
The Disease Pattern and Causes of Death of Spinal Cord Injured Patients in Japan

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Summary

In recent years, the lifespan of patients with spinal cord injury (SCI) in Japan has been markedly prolonged, resulting in changes in the pattern of diseases developing after SCI and causes of death. We carried out a questionnaire survey on these problems and obtained the following results:

1. Disease pattern in SCI patients. The morbidity during 3 days in October 1987 and the past history after SCI were investigated in 426 SCI patients, and the results were compared with those in the national health survey carried out by the Japanese government in 1984.

The incidence of urological complications and pressure ulcer was high, as was to be expected. In addition, the incidence of diabetes, hypertension, skin diseases, peptic ulcer, and hepatic disease were also significantly higher in the SCI patients.

2. Causes of death in SCI patients. Causes of death were analysed in 522 SCI patients who died, and the results were compared with those of the survey undertaken in 1967.

The major causes of death were urinary tract infections and respiratory dysfunction in the early stage of cervical cord injury. Comparison with the results of the survey in 1967 showed a significant decrease in deaths from urinary tract infection; and a significant increase in those from CVA.

Key words: *Spinal cord injury; Japan; Aging; Morbidity; Cause of death.*

With recent advances in the treatment of spinal cord injury (SCI) in the early stage, the lifespan of SCI patients has been markedly prolonged. This has resulted in changes in the pattern of complications developing after SCI, such as an increase in diseases of adults and the resulting changes possibly resulting in death.

To evaluate these changes, we carried out a questionnaire survey.

Morbidity rates in SCI patients

Methods

A questionnaire was sent to 700 rehabilitated SCI patients with complete paralysis 3 years or more after discharge from Rosai hospitals to examine the morbidity during 3 days in October 1987 and the incidence of complications after SCI. The replies were compared with the result of the national health survey carried out by the Japanese government in 1984.

Results

Valid replies were obtained from 426 patients (407 males and 19 females). The level of motor paralysis (the lowest level effective segment), age of the subjects, and duration of SCI are shown in Table I.

Morbidity

The morbidity during 3 days in October 1987 according to age, level of motor paralysis, and duration of SCI are shown in Tables II and IV respectively.

The morbidity rates according to ages (Table II) in these SCI patients were compared with those of the national health survey in 1984 (Table III). As was expected, differences were observed in the morbidity rates of urinary tract infection, etc., and pressure ulcers. In addition, the morbidity rates of hypertension, diabetes, skin diseases, peptic ulcer, and liver disease were significantly higher in the SCI patients ($p < 0.05$), the difference being especially marked in the first 3 diseases.

The morbidity rates according to the level of motor paralysis (Table IV) showed a significant difference in the morbidity of urinary tract disorders between the group with C level paralysis and that with T1-10 level paralysis, in the morbidity of pressure ulcer between the group with T1-10 level paralysis and that with the T11 level paralysis, and in the morbidity of circulatory diseases between the group with C levels paralysis and that with T1-10 level paralysis as well as that with T11 level paralysis ($p < 0.05$). In particular, there was an apparent difference in the morbidity rates of hypertension between the group with cervical cord injury and those with thoracic or lumbar cord injury.

The morbidity rates according to duration of SCI showed a marked difference in the morbidity of urinary tract disease between the group with a duration ≤ 10 years (6.7%) and that with a duration > 10 years (17.8%). The morbidity of pressure ulcer significantly differed between the group with a duration ≤ 5 years (11.5%) and that with a duration > 15 years (22.4%) ($p < 0.05$), showing a gradual increase with prolongation of the duration. The morbidity of circulatory disease significantly differed between the group with a duration ≤ 10 years (3.1%) and that with a duration > 10 years (15.4%).

Table I SCI level, age and duration of subjects

	Age							SCI duration (Years)			Total
	15-24	25-34	35-44	45-54	55-64	65-74	75 +	3-5	6-15	16+	
C	6	24	39	37	19	15	1	35	77	28	140
Th ₁ -Th ₁₀	3	22	32	46	19	7	2	19	59	52	130
Th ₁₁ -	1	17	42	55	28	7	1	23	62	64	149
?	1	0	2	1	2	1	0	1	6	0	7
Total	11	63	115	139	68	30	4	78	204	144	426

Table II Morbidity rate according to age during 3 days in October 1987

	Age								Total
	15-24	25-34	35-44	45-54	55-64	65-74	75+		
Pyelonephritis	0(0.0)	2(3.2)	6(5.2)	3(2.2)	4(5.9)	1(3.3)	0(0.0)	16(3.6)	
Kidney and ureter stone	0(0.0)	1(1.6)	1(0.9)	1(0.7)	0(0.0)	0(0.0)	0(0.0)	3(0.7)	
Cystitis	0(0.0)	0(0.0)	3(2.6)	4(2.9)	2(2.9)	1(3.3)	0(0.0)	10(2.4)	
Bladder stone	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(1.5)	0(0.0)	0(0.0)	1(0.2)	
Others	0(0.0)	0(0.0)	1(0.9)	0(0.0)	3(4.4)	0(0.0)	0(0.0)	4(0.9)	
Unknown	0(0.0)	2(3.2)	2(1.7)	10(7.2)	8(11.8)	0(0.0)	0(0.0)	22(5.2)	
Pressure ulcer	1(9.1)	13(20.6)	22(19.1)	28(20.1)	15(22.1)	2(6.7)	0(0.0)	81(19.0)	
Hypertension	0(0.0)	0(0.0)	6(5.2)	15(10.8)	8(11.8)	5(16.7)	0(0.0)	34(8.0)	
CVA	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	
Heart disease	0(0.0)	2(3.2)	0(0.0)	3(2.2)	4(5.9)	0(0.0)	0(0.0)	9(2.1)	
Peptic ulcer	0(0.0)	0(0.0)	0(0.0)	3(2.2)	4(5.9)	1(3.3)	0(0.0)	8(1.9)	
Disease of liver/gallbladder	0(0.0)	0(0.0)	2(1.7)	4(2.9)	4(5.9)	0(0.0)	0(0.0)	10(2.4)	
Others	0(0.0)	0(0.0)	2(1.7)	4(2.9)	6(8.8)	1(3.3)	0(0.0)	13(3.1)	
Unknown	0(0.0)	0(0.0)	4(3.5)	4(2.9)	2(2.9)	0(0.0)	0(0.0)	10(2.4)	
Diabetes	0(0.0)	0(0.0)	4(3.5)	6(4.3)	4(5.9)	3(10.0)	0(0.0)	17(4.0)	
Respiratory disease	0(0.0)	1(1.6)	3(2.6)	2(1.4)	1(1.5)	0(0.0)	1(25.0)	8(1.9)	
Skin disease	1(9.1)	3(4.8)	7(6.1)	5(3.6)	5(7.4)	0(0.0)	1(25.0)	22(5.2)	
Others	0(0.0)	2(3.2)	2(1.7)	4(2.9)	3(4.4)	2(6.7)	0(0.0)	13(3.1)	

()-morbidity in each age (%)

Table III National health survey in 1984

	Age						
	15-24	25-34	35-44	45-54	55-64	65-74	75 +
Kidney disease	0.01	0.05	0.10	0.17	0.15	0.21	0.16
Hypertension	0.03	0.12	0.80	3.31	7.51	12.82	16.25
CVA	0.01	0.01	0.02	0.19	0.70	1.61	3.01
Heart disease	0.01	0.04	0.18	0.63	2.16	3.42	4.71
Peptic ulcer	0.06	0.23	0.61	0.79	1.24	1.49	1.08
Liver disease	0.03	0.08	0.17	0.66	0.99	0.89	0.81
Diabetes	0.01	0.11	0.17	0.73	1.55	2.15	2.47
Respiratory disease	0.14	0.07	0.09	0.38	0.49	1.16	1.45
Skin disease	0.33	0.41	0.30	0.33	0.31	0.42	0.22

Table IV Morbidity rate according to level of motor paralysis during 3 days in October 1987

	Level of motor paralysis				Total
	C	T ₁ -T ₁₀	T ₁₁ -	?	
Pyelonephritis	4(2.9)	4(3.1)	8(5.4)	0(0.0)	16(3.8)
Kidney and ureter stone	2(1.4)	1(0.8)	0(0.0)	0(0.0)	3(0.7)
Cystitis	3(2.1)	6(4.6)	1(0.7)	0(0.0)	10(2.4)
Bladder stone	1(0.7)	0(0.0)	0(0.0)	0(0.0)	1(0.2)
Others	2(1.4)	1(0.8)	1(0.7)	0(0.0)	4(0.9)
Unknown	2(2.1)	12(9.2)	7(4.7)	0(0.0)	22(5.2)
Pressure ulcer	25(17.9)	33(25.4)	21(14.1)	2(28.5)	81(19.1)
Hypertension	1(0.7)	15(11.5)	17(11.4)	1(14.3)	34(8.0)
CVA	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Heart disease	3(2.1)	4(3.1)	2(1.3)	0(0.0)	9(2.1)
Peptic ulcer	0(0.0)	2(1.5)	6(4.0)	0(0.0)	8(1.9)
Disease of liver and gallbladder	1(0.7)	4(3.1)	5(3.4)	0(0.0)	10(2.4)
Others	4(2.9)	4(3.1)	5(3.4)	0(0.0)	13(3.1)
Unknown	3(2.1)	4(3.1)	2(1.3)	1(14.3)	10(2.4)
Diabetes	3(2.1)	5(3.9)	9(6.0)	0(0.0)	17(3.9)
Respiratory disease	1(0.7)	3(2.3)	4(2.7)	0(0.0)	8(1.9)
Skin disease	5(3.6)	9(6.9)	8(5.4)	0(0.0)	22(5.2)
Others	4(2.9)	6(4.6)	3(2.0)	0(0.0)	13(3.1)

()—morbidity in each groups (%)

Table V Past history after SCI according to level of motor paralysis

	Level of motor paralysis			Total
	C	T ₁ -T ₁₀	T ₁₁ -L	
Pyelonephritis	12(8.6)	11(8.5)	17(11.4)	40(9.4)
Kidney and ureter stone	6(4.3)	4(3.1)	3(2.0)	13(3.1)
Cystitis	12(8.6)	16(12.3)	17(11.4)	45(10.6)
Bladder stone	8(5.7)	7(5.4)	5(3.4)	20(4.7)
Others	8(5.7)	3(2.3)	6(4.0)	17(4.0)
Unknown	6(4.3)	15(11.5)	12(8.1)	33(7.7)
Pressure ulcer	61(43.6)	61(46.9)	63(42.3)	185(43.4)
Hypertension	2(1.4)	8(6.2)	10(6.7)	20(4.7)
CVA	0(0.0)	0(0.0)	3(2.0)	3(0.7)
Heart disease	0(0.0)	3(2.3)	2(1.3)	5(1.2)
Peptic ulcer	6(4.3)	2(1.5)	3(2.0)	11(2.6)
Disease of liver and gallbladder	5(3.6)	2(1.5)	1(0.7)	8(1.9)
Others	8(5.7)	3(2.3)	4(2.7)	15(3.5)
Unknown	2(1.4)	3(2.3)	2(1.3)	7(1.6)
Diabetes	2(1.4)	3(2.3)	5(3.4)	10(2.4)
Respiratory disease	16(11.4)	6(4.6)	3(2.5)	25(5.9)
Skin disease	10(7.1)	18(13.9)	14(9.4)	42(9.9)
Others	7(5.0)	8(6.2)	6(4.0)	21(4.9)

()—morbidity in each groups (%)

Past history after SCI

The past history according to motor paralysis (Table V) showed no significant difference in the incidence of urinary tract disturbance or pressure ulcer among the groups. However, the incidence of circulatory disease was significantly lower and that of respiratory disease was significantly higher in the group with cervical cord injury.

The past history according to age showed no significant age difference in the incidence of urinary tract disease or pressure ulcer. The incidence of circulatory disease and diabetes did not significantly differ between adjacent age groups but tended to increase with age.

The past history according to the duration of SCI showed higher incidences of urinary tract disease and pressure ulcer in longer duration groups with a significant difference (Urinary tract disease; ≤ 15 years, 30.5%, > 16 years 53.9%) (pressure ulcer; ≤ 15 years 36.5%, > 16 years 56.9%). The incidences of circulatory disease and digestive tract disease gradually increased with the prolongation of the duration of SCI probably due to increases in age. The former was significantly high in the group with a duration of ≤ 15 years (3.2%) and that with a duration > 21 years (15.6%) but the latter did not significantly differ among the groups.

Cause of death in SCI patients*Methods*

A questionnaire was sent to 22 Rosai hospitals to examine the cause of death in SCI patients who died between October 1967 and December 1968.

The results of the replies were compared with those of the survey in 1967 on the causes of death in SCI patients who died between 1955 and September 1967.

Results

Twenty two Rosai hospitals confirmed 522 deaths of SCI patients. The cause of death according to age, SCI level, and SCI duration are shown in Tables VI, VII and VIII, respectively.

A significant difference was observed in the percentages of patients who died at the age < 49 years to the total patients who died between the present survey (56.9%) and the survey in 1967 (74.1%) ($p < 0.05$), showing an increase in the age at death.

There was no difference in the percentages of deaths within 1 month after SCI between the two surveys. However, the percentages of deaths within 5 years were significantly higher in the previous survey (82.6%) than in the present survey (60%). These results suggest prolongation of the lifespan of SCI patients.

The major causes of death were urinary tract and respiratory disease. Comparison with the results of the survey in 1967 showed a significant decrease in the percentages of deaths from urinary tract disease and an increase in those

Table VI Age and cause of death

	Age										Total	
	< 29		< 49		< 69		70 <		?			
Shock	1	1	3	3	3	0	0	0	1	2	8	6
Disease of urinary tract	1.2	1.7	1.4	2.3	1.6	0.0	0.0	0.0	6.3	25.0	1.5	2.2
Sepsis (Decubitus, etc.)	27	28	54	56	35	19	1	0	2	1	119	104
Heart disease	32.1	48.3	25.4	42.4	18.2	28.8	5.9	0.0	12.5	12.5	22.8	38.8
CVA	3	1	13	5	3	0	2	0	1	0	22	6
Respiratory disease	3.6	1.7	6.1	3.8	1.6	0.0	11.8	0.0	6.3	0.0	4.2	2.2
Disease of digestive tract	4	3	22	9	28	10	1	3	3	0	58	25
Disease of liver	4.8	5.2	10.3	6.8	14.6	15.1	5.9	75.0	18.8	0.0	11.1	9.3
Malignancy	2	0	16	1	8	3	2	0	1	0	29	4
Others and unknown	2.4	0.0	7.5	0.8	4.2	4.5	11.8	0.0	6.3	0.0	5.6	1.5
Total	18	14	35	22	64	18	9	1	3	1	129	56
	21.4	24.1	16.4	16.7	33.3	27.3	52.9	25.0	18.8	12.5	24.8	20.9
	8	4	19	9	17	5	1	0	0	0	45	18
	9.5	7.0	8.9	6.8	8.9	7.6	5.9	0.0	0.0	0.0	8.6	6.7
	0	1	6	2	2	2	0	0	2	0	10	5
	0.0	1.7	2.8	1.5	1.0	3.0	0.0	0.0	12.5	0.0	1.9	1.9
	5	2	9	17	12	2	1	0	0	0	27	21
	6.0	3.4	4.2	12.9	6.2	3.0	5.9	0.0	0.0	0.0	5.2	7.8
	16	4	36	8	20	7	0	0	3	4	75	23
	19.0	7.0	16.9	6.1	10.4	10.6	0.0	0.0	18.8	50.0	14.4	8.6
	84	58	213	132	192	66	17	4	16	8	522	268
	16.1	21.6	40.8	49.3	36.8	24.6	3.3	1.5	3.1	3.0		

No.

—: October 1967–December 1982

%

No.

—: 1953–September 1967

%

from CVA. Especially, there was a marked decrease in patients who died of urinary tract disease at the age < 49 years.

The percentages of deaths from respiratory disease tended to be higher in the younger age groups and lower in the older groups in the present survey than in the previous survey.

Evaluation according to the level of paralysis revealed that more than 50% of the total patients who died had had a cervical cord injury. Comparison with the previous survey showed a marked increase in the percentages of patients with cervical cord injury to the total patients who died and a decrease in those patients with a lumbar and sacral cord injury who died of urinary tract disease. In the patients who died of circulatory disease, the percentages of those with thoracic cord injury significantly increased, whilst in the patients who died of CVA,

Table VII SCI level and cause of death

	Level of SCI								Total	
	C		Th		L&S		?			
Shock	6	6	1	0	1	0	0	0	8	6
	1.9	4.8	0.9	0.0	1.1	0.0	0.0	0.0	1.6	2.2
Disease of urinary tract	46	28	42	29	28	42	3	5	119	104
	15.0	22.2	38.9	49.2	29.8	57.5	23.1	50.0	22.8	38.8
Sepsis (Decubitus, etc.)	13	1	4	5	4	0	1	0	22	6
	4.2	0.8	3.7	8.5	4.3	0.0	7.7	0.0	4.2	2.2
Heart disease	32	11	14	3	9	9	3	2	58	25
	10.4	8.7	13.0	5.1	9.6	12.3	23.1	20.0	11.1	9.3
CVA	14	1	4	2	11	1	0	0	29	4
	4.6	0.8	3.7	3.4	11.7	1.4	0.0	0.0	5.7	1.5
Respiratory disease	117	46	7	6	4	4	1	0	129	56
	38.1	36.5	6.5	10.2	4.3	5.5	7.7	0.0	24.7	20.9
Disease of digestive tract	30	4	8	4	7	9	0	1	45	18
	9.8	3.2	7.4	6.8	7.4	12.3	0.0	10.0	8.6	6.7
Disease of liver	4	3	2	2	2	0	2	0	10	5
	1.3	2.4	1.9	3.4	2.1	0.0	15.4	0.0	1.9	1.9
Malignancy	13	14	5	4	9	3	0	0	27	21
	4.2	11.1	4.6	6.8	9.6	4.1	0.0	0.0	5.2	7.8
Others and unknown	32	12	21	4	19	5	3	2	75	23
	10.4	9.5	19.4	6.8	20.2	6.8	23.1	20.0	14.4	8.6
Total	307	126	108	59	94	73	13	10	522	268
	58.8	47.0	20.7	22.0	18.0	27.2	2.5	3.7		

No.
 —: October 1967–December 1982
 %
 No.
 —: 1955–September 1967
 %

the percentages of those with cervical or lumbar and sacral cord injury significantly increased. In the patients who died of respiratory disease, the percentages of those with cervical cord injury were predominantly high, and in the patients who died of digestive tract disease, the percentages of those with cervical cord injury were high; comparison with the survey in 1967 also showed marked increases in these percentages. In patients who died of malignant disease, the percentages of those with cervical cord injury decreased, but those of patients with lumbar and sacral cord injury increased.

The data according to the duration of SCI showed a prolonged interval between SCI and death in the patients who died of urinary tract disease. In the patients who died of respiratory disease, 50% died within 1 month of SCI, and comparison with the survey in 1967 showed higher percentages of deaths within

Table VIII SCI duration and cause of death

	Duration of SCI												Total	
	< 1m	< 1 year		< 5 years		< 10 years		10 years		?				
Shock	8	5	0	0	0	1	0	0	0	0	0	0	8	6
Disease of urinary tract	7.3	7.8	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.5	2.2
Sepsis (Decubitus, etc.)	8.2	4.7	15.8	32.8	24.5	59.8	31.8	45.9	34.8	66.7	18.2	100	22.8	38.8
Heart disease	0.9	0.0	8.9	6.3	4.9	1.1	3.0	2.7	3.0	0.0	9.1	0.0	4.2	2.2
CVA	13.6	3.1	14.9	12.5	8.8	10.9	3.0	10.8	11.4	11.1	18.2	0.0	11.1	9.3
Respiratory disease	4.5	1.6	5.0	0.0	3.9	2.2	7.6	2.7	6.8	0.0	9.1	0.0	5.6	1.5
Disease of digestive tract	54.5	57.8	36.6	18.8	17.6	2.2	10.6	10.8	3.8	11.1	18.2	0.0	24.8	20.9
Disease of liver	8.2	1.6	9.9	9.4	6.9	6.5	15.2	13.5	6.8	0.0	0.0	0.0	8.6	6.7
Malignancy	0.9	0.0	1.0	1.6	2.0	4.3	1.5	0.0	2.3	0.0	18.2	0.0	1.9	1.9
Others and unknown	0.0	12.5	0.0	7.8	13.7	4.3	7.6	8.1	6.1	11.1	0.0	0.0	5.2	7.8
Total	110	64	101	64	102	92	66	37	132	9	11	2	522	268
	21.2	24.7	19.4	23.6	19.5	34.3	12.6	13.6	25.3	3.4	2.1	1.1		

No.

—: October 1967–December 1982

%

No.

—: 1953–September 1967

%

5 years after excluding those in the acute stage in the present survey than in the previous survey.

Conclusion

Comparison of the results of the two surveys showed prolongation of the life-span of SCI patients and changes in the pattern of diseases developing after SCI.

The incidence of urinary tract disease tended to decrease, but that of diseases of adults increased. The incidence of hypertension, diabetes, skin disease, peptic ulcer, and liver disease were high.

Deaths from urinary tract disease markedly decreased, but those from diseases for adults such as CVA tended to gradually increase.

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