



Surgical Treatment for Hemodialysis Associated Cervical Spondyloarthropathy

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Abstract

Background: Hemodialysis associated cervical spondyloarthropathy (HA-CSA) is a serious pathology to affect not only quality of life but also life expectancy. The purpose of this study was to elucidate the long-term clinical results of surgical treatment for HA-CSA.

Methods: Ten of the 15 patients (9 male and 1 female, mean age of 61 years) of HA-CSA who were surgically treated and underwent periodic follow-up review for more than 5 years after surgery were enrolled in this study. We retrospectively investigated preoperative complications, surgical procedures, treatment outcomes, and perioperative complications.

Results: Various preoperative complications were observed in all cases except 1. Posterior decompression and fusion was performed in 4 cases, posterior fusion in 1, and laminoplasty in 5. Japanese Orthopaedic Association (JOA) score excluding bladder function (on a 14-point scale) improved 4.6 points postoperatively (mean recovery rate: 46.9%). Perioperative complications occurred in 5 cases. In 8 cases, a lumbar destructive lesion with spinal canal stenosis was developed and 3 of them were subsequently performed lumbar decompressive surgery.

Conclusion: Pathological conditions of HA-CSA are divided into proliferation of the soft tissue and destruction of the bony tissue. Even in hemodialysis patients, decompressive procedure must warrant long-term acceptable clinical results if the basal cause of symptom is spinal canal stenosis due to proliferation of the soft tissue. When selecting fusion surgery for the patient with the destructive change, shorter posterior fusion should be adopted to reduce invasiveness of surgery. Although the risk of surgery must be extremely high in the patient on hemodialysis due to problems of general conditions, favorable clinical results are anticipated if no perioperative complications have been encountered. However, progression of lumbar lesion deteriorated the physical function again even though improvement of symptoms by cervical lesion relatively maintained for a long time after surgery.

Keywords: Cervical spine; Destructive spondyloarthropathy; Hemodialysis; Surgical treatment and β 2-microglobulin

Introduction

Hemodialysis associated cervical spondyloarthropathy (HA-CSA) was first introduced as destructive spondyloarthropathy (DSA) that is a serious complication of chronic hemodialysis by Kuntz et al. [1] in 1984. It was radiographically characterized by severe narrowing of the intervertebral disc space, erosions and geodes of adjacent vertebral plates, and the absence of significant osteophytosis. The prevalence of HA-CSA is difficult to estimate, but it has been reported around 20% in the past [2-4].

β 2-microglobulin (β 2-M) amyloidosis is a main cause of HA-CSA although the etiology assumes to be probably multifactorial. β 2-M serum level in patients undergoing chronic renal dialysis have been found to be elevated 50 to 60 times the normal level [5]. Loss of renal function and lack of satisfactory elimination through dialysis membranes are the main factors responsible for β 2-M accumulation [6].

HA-CSA is a serious pathology to affect not only quality of life but also life expectancy. It may be treated conservatively in cases their neurological symptoms are mild, but some require an operation because of deterioration of their symptoms. Whereas, the standard surgical management of HA-CSA is still unclear, and there are no published guidelines or recommendations [7].

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Table 1: Scoring system for cervical myelopathy (Japanese Orthopaedic Association).

Motor function
Fingers
0 = unable to feed oneself with any tableware including chopsticks, a spoon, or a fork and/or unable to fasten buttons of any size
1 = can manage to feed oneself with a spoon and/or a fork but not with chopsticks
2 = either chopsticks-feeding or writing is possible but not practical and/or large buttons can be fastened
3 = either chopsticks-feeding or writing is clumsy but practical and/or cuff buttons can be fastened
4 = normal
Shoulder and elbow
Evaluated by MMT score for the deltoid or biceps muscles, whichever is weaker
-2 = MMT 2 or below
-1 = MMT 3
-0.5 = MMT 4
0 = MMT 5
Lower extremity
0 = unable to stand up and walk by any means
0.5 = able to stand up but unable to walk
1 = unable to walk without a cane or other support on a level
1.5 = able to walk without a support but with a clumsy gait
2 = walks independently on a level surface but needs support on stairs
2.5 = walks independently when going upstairs but needs support when going downstairs
3 = capable of fast walking but clumsily
4 = normal
Sensory function
Upper extremity, trunk, lower extremity
0 = complete loss of touch sensation
0.5 = 50% or below normal sensation and/or severe pain or numbness
1 = more than 60% normal sensation and/or moderate pain or numbness
1.5 = subjective numbness of slight degree without any objective sensory deficit
2 = normal
Bladder function
0 = urinary retention and/or incontinence
1 = sense of retention and/or dribbling and/or thin stream and/or incomplete continence
2 = urinary retardation and/or pollakiuria
3 = normal

The purpose of this study was to retrospectively investigate the long-term clinical results of surgical treatment for HA-CSA and to explore the optimal strategies for such a challenging disorder based on pathological conditions.

Materials and methods

From September 1998 through August 2010, 15 patients of HA-CSA were surgically treated. Of those, 10 cases underwent a periodic follow-up review for more than 5 years after surgery were enrolled in this study. With regard to the remaining 5 cases, 2 cases were died of hepatic cancer and cerebral hemorrhage, 2 cases were terminated follow-up by deteriorated general condition, and 1 case dropped out of the scheduled consultation. They included 9 males and 1 female ranging in age from 49 years to 72 years, with a mean age of 61 years. The duration of hemodialysis was from 8 years to 35 years, with a mean duration of 21 years and 4 months. The causes of renal failure were glomerulonephritis in 4 cases, diabetic nephropathy in

1, polycystic kidney disease in 1, and unknown in 4. The length of postoperative follow-up was from 5 years to 15 years and 4 months, with a mean length of 8 years and 2 months.

We clinically investigated preoperative complications, surgical procedures, clinical outcomes, and perioperative complications. Clinical outcomes were assessed by Japanese Orthopaedic Association (JOA) score excluding bladder function on a 14-point scale (Table 1). Also, mobile ability was independently evaluated. Recovery rate (%) of JOA score was calculated by a formula of “{(postoperative score – preoperative score)/(14 – preoperative score)} x 100”.

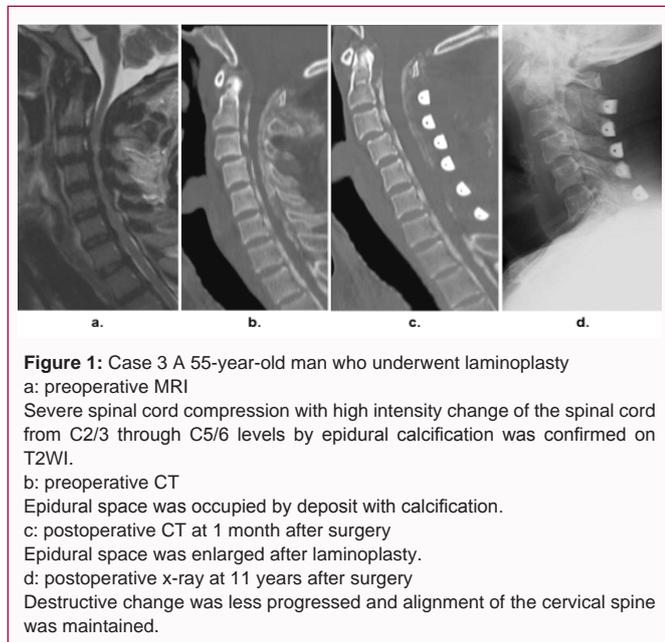
Statistical analysis was performed using a two-tailed paired *t*-test. *P* < 0.05 level was considered statistically significant.

Written informed consent for participation in the study and publication of this report was obtained from all patients after the contents of the study had been fully explained. And all procedures

Table 2: Summary of patients.

Case	Age	Sex	Duration of HD	Length of F/U	Causes of RF	Pathological condition		Surgical procedure	Associated comorbidities	Perioperative complications	JOA score		Recovery rate	Mobile ability		Sequential advent of lumbar lesion
						stenosis	instability				preop	final		preop	final	
1	49	M	26y9m	15y4m	glomerulo-nephritis	C3/4, 4/5, 5/6	C4-7	post decomp (C3-6) and fusion (C2-T1)	carpal tunnel syndrome, trigger finger	pneumonia (MRSA)	5	8	33.3%	walk without support	walk with support	DSA(+), surgery (-)
2	70	M	8y6m	13y11m	unknown	C3/4, 6/7	C3/4	post decomp (C3-7) and fusion (C2-4)	-	gastric ulcer	4	10	60.0%	walk without support	walk with support	DSA(-)
3	55	M	21y2m	11y3m	unknown	C2-7	-	laminoplasty (C3-7)	hyperparathyroidism, hypothyroidism	-	2	11	75.0%	bedridden	walk with support	DSA(+), laminectomy (L3/4/5)
4	57	F	19y6m	10y	glomerulo-nephritis	C3/4	C3/4	post fusion (C2-T1)	hyperparathyroidism, carpal tunnel syndrome	-	3	9	54.5%	wheel chair	walk with support	DSA(+), surgery (-)
5	62	M	8y	5y	diabetic nephropathy	C3/4, 7/T1	C4-6	post decomp (C3-7) and fusion (C2-T1)	diabetes mellitus	-	1	7	46.2%	bedridden	walk with support	DSA(+), surgery (-)
6	67	M	20y	6y3m	polycystic kidney disease	C3/4, 4/5, 5/6	-	laminoplasty (C3-6)	hyperparathyroidism	superficial surgical site infection	2	9	58.3%	walk with support	walk with support	DSA(+), laminectomy (L3/4/5)
7	57	M	22y	5y8m	unknown	C4/5, 5/6, 6/7, 7/T1	C4-6	laminoplasty (C3-7)	hyperparathyroidism, carpal tunnel syndrome	cervical axial pain	10.5	10.5	0.0%	walk without support	walk without support	DSA(+), surgery (-)
8	67	M	27y	5y9m	unknown	C5/6, 6/7	-	laminoplasty (C3-7)	hypertension, trigger finger	-	5.5	6.5	11.8%	walk with support	walk with support	DSA(+), surgery (-)
9	72	M	25y6m	5y1m	glomerulo-nephritis	C3/4, 4/5	C3-5	post decomp (C3-5) and fusion (C2-T1)	complete right bundle branch block, carpal tunnel syndrome, trigger finger	deep surgical site infection (pelvis: bone graft harvested site)	4	6	20.0%	walk with support	wheel chair	DSA(+), laminectomy (L3/4/5)
10	56	M	35y0m	5y2m	glomerulo-nephritis	C3-6	-	laminoplasty (C3-6)	mitral valve stenosis, carpal tunnel syndrome, trigger finger	-	5	10.5	61.1%	walk without support	walk without support	DSA(-)

HD: Hemodialysis, RF: Renal Failure, JOA: Japanese Orthopaedic Association, DSA: Destructive Spondyloarthropathy



were in accordance with the Helsinki declaration.

Results

Various preoperative complications were observed in all cases except 1. The most common systemic complication was hyperparathyroidism observed in 4 cases. Others were heart disease in 2 cases, hypertension in 1, diabetes mellitus in 1, and hypothyroidism

in 1. Carpal tunnel syndrome and trigger finger were recognized in 5 cases and 4, respectively.

With regard to surgical procedures, posterior decompression was employed in 9 of 10 cases who had spinal canal stenosis. In 6 of 10 cases, DSA change was accompanied. Of those, posterior fusion underwent in 5 cases.

JOA score improved from 4.2 points preoperatively to 8.8 points postoperatively (mean recovery rate of 46.9%). Mobile ability was recovered in 3 cases, maintained in 4 cases, and worsened in 3 cases.

Perioperative complications requiring serious management occurred in 5 cases; surgical site infection in 2 cases, pneumonia in 1, gastric ulcer in 1, and cervical axial pain in 1.

At a couple of years after cervical surgery, 8 cases suffered from a lumbar destructive lesion with spinal canal stenosis. Three cases of them developed walking disability with neurological deficits and obliged to subsequently receive additional lumbar decompressive surgery (Table 2).

Illustrative Cases

Case 3

A 55-year-old man had received hemodialysis for 21 years and 2 months to treat chronic renal failure. He complained gait disturbance due to gradually progressive quadriplegia. Preoperative images indicated severe cord compression by epidural calcified deposits without any destructive change of the cervical spine. At 11 years after laminoplasty, his neurological function including walking ability was completely recovered (Figure 1).

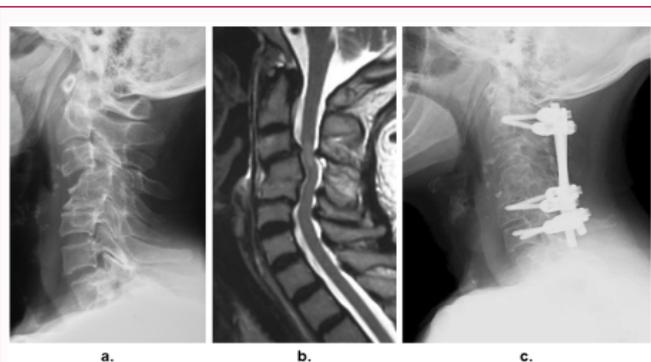


Figure 2: Case 4 A 57-year-old woman who underwent posterior fusion
 a: preoperative x-ray
 Destructive change with spondylolisthesis of the C3 vertebra was observed.
 b: preoperative MRI
 Severe spinal cord compression with high intensity change of the spinal cord at C3/4 level by spondylolisthesis of the C3 vertebra was revealed on T2WI.
 c: postoperative x-ray at 10 years after surgery
 Reposition of spondylolisthesis of the C3 vertebra was maintained even though destructive change had been slightly progressed.

Case 4

A 57-year-old woman had received hemodialysis for 16 years and 6 months to treat chronic renal failure due to glomerulonephritis. She suffered from incomplete quadriplegia by a fall. Preoperative images revealed severe cord compression by vertebral slippage at C3/4 level. At 10 years after posterior fusion, her paralysis was extremely recovered (Figure 2).

Discussion

In Japan, the patients who are newly instituted hemodialysis have been increasing year by year. At the end of 2014, the number of patients receiving hemodialysis reached 320,000, and further, the patients with a history of more than 25 years of hemodialysis treatment are no longer rare with the number of about 13,000 [8]. In our series, the most frequent cause of renal failure was glomerulonephritis. However, in 2010, diabetic nephropathy replaced glomerulonephritis as the most common cause of renal failure across the country [8]. Associated risk factors for the development and the progression of HA-CSA were found to be the patient's age at onset of hemodialysis [9] and the duration of hemodialysis [3,9]. Therefore, the cervical and lumbar spines are affected by long-term hemodialysis, which can cause DSA. Yamamoto et al. [4] reported that the patients who received hemodialysis more than 15 years tend to develop DSA.

Successful surgical results have been reported even in the patients with HA-CSA, so far. Driessche et al. [10] reported favorable functional and neurologic improvement of anterior spinal fusion for cervical DSA in hemodialysis patients despite a higher rate of complications and mortality. Abumi et al. [11] also stated that successful surgical outcomes can be obtained in the hemodialysis patients with cervical DSA if anesthesiologist, nephrologist, and spine surgeons cooperate together to prevent postoperative fetal complications. Therefore, aggressive intervention should be considered for the HA-CSA patients with the neurologic impairment if they are strongly willing to receive surgical treatment.

Meanwhile, surgical intervention for HA-CSA is still regarded as a non-curative treatment and remains challenging due to multiple medical problems. Kumar et al. [12] reported high mortality rate of surgery for the treatment of HA-CSA. In their group of 11 patients, 3

died in the immediate postoperative period, and 2 died at 6 months and 7 months after surgery, respectively. When attempting the surgical management for the HA-CSA patients, not only countermeasures for surgical site problems, such as susceptibility of bacterial infection and severe fragility of bone, but also attention for general conditions, such as anemia, water volume, electrolyte, and blood pressure are imperative in preventing occurrence of critical complications. Since increment of hemodialysis patients with systemic arteriosclerosis due to diabetes mellitus will be expected, more cautious attention in general management must be demanded.

For safety assurance, we usually attend to make more minimally invasive method a priority as a general rule. Sudo et al. [13] advocated that patients undergoing hemodialysis must be properly treated according to the pathological conditions at the time they present with their symptoms, because their general condition is usually not ideal for invasive surgery. Cuffe et al. [5] also stated that the specific treatment plan for a given patient must be individually determined based upon the correct diagnosis, the presence of neural compression and/or spinal instability, and the patient's general condition and projected life expectancy.

The pathological conditions of HA-CSA were broadly divided into destruction of the bony tissue and proliferation of the soft tissue, and differ from usual cervical spondylotic myelopathy. In our series, regardless of HA-CSA, decompressive procedure alone achieved good clinical results if the basal pathological condition of the patient was spinal canal stenosis due to proliferation of the soft tissue without spinal instability. Also, when doing fusion surgery for the HA-CSA patients with destruction of the bony tissue, selective fusion instead of long fusion should be adopted to reduce surgical invasiveness as much as possible. Further, posterior approach must be done because anterior approach to the cervical spine has a high risk for postoperative complications [14].

Unfortunately, the number of cases enrolled in current study was small and a 5 year follow-up period remained relatively short. Abumi et al. [11] stated that progressive instability at the levels adjacent to a previous circumferential spinal fusion is one of the main problems to be solved. Therefore, further long-term investigation involved much more patients must be necessary to confirm the validity of our strategies. But we believe that our study will contribute to some improvement of the management of HA-CSA because accumulation of these minor data based on clinical experiences from a great number of institutions may be essential to the future solution of issues around such kind of uncommon challenging spinal disorders.

In our series, surgical outcomes of more than 5 years for the patients with HA-CSA were acceptable. However, the rate of perioperative complications was relatively high. After securing the patient agreement on the hazardous treatment, the specific and appropriate surgical method for a given patient must be individually determined based on the correct judgment of pathological conditions in a reasonable timing. Moreover, a prolonged periodic follow-up should be delivered for the HA-CSA patients to lead to early detection of not only recurrence of cervical lesion but also advent of lumbar DSA because of their hemodialysis for the entire lifetime.

Conclusion

Although the risk of surgery must be extremely high in the patient on hemodialysis due to problems of general conditions, surgical treatment for cervical lesion is effective if no perioperative

complications have been encountered. However, when planning surgical strategy to treat HA-CSA, it is important to understand accurately the pathological conditions and select suitable less invasive surgical method that is sustainable their poor general condition. Progression of lumbar lesion deteriorated the physical function again even though improvement of symptoms resulting from cervical lesion relatively maintained for a long time after surgery.

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