients. With improved primary care of the tetraplegic patient acute mortality can be reduced.

RÉSUMÉ

Dans une série de 166 patients tétraplégiques masculins admis durant une période de 11 ans, il y avait une mortalité aigue de quatre cas. L'âge de trois de ces quatre cas était plus de soixante ans au temps d'accident. On a pu tracer¹ 143 des 162 patients tétraplégiques. Par conséquence, on a perdu les autres vingt et un pour les investigations. Pendant cette période d'investigation seize patients étaient morts. On n'a pas recorder mortalité dans les tétraplégiques qui ont survécu par plus de cinq ans après leur accident. Les infections respiratoires étaient la cause majeure de la mortalité des patients tétraplégiques.

ZUSAMMENFASSUNG

Rueckblickend auf 166 eingewiesene, maennliche Tetraplegiker im Zeitraum von 11 Jahren sind 4 akute Todesfaelle zur verzeichnen. 3 der 4 Faelle waren zur Zeit ihrer Verletzung ueber 60 Jahre alt. Von den verbleibenden 162 Patienten konnte der Aufenthalt nur von 143 Patienten ermittelt werden; die anderen 23 Patienten gingen fuer die weiteren Ermittlungen verloren. 16 Patienten starben waehrend dieser Untersuchungsperiode. Unter diesen waren keine tetraplegiker, die mindestens die ersten 5 Jahre nach ihrer Verletzung ueberlebt hatten. Infektionen des Respirationstraktes waren die haeufigsten Todesursachen der tetraplegischen Patienten.

REFERENCES

- BREITHAUP, D. J., JOUSSE, A. T. & WYNN-JONES, M. (1961). Late causes of death and life expectancy in paraplegia. *Can. Med. Assoc. J.*, **85**, 73-77.
- GEISLER, W. O., JOUSSE, A. T. & WYNN-JONES, M. (1977). Survival in traumatic transverse myelitis. *Brit. J. Phys. Med.*, **9**, 162-171.
- GUTTMANN, L. (1946). Rehabilitation after injuries to the spinal cord and cauda equina. *Brit. J. Phys. Med.*, **9**, 162-171.
- JOUSSE, A. T., WYNN-JONES, M. & BREITHAUP, D. J. (1968). A follow up study of life expectancy and mortality in traumatic transverse myelitis. *Can. Med. Assoc. J.*, **98**, 770-771.
- HARDY, A. G. (1976). Survival periods in traumatic tetraplegia. *Paraplegia*, **14**, 41-46.
- RICHES, E. W. (1944). Methods and results of treatment in cases of paralysis of bladder following spinal injury. *Brit. J. Surg.*, **31**, 135-146.
- SILVER, J. R. & GIBBON, N. O. K. (1968). Prognosis in tetraplegia. *Brit. Med. J.*, **4**, 79-83.
- SILVER, J. R. (1971). Initial management of the chest in acute traumatic tetraplegia. *Ann. Roy. Col. Surg.*, **48**, 17-20.

¹ on a trouver leur adresse