

The causes, sequelae and attempts at prevention of cervical spine injuries in Poland

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There are certain differences between the causes of spinal injuries in Poland and in the developed countries of the West. The most common causes of injuries to the cervical spine in Poland are: falls from a horse-cart, diving into shallow water and automobile accidents. This paper presents an analysis of the causes of cervical spine injuries in a series of 1937 patients treated at the Spinal Cord Injury Department of the Metropolitan Rehabilitation Center in Konstancin, Poland, in the years between 1965 and 1991, admitted to hospital within the first hours or days after spinal injury. The relations between the mechanism of injury and the cause of injury, as well as the neurological sequelae of the injuries, are analysed.

Keywords: cervical spinal cord injury; neurological outcomes.

Introduction

There are certain differences between the causes of spinal injuries in Poland and in the developed countries of the West.^{1–6} Poland is to a large extent an agricultural country, with a large number of small farms and rather poorly developed agricultural engineering, although in recent years there has been some integration of land property and small farms and some advancement in the farming techniques. But it is still the horse-driven vehicle, the horse cart, which is the basic means of transport of hay, corn and other farm produce on many farms, falls from which account for the largest percentage of spinal cord injury (SCI). The motorcycle is another very popular means of transport in the country and a common cause of SCI; the number of cars is increasing gradually.

A frequent cause of injury to the spine sustained by young people is diving into shallow water.⁷ There are insufficient numbers of swimming pools in Poland, and therefore the natural water reservoirs, such as rivers and lakes, are often used even although they do not meet the basic safety requirements.

This paper presents an analysis of the causes of cervical spine injuries in a series of

1937 patients treated at the Spinal Cord Injury Department of the Metropolitan Rehabilitation Center in Konstancin, Poland, in the years between 1965 and 1991, admitted to hospital within the first hours or days after spinal injury. The relations between the mechanism of injury and the cause of injury, as well as the neurological sequelae of the injuries, are analysed.

Causes of spinal injury

Table I presents the commonest causes of cervical spine injuries with regard to the community background of the patients (urban vs rural areas). The overall commonest causes of injury in our material were: falls from a horse-cart (about 25% of cases), diving (about 20%) and automobile accidents (13.5%). The ratios differ, however, according to the community background. Among patients from urban areas, the single most common cause of injury to the cervical spine was diving (over 30% of cases), followed by automobile accidents (24%) and falls from low heights (10%), supplemented by quite a number of falls from stairs (5.5%). Among patients from rural areas, the dominant causes of injury were falls from a horse-cart, accounting for

Table I The causes of cervical spine injuries

Cause of injury	Urban areas		Rural areas		Total	
	No	%	No	%	No	%
Falls from a height						
Horse-cart	23	2.6	447	42.0	470	24.3
Roof	6	0.7	49	4.6	55	2.8
Ladder	21	2.4	85	8.0	106	5.5
Stairs	48	5.5	15	1.4	63	3.2
Scaffolding	27	3.1	7	0.7	34	1.8
Tree	17	1.9	33	3.1	50	2.6
Suicidal	12	1.4	3	0.3	15	0.8
Small height	86	9.9	47	4.4	133	6.9
Other falls						
Great height	23	2.6	12	1.1	35	1.8
Diving	265	30.4	118	11.1	383	19.8
Road accidents						
Automobile	210	24.1	52	4.9	262	13.5
Motorcycle	22	2.5	52	4.9	74	3.8
Bicycle	13	1.5	25	2.4	38	2.0
Pedestrian	30	3.4	46	4.3	76	3.9
Other	8	0.9	18	1.7	26	1.3
Compression by a heavy object	28	3.2	27	2.5	55	2.8
Other causes	34	3.9	28	2.6	62	3.2
Total	973	100.0	1064	100.0	1937	100.0

as many as 42% of cases, followed much less frequently by diving accidents (11%), and falls from a ladder (8%). Table II shows the age distribution of the patients. The majority sustained the injury in the most active period of their lives, between 20 and 60 years of age (over 64%). The fewest were in the youngest age group, up to 20 years (15%). Certain causes of injury are age related: falls from a horse-cart more often led to an injury in older people (46% of patients were aged over 60 years, only 14% were aged up to 40 years); the situation was similar in the group of injuries caused by falls from a ladder, where 44% of patients were aged over 60 years, and only 14% were under 40. Pedestrian accidents also more often involved older individuals (77% of the patients were over 40 and 33% over 60 years of age). Spinal fractures following suicidal jumps were only found in young people, aged up to 40 years. Young individuals

prevailed also among the victims of falls from a tree (64% were aged up to 40 years), falls from great heights (77% were aged up to 40 years), diving (47% were aged up to 20 years, 97% up to 40 years) and automobile accidents (over 86% of patients were aged up to 40 years).

Table III shows the time (the quarter of the year) when the injury was sustained. Fewest accidents occurred in the first 3 months of the year (about 9%), while the third quarter of the year was the period for the highest incidence of traumas (61% of all the injuries to the cervical spine). The relation with summertime (the third quarter of the year) is particularly prominent in patients who have fallen from a horse-cart (over 72% of traumas took place within the third quarter), falls from a ladder (56%), tree (84%), great heights (57%), diving (88%), automobile (55%) and other road accidents (58%).

Table II Age of patients

Cause of injury	Age of patients								Total
	Up to 20	%	21-40	%	41-60	%	Over 60	%	
Falls from a height									
Horse-cart	3	1.0	64	9.4	188	33.4	215	53.1	470
Roof	—	—	23	3.4	20	3.6	12	3.0	55
Ladder	—	—	15	2.2	44	7.8	47	11.6	106
Stairs	2	0.7	16	2.3	28	5.0	17	4.2	63
Scaffolding	—	—	14	2.0	17	3.0	3	0.7	34
Tree	10	3.5	22	3.2	13	2.3	5	1.2	50
Suicidal	3	1.0	12	1.8	—	—	—	—	15
Small height	15	5.2	40	5.9	45	8.0	33	8.2	133
Other falls									
Great height	3	1.0	24	3.5	8	1.4	—	—	35
Diving	179	62.0	194	28.5	10	1.8	—	—	383
Road accidents									
Automobile	23	8.0	133	19.6	84	14.9	22	5.4	262
Motorcycle	24	8.3	40	5.9	9	1.6	1	0.2	74
Bicycle	7	2.4	12	1.8	15	2.6	4	1.0	38
Pedestrian	5	1.7	12	1.8	34	6.0	25	6.2	76
Other	2	0.7	10	1.5	10	1.8	4	1.0	26
Compression by a heavy object	6	2.1	18	2.6	20	3.6	11	2.7	55
Other causes	7	2.4	31	4.6	18	3.2	6	1.5	62
Total	289	100	680	100	563	100	405	100	1937

Mechanism of the spinal injury

The mechanism of the spinal injury was assessed on the basis of the initial radiographs and anamnesis data. In accordance with earlier observations, the injuries from a flexion mechanism are divided into fractures and dislocations,⁸ while compression injuries are either fractures or crush injuries.⁹

Table IV shows the mechanism of spinal injury in relation to the cause of injury. For classification, all falls from a height are grouped together, except falls from a horse-cart as being the most frequent; and similarly, road accidents are presented here as one group with the exception of the most frequent automobile accidents.

In general, the commonest mechanism of injury was flexion (48% of all cases) with a prevalence of a flexion dislocation (35%). Injuries from an extension mechanism (26%) were of approximately the same incidence as were injuries from a compression mechanism. The incidence of particular

mechanisms of injury was to some extent dependent on the cause of injury. Among the injuries following falls from a horse-cart, flexion dislocations were in fact dominant (45%), but injuries from an extension mechanism were not much less frequent (35%). Similarly, among patients whose trauma was caused by other falls from a height, both kinds of injuries were equally frequent (33%). Injuries following diving were mainly from a compression mechanism (61% of cases), with a prevalence of crush fractures (39%) which were relatively rare in the other groups of trauma.

Automobile accidents most often resulted in injuries from a flexion mechanism (62%) with a prevalence of dislocations (46%). In other road accidents, however, injuries from an extension mechanism were more frequent (40%) than were flexion dislocations (34%), which were second in incidence. Flexion dislocations also prevailed among injuries due to compression by heavy objects

Table III Time (quarter of the year) of spinal injury

Cause of injury	Quarter of the year									
	I		II		III		IV		Total	
	No	%	No	%	No	%	No	%	No	%
Falls from a height										
Horse-cart	22	4.7	88	18.7	340	72.3	20	4.3	470	100
Roof	3	5.5	7	12.7	24	43.6	21	38.2	55	100
Ladder	12	11.3	17	16.0	59	55.7	18	17.0	106	100
Stairs	6	9.5	20	31.7	19	28.6	18	28.6	63	100
Scaffolding	4	11.8	11	32.3	14	41.2	5	14.7	34	100
Tree	—	—	5	10.0	42	84.0	3	6.0	50	100
Suicidal	2	13.3	4	26.7	6	40.0	3	20.0	15	100
Other falls										
Small height	32	24.0	30	22.6	41	30.8	30	22.6	133	100
Great height	4	11.4	8	22.9	20	57.1	3	8.6	35	100
Diving	3	0.8	42	11.0	336	87.7	2	0.5	383	100
Road accidents										
Automobile	38	14.5	37	14.1	145	55.4	42	16.0	262	100
Motorcycle	1	1.4	38	51.4	30	40.5	5	6.7	74	100
Bicycle	—	—	16	42.1	18	47.4	4	10.5	38	100
Pedestrian	25	32.9	11	14.5	18	23.7	22	28.9	76	100
Other	1	3.9	3	11.5	15	57.7	7	26.9	26	100
Compression by a heavy object	6	10.9	18	32.7	19	34.6	12	21.8	55	100
Other causes	11	17.7	12	19.4	27	43.5	12	19.4	62	100
Total	170	8.8	367	18.9	1173	60.6	227	11.7	1937	100

(52%), and in the group of injuries due to other causes (37%).

Neurological sequelae of the cervical spine injury

Table V presents the degree of spinal cord injury assessed on admission in relation to the most common causes of injury. The degree of the damage to the spinal cord is assessed according to a modification of the classification of Frankel *et al.*,¹⁰ ie complete, three incomplete groups^{8,11} and essentially normal. The injury is assessed as complete if there is motor paralysis and absence of all sensation below the level of the spinal cord lesion. Incomplete injuries are divided into three groups: group 1—motor paralysis with at least traceable deep sensation preserved in the feet; group 2—severe tetraparesis (or hemiparesis); group 3—pareses of lesser severity, with paretic muscle strength over 3° on the MRC scale.

In total, 39% of the patients had the signs and symptoms of a complete spinal cord injury on admission. Over 50% of patients had tetraplegia (including group 1 of the incomplete injuries). Only 10% had no significant neurological deficits (with the possibility of paraesthesiae, numbness, and radiculalgia).

The most serious sequelae were noted in patients with injuries caused by diving. As many as 64% of them had tetraplegia, and 50% had a complete spinal cord injury on admission. Eight percent of the victims of diving had no significant neurological deficits. Much better neurologically were the patients injured in automobile accidents, 39% of these patients having a complete spinal cord lesions and 15% having no significant neurological deficits. More serious damage to the spinal cord was found in victims of other road accidents, particularly motorcycle and pedestrian accidents. Among these patients, 55% had motor

Table IV Mechanism of cervical spine injury

Cause of injury	Flexion fracture		Mechanism of injury				Compression				No xray changes	
	No	%	dislocation		extension		fractura		crush		No	%
			No	%	No	%	No	%	No	%		
Falls from horse-cart	41	8.7	212	45.1	166	35.3	43	9.2	7	1.5	1	0.2
Other falls	74	15.1	161	32.8	163	33.2	56	11.4	36	7.3	1	0.2
Diving	77	20.1	59	15.4	13	3.4	84	21.9	150	39.2	-	-
Automobile	42	16.0	121	46.2	42	16.0	26	9.9	30	11.5	1	0.4
Other road accidents	14	6.5	72	33.7	86	40.2	15	7.0	25	11.7	2	0.9
Compression by a heavy object	10	18.2	23	41.8	11	20.0	7	12.7	3	5.5	1	1.8
Other causes	7	11.3	23	37.1	16	25.8	8	12.9	3	4.8	5	8.1
Total	265	13.7	671	34.6	497	25.7	239	12.3	254	13.1	11	0.6

paralysis (42% had complete spinal cord lesions) and only 8% had no significant neurological disorder.

Similar neurological sequelae were observed in patients with spinal injuries following falls from a horse-cart and other falls from a height. In both of these groups, complete spinal cord injury was found in 34% of cases, while about 10% of patients in both groups had no significant neurological deficit.

Attempts at prevention of cervical spine injuries

The most common causes of injuries to the cervical spine in Poland are: falls from a horse-cart; diving into shallow water; and road accidents, particularly those involving automobiles. Altogether, these causes account for nearly 70% of the cervical spine injuries. Therefore the preventive measures focus on warning against the threatening dangers.

In the spring and summer, a special campaign is run in the mass media, especially radio and TV programmes for young people, to warn of and heighten the awareness of the possible consequences of haphazard diving into unfamiliar or shallow water reservoirs, on unguarded beaches. The majority of spinal injuries due to diving take place at the end of June and the beginning of holidays for students of all education levels.

Falls from a horse-cart resulting in spinal injuries are also most frequent in the summertime, during the harvesting and hay gathering. Hopefully, some improvement in this respect may be brought about by the warning campaign in the press and programmes for farmers pointing to the risks connected with placing the carter's seat on the top of the heavily loaded wagons of hay or corn. On the other hand, the modernisation of farming techniques and gradual replacement of the horse-driven vehicles by modern machines will further reduce the numbers of this kind of accident.

Regrettably, the frequent radio and TV announcements reporting on the worsening driving conditions in particular regions of the country and on the tragic consequences

Table V Initial neurological state

Cause of injury	Degree of spinal cord injury											
	Complete		Incomplete						Without neurological deficit		Total	
	No	%	1		2		3		No	%	No	%
Falls from horse-cart	162	34.5	52	11.1	107	22.7	102	21.7	47	10.0	470	100
Other falls	168	34.2	48	9.8	96	19.5	125	25.5	54	11.0	491	100
Diving	192	50.1	54	14.1	47	12.3	60	15.7	30	7.8	383	100
Automobile	102	38.9	29	11.1	33	12.6	60	22.9	38	14.5	262	100
Other road accidents	89	41.6	28	13.1	35	16.4	45	21.0	17	7.9	214	100
Compression by a heavy object	21	38.2	10	18.2	10	18.2	11	20.0	3	5.4	55	100
Other causes	20	32.3	3	4.8	13	21	14	22.6	12	19.3	62	100
Total	754	38.9	224	11.6	341	17.6	417	21.5	201	10.4	1937	100

of road accidents are disappointingly ineffective. The growing number of motor vehicles on the road, combined with the bravado and carelessness on the part of the drivers, frequently augmented by imbibing alcohol, are factors that contribute to the gradual increase in the number of accidents and the subsequent injuries to the spine. Hopefully, the recent introduction of new road regulations making it compulsory to drive with the headlights on during the autumn and winter months, and the tightened sanctions against unruly or inebriated drivers will bring about a change and decrease the number of road accidents and their tragic consequences.

Conclusions

1 The commonest causes of injuries to the cervical spine in Poland are: falls from a

horse-cart, diving into shallow water and road accidents, especially those involving cars.

- 2 The causes of the different aetiologies in the urban areas are: diving (30% of cases), automobile accidents (24%), and falls from low heights (10%). In the rural areas the dominant causes are falls from a horse-cart (42%), diving (11%) and falls from a ladder (8%).
- 3 Injuries to the cervical spine are most often sustained in the summertime due to the high incidence of falls from a horse-cart, tree, diving and road accidents during that period of time.
- 4 The neurological sequelae of these injuries are severe. On admission over 50% of the patients presented with tetraplegia.
- 5 The preventive measures focus on campaigns run in the mass media to warn against the consequences of the most frequent injuries.

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