SPINAL CORD INJURIES DUE TO DIVING

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Introduction

THE relative frequency of tetraplegia and tetraparesis due to diving was shown by Frankel *et al.* (1969). Burke (1972) described the incidence in the State of Victoria, Australia, and also discussed the mechanisms of injury; Burke (1978) was able to analyse a hundred cases of tetraplegia due to diving admitted between the years 1955-77. An increasing awareness of and interest in the subject is shown in papers by Albrand and Corkhill (1976), Kewalramani and Kraus (1977) and Scher (1978).

Methods and Results

Notes of all patients injured in diving accidents who were admitted to the National Spinal Injuries Centre, Stoke Mandeville Hospital since its founding in 1944 until the end of 1977 were examined. A total of 150 patients, 142 male and 8 females were admitted. The age structure of the patients admitted is shown in Fig. 1. The vertebral body or bodies shown to be involved are illustrated in Table I. The expected preponderance of C5 on C6 dislocations and fracture dislocations was found, we were surprised to find four patients with upper dorsal lesions. On discharge from hospital 79 patients had complete lesions and 71 had incomplete lesions. The type of water into which they dived was swimming pool 48, sea 65, river 21, lake 3, not known 13. The year in which the patients were injured is shown in Fig. 2. This shows an apparent 'epidemic' in the mid 1960s followed by a dramatic decline which has now relatively levelled off. In order to find out how this decline arose we have examined four groups of patients separately: 1. British residents injured in Britain (64); 2. British residents injured while on holiday abroad (16); 3. British Servicemen injured while serving abroad (29); 4. Foreign residents injured outside Great Britain and admitted for treatment at a late stage as private patients (41). Their occurrence over the years is shown in Fig. 2 which shows that much of the apparent epidemic of the mid 1960s was due to large numbers of British Servicemen injured abroad in those years. Foreign patients were self selected and of no value in epidemiological studies. The large number of British Servicemen injured abroad were a passing phenomenon of the period between 1953 and 1964 and the British civilians injured abroad are small in number. We have, therefore, analysed in further detail only the 64 British residents injured in Britain. One of the purposes of this analysis was to see whether the intensive safety campaign conducted by one of us (P.T.P.) in 1965 and 1966 which concentrated on swimming pool safety had any effect. The pattern

of injury in swimming pools, sea and rivers is shown in Fig. 3, this does not show a convincing diminution of swimming pool accidents. Table II shows approximately half the cases occurred by diving into the shallow end of a swimming pool.

FIG. 1

Age structure of patients

TABLE I
Bony Injury

C2-3	1
C3-4	2
C4	4
C4-5	20
C5	14
C5-6	59
C6	11
C6-7	23
C7	4
C7-T1	2
Thoracic	4
No bony injury	2
Not known	4

FIG. 2
Diving accidents from 1948 to 1976.

FIG. 3
Types of injury in Britain over the years.

TABLE II

Swimming Pool Accidents in the United Kingdom

Shallow end	13
Deep end (diving board)	6
Hit edge of pool	1
Hit by another diver	2
Found floating on pool	1
Not known	4
Total	28

Discussion

The tragedy of tetraplegia due to diving has not been eliminated by previous publicity relating to swimming pools. Although injuries caused by diving from a height into the 'deep' end of swimming pools has been virtually eliminated from Britain by the regulations agreed by the Federation International Natation Association (see appendix), injuries due to diving into the shallow end of swimming pools have continued and in two cases were due to children who were being taught to dive. Two thirds of our cases were due to diving into the sea or rivers and the general public seem to be unaware of the risks of diving into unknown depths of sea water and the risks of striking submerged objects. The possibility that deaths reported as drowning were in fact due to tetraplegia followed by drowning was mentioned by Burke (1972) and it is probable that many such cases occur.

Notices in swimming pools and popular beaches are either not read or widely ignored. We would suggest that the most effective way of teaching the population about the dangers of diving into shallow water would be at the time when they are learning to swim. In Britain the majority of children learn to swim at school or in public swimming pools. We propose to initiate an educational campaign in Great Britain which we hope will reach all children at a time when they are learning to swim. This could be reinforced by dramatic warnings on television shown in the Summer.

SUMMARY

One hundred and fifty patients with spinal cord lesions due to diving accidents were admitted to Stoke Mandeville Hospital between 1944-77. Most of the patients were young men, 65 had dived into the sea, 48 into swimming pools, 21 into rivers and 3 into lakes. Injuries due to diving into the deep end of swimming pools appear to have been eliminated in Great Britain but injuries due to diving into the shallow end of swimming pools and into the sea continue to occur. The public need further education about the dangers of diving.

RÉSUMÉ

150 malades de lésions traumatique de la moelle épinière ont été traités à Stoke Mandeville Hospital en la période 1944-1977.

La majorité était des jeunes hommes.

Les lésions étaient dues aux plongeurs de mer: 65

Plongeurs de piscine: 48

c} rivière: 21

Plongeurs de lac: 3

Les injures de plongeon dans la profondeur de la piscine semblent avoir disparu; tandis que l'on continue à voir des injures de plongeon dans le bas fond de la piscine et de la mer.

Le public a besoin de plus d'éducation au sujet des dangers des accidents de plongeon.

ZUSAMMENFASSUNG

150 Patienten mit Rückgratsverletzungen durch Tauchunfälle wurden in den Jahren 1944–1977 im Stoke Mandeville Hospital behandelt. Bei den meisten Patienten handelte es sich um junge Männer; 65 von ihnen waren ins Meer gesprungen, 48 in Schwimmbecken, 21 in Flüsse und 3 in Seen. Verletzungen durch Sprünge in den tiefen Teil eines Schwimmbeckens scheinen in Grossbritannien nicht mehr vorzukommen, wohl aber Verletzungen bei Sprüngen in den flachen Teil von Schwimmbecken und ins Meer. Die Öffentlichkeit muss weiterhin auf die Gefahren beim Tauchen hingewiesen werden.

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APPENDIX

Recreational Diving (Firm Board)								
A	Board height from water	1 m	1 m	2 m	2 m	3 m	3 m	5 m
B	Board length	0.75	1.75	0.75	1.75	0.75	1.75	5.0
C	Board width	0.75	0.75	0.75	0.75	0.75	0.75	2.0
D	Depth of water at plummet	2.6	2.6	3.0	3.0	3.25	3.25	3.8
E	Distance depth D maintained forward	3.0	4.0	3.0	4.0	3.5	4.5	6.0
F	Distance depth D maintained to sides	2.2	2.2	2.4	2.4	2.6	2.6	3.0
G	Clearance forward	4.5	5.5	5.5	6.5	6.5	7.5	10.25
H	Clearance to sides	2.5	2.5	3.0	3.0	3.5	3.5	3.8
I	Distance to adjacent board	2.5	2.5	2.5	2.5	2.5	2.5	2.5
J	Clearance behind	1.25	1.25	1.25	1.25	1.25	1.25	1.25
K	Clearance behind board to wall	0.8	0.8	0.8	0.8	0.8	0.8	0.8
L	Clearance overhead	3.0	3.0	3.0	3.0	3.0	3.0	3.0