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ORIGINAL ARTICLE

Medical rehabilitation of the patients with spinal cord injury caused by aortic aneurysm and its operation

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Objectives: To determine the natural course of spinal cord injury (SCI) after aortic aneurysm surgery.
Setting: Acute care and semi-acute wards in Osaka Rosai Hospital, Japan.
Methods: From 1998 to 2003, 12 patients with thoracic SCI (eight men and four women; mean age: 69 years) were enrolled and evaluated by the American Spinal Injury Association (ASIA) impairment scale and Functional Independence Measure (FIM), and the results were analyzed.
Results: The level of SCI was distributed from T5 to L1. The ASIA impairment scale was A in four patients, B in four, C in three and D in one. Finally, six patients were discharged to home, and two patients died during hospitalization. Excluding the value of the deceased patients, the mean motor FIM was initially 32 ± 15.6 (13–59) points and became 61 ± 21.4 (29–88) points at discharge. Referencing the databases of SCI in Japan and USA revealed that the complication rates of pneumonia and aspiration were higher in our cases. The motor FIM before rehabilitation and at discharge were relatively lower than in the databases, but the gain and the rate of gain were similar to the Japanese database.
Conclusion: SCI associated with aortic aneurysm surgery was noticed especially in the elderly patients using airways (for example, tracheostomy). The higher age and recurrent nerve palsy were associated with deconditioning state to develop aspiration pneumonia. This state impaired the general condition, and such vicious cycle led to poor prognosis and functional outcome.
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Keywords: thoracic spinal cord injury; aortic aneurysm; rehabilitation efficacy

Introduction

Aortic aneurysm sometimes causes thoracic spinal cord infarction with thoracic spinal artery occlusion.[1–3] Renal and respiratory failures also sometimes occur. The incidence of left recurrent nerve palsy (RNP) was 8.6% in a study on 500 patients[4] and 5% in another study on 168 cases.[5] Most of the patients with the above-mentioned syndrome were elderly. Therefore, the rehabilitation is difficult in contrast to that for the young patients with traumatic spinal cord injury (SCI).[6,7] We rehabilitated several patients with thoracic SCI after aortic aneurysm operation. The results and problems are discussed herein.

Patients and methods

From 1998 to 2003, we treated 12 patients with medical rehabilitation in our hospital. There were eight men and four women, and their mean age was 69 years (range: 55–80 years). They were diagnosed as having thoracic aortic aneurysm (TAA; eight cases) and dissecting aneurysm (DA; four cases). The patients' details are shown in Table 1. The Functional Independence Measure (FIM)[8,9] and American Spinal Injury Association (ASIA)[10,11] impairment scale (AIS) were used for clinical evaluation.

Results

The level of SCI was distributed from T5 to L1 as shown in Table 1. Six patients were injured at T5 and T6 levels, and were classified as the upper thoracic group, while the other six had injury at T8–L1 levels and were classified as the lower thoracic group. Their impairments were classified into A, four cases; B, four cases; C, three cases; and D, one case, according to AIS. Regarding the final results, six patients were discharged, four were referred to another hospital, while two died.

Two elderly patients (78 and 80 years old) died during hospitalization. Both of them had TAA complicated with aspiration pneumonia. One of them had intubation and the other underwent mini-tracheostomy. One of them had RNP that was diagnosed postoperatively with laryngoscope. Both of them had a long smoking history. One of them had a history of bronchial asthma. They also had renal failure, and one of them was under hemodialysis (HD). Their poor

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Table 1 Demographic and Clinical data

Case	Diagnosis	Sex	Age onset	Tobacco packs/years	HT	Preop lung disease	ASIA	BW	Level of injury	Chronic pain	Dysphagia	Pneu monia	RNP	Preop RNP	PEG	Airway	Decubitus	Complications	LOS (day)	Rehab-delay (M)	ASIA preM	ASIA postM	Pre mFIM	Post mFIM	Dmfim	Dmfim/los	Outcome	F/U (M)
1	DA	M	69	N	N	N	D	54	L1	N	N	N	Y	N	N	N	N	N	742	1	78	90	59	88	29	0.039	Independent at home	29
2	TAA	M	74	0.5/60	Y	N	B	70	T6	N	N	N	N	N	N	N	Sacral	Rt U/E paresis	171	0.5	50	62	20	66	46	0.269	Independent at home	10
3	DA	M	55	N	N	N	C	45	L1	N	N	N	Y	N	N	N	N	N	84	2	78	85	50	81	31	0.369	Return to original hospital	5
4	TAA	F	72	N	N	N	A	43	T5	N	N	N	N	N	N	N	Sacral	N	57	0.5	63	63	21	39	18	0.316	Transfer to a long-term care unit	3
5	DA	F	64	N	N	N	A	66	T10	N	N	N	N	N	N	Mini	Sacral	HD	171	1	39	50	13	40	27	0.158	Dependent at home	7
6	TAA	M	69	4/55	N	N	C	65	T12	Y	Y	Y	Y	Y	N	TH	N	HCV, depression, CH	341	0.5	72	69	28	29	1	0.003	Transfer to a long-term care unit	12
7	DA	M	60	1/20	N	N	C	60	T6	N	N	N	N	N	N	N	N	Intracardiac thrombus	87	1.5	83	94	38	83	45	0.517	Independent at home	23
8	TAA	M	77	N	Y	LC	B	50	T5	Y	Y	Y	Y	Y	Y	IT	Sacral	MRSA, HD	646	0.5	50	82	13	44	31	0.048	Transfer to a long-term care unit	22
9	TAA	F	80	1/60	Y	N	B	40	T5	Y	Y	Y	Y	N	N	TH	Sacral	Respiratory failure, HD	118	1.5	30	NA	13	NA	NA	NA	Died	5
10	TAA	F	78	1/60	Y	BA	A	44	T10	Y	N	Y	N	N	Y	Mini	Sacral	Renal failure	110	2.5	50	NA	20	NA	NA	NA	Died	5
11	TAA	M	65	N	N	N	A	57	T8	Y	N	N	Y	N	N	N	Sacral	N	239	8	50	50	36	59	39	0.163	Dependent at home	65
12	TAA	M	69	N	Y	N	B	73	T6	Y	N	N	Y	N	N	N	Sacral	N	110	4	59	59	41	76	40	0.364	Independent at home	45

Abbreviations: ASIA, American Spinal Cord Injury Association; BA, bronchial asthma; BW, body weight; CH, cerebral hemorrhage; DA, dissecting aneurysm; dmFIM, mFIM at discharge-mFIM at start; F/U (M), follow-up period (months); FIM, functional independence measure; HCV, hepatitis C virus infection; HD, hemodialysis; HT, hypertension; IT, intubation; LC, lung cancer; LOS, length of stay; mini, mini-track; MRSA, methicillin resistant staphylococcus aureus; N, no; NA, not applicable; PEG, percutaneous endoscopic gastrostomy; PostM, motor score at discharge; postmFIM, FIM motor score at discharge; preM, motor score at start; premFIM, FIM motor score at start; preop, preoperative; RNP, recurrent nerve palsy; TAA, thoracic aortic aneurysm; TH, thoracostomy; Y, yes.

general condition led to delay of rehabilitation start. Only range of motion exercises were performed in the intensive care unit. They also had sacral decubitus due to deterioration of their general condition and long bed rest. The clinical course in both cases was 5 months, one died of tracheal bleeding and the other died of hypotension during HD.

Postoperatively, rehabilitation was started within 1 month. The patients, transferred to our hospital after operation, had delay in the start of rehabilitation because the rehabilitation beds for the patients with SCI are limited. The ASIA motor score at the beginning of rehabilitation was 62.2 ± 15.0 (39–83) points, improved by 8.2 ± 10.2 (3–32) points and became 70.0 ± 16.3 (50–94) points at discharge. The AIS score of the patients did not change during the hospital rehabilitation. The motor FIM at the beginning of rehabilitation was 31.9 ± 15.4 (13–59) points, improved by 28.6 ± 13.1 (1–46) points, and became 60.5 ± 21.4 (29–88) points at discharge. Four patients were referred to another hospital. In one patient, dehiscence of the surgical wound started, and he was sent back to the original hospital where operation was performed. The other three were transferred to a long-term care hospital like nursing home.

Complications

Renal failure and RNP occurred in four and seven cases, respectively, before rehabilitation. In five out of the latter seven cases, RNP probably developed perioperatively. Postoperatively, five patients had respiratory failure that was managed with intubation, tracheostomy or mini-tracheostomy. Sacral decubitus developed in eight patients. Most of them had slightly reddish skin on the sacral region without ulcer formation.

Factors influencing outcome

Statistical analysis was not conducted because of small number of cases. However, to find out the factors influencing the patient's function at discharge and the place to discharge, we selected some factors; namely, gender, diagnosis (TAA or DA), preoperative lung disease, smoking history, hypertension, HD, airway (tracheostomy, intubation, mini-tracheostomy), RNP, dysphagia, pneumonia, level of SCI (upper and lower thoracic groups), decubitus and chronic pain. The scores of the two deceased patients were excluded from the analysis. As shown in Table 2, we compared the gain of the motor FIM (during hospitalization) and the rate of this gain. The gain of the motor FIM seemed to be lower with airway intervention, dysphagia and pneumonia. The independent patients at home had a mean gain of motor FIM of 39 points, and their rate of improvement was also very high when compared to the other patients. The good and fast functional improvement allowed them to return to their home enjoying independent living.

Discussion

Referencing the databases of SCI in Japan[6,7] and USA[12–17] revealed that the complication rates of pneumonia and

Table 2 The gain of motor FIM and the rate of gain during hospital stay[a]

	n	*Mean of dmFIM*	*S.d.*	*Mean of dmFIM/LOS*	*S.d.*
Gender					
Women	2	22.5	6.4	0.24	0.11
Men	8	30.1	14.1	0.21	0.19
Diagnosis					
TAA	6	25.7	15.5	0.18	0.14
DA	4	33.0	8.2	0.27	0.21
Preop lung disease					
N	9	28.3	13.8	0.23	0.17
Y	1	31	—	0.05	—
Smoking history					
N	7	27.7	5.7	0.19	0.14
Y	3	30.7	25.7	0.26	0.26
Hypertension					
N	7	24.9	13.5	0.21	0.19
Y	3	37.3	7.8	0.21	0.14
HD					
N	8	28.5	14.8	0.24	0.18
Y	2	29.0	2.8	0.10	0.08
Airway					
N	7	32.4	10.5	0.27	0.16
Y	3	19.7	16.3	0.07	0.08
RNP					
N	4	34.0	13.8	0.31	0.15
Y	6	25.0	12.4	0.15	0.16
Dysphagia					
N	8	31.8	9.9	0.26	0.16
Y	2	16.0	21.2	0.03	0.03
Pneumonia					
N	8	31.8	9.9	0.26	0.16
Y	2	16.0	21.2	0.03	0.03
Level of injury					
Lower	5	22.2	12.2	0.13	0.14
Upper	5	35.0	11.5	0.29	0.18
Decubitus					
N	4	26.5	18.4	0.23	0.25
Y	6	30.0	9.8	0.20	0.12
Chronic pain					
N	6	32.7	10.9	0.28	0.17
Y	4	22.5	15.2	0.12	0.14
Independent at home					
N	6	21.8	11.4	0.16	0.15
Y	4	38.8	8.2	0.29	0.20

Abbreviations: DA: dissecting aneurysm; dmFIM: gain of motor FIM; HD: hemodialysis; LOS: length of stay (days); RNP: recurrent nerve palsy; TAA: thoracic aortic aneurysm.
[a]We excluded the scores of two deceased patients.

Table 3 Comparison between the databases of thoraco-lumbar spinal cord injury

	Our cases[a]	*Database (Japan)*[b]	*Database (USA)*[c]
Pneumonia	4/12	3.7%	15.2%
Aspiration	4/12	*n*	1.5%
mFIM at start	32	37.6	33.3
mFIM at discharge	61	71	72.7
Gain of mFIM	28.6	34.1	39.4
Gain/LOS	0.21	0.21	0.72

Abbreviations: LOS: length of stay; mFIM: motor FIM; *n*: not mentioned.
[a]We excluded the scores of two deceased patients.
[b]6, 7.
[c]12, 13, 14, 15, 16, 17.

aspiration were higher in our cases. The motor FIM before rehabilitation and that at discharge were relatively lower than in the databases (Table 3). The gain and the rate of gain during hospitalization were also less than those in the databases. Finally, SCI associated with aortic aneurysm operation was especially noticed in the elderly persons using airways such as intubation, tracheostomy or mini-tracheostomy. Because of the long operation time, the tracheal secretion increased, resulting in longer stay in the intensive care unit and worse deconditioning state. Deterioration of the swallowing activity in the elderly patients[18] and impairment of expectoration due to paraplegia resulted in aspiration pneumonia. The above-mentioned state easily worsened the general condition, and such vicious cycle led to a poor prognosis.

The anatomy of the left recurrent nerve makes it vulnerable to injury as it courses around the aortic arch.[4,5] RNP was reported by Ortner 100 years ago.[19,20] Aspiration caused by RNP was also reported.[21,22] In the patients with SCI, coughing, which prevents aspiration pneumonia, is impaired. We thought that the upper thoracic SCI patients would have lower ability of coughing and breathing, but there were no differences in the outcomes between the upper thoracic palsy and lower thoracic palsy groups. This means that the devastating disease, that is, paraplegia, severely influenced all patients especially the elderly who died during hospitalization.

The incidence of pressure sores was very high in our series. In the Japanese database, this incidence is 45.4% in the complete SCI patients aged 30 years or higher, and 17.3% in those aged below 30 years. However, the United States database showed no difference in the age, and the rate was 23.7%. These results may be attributed to the smaller nursing facilities in Japan.

The final outcome in our series was poor. Only one-third of the patients were independent in their homes. One of the reasons is that the caregiver was old, too. This poor care potential led to a long-term care in hospitals.

In conclusion, SCI associated with aortic aneurysm surgery was noticed especially in the elderly patients, who likely tend to have respiratory dependency or application of airways (for example, tracheostomy). The higher age and RNP were associated with deconditioning state resulting in aspiration pneumonia. This state impaired the general condition, and such vicious cycle led to poor prognosis and functional outcome.

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