Original Research

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Cervical Spinal Cord Injury in Patients with Cervical Canal Stenosis without Radiologic Evidence of Trauma: Evaluation of 15 Consecutive Cases

Burak Eren[1], Azmi Tufan[1], Eyup Cetin[1], Feyza Karagoz Guzey[1], Ozgur Yusuf Aktas[1], Abdurrahim Tas[2], Ebru Doruk[1], Ilker Gulec[1], Mustafa Safi Vatansever[1]

ABSTRACT

Objective: Cervical spinal canal stenosis is a well-known risk factor for spinal cord injury. In some patients, spinal cord injury is the first symptom of spinal stenosis. Therefore, some authors recommend preventive decompression of the spinal canal in asymptomatic patients with spinal stenosis. In this study, we aimed to determine the outcome of patients with spinal cord injury associated with cervical spinal canal stenosis and the rate of previously asymptomatic patients.

Material and Methods: Data of 15 consecutive patients were evaluated. Improvement of neurological deficits during follow-up was accepted as good outcome and mortality and unchanging neurological deficits were accepted as worse outcome.

Results: All patients were male, aged between 44 and 85 years. High-energy traumas caused injury in 7 of the cases and low-energy traumas in the others. Nine cases had central cord injury and 6 had other types of traumas. Only 2 patients had been diagnosed with minor symptoms associated with cervical canal stenosis before trauma, while the other patients had been asymptomatic.

One patient did not consent to undergo an operation and two others could not be operated because of their general status; the latter 2 patients died. The other 12 patients were decompressed 0 to 40 days after trauma. Two other patients with severe transverse-type cord injury also died postoperatively. The other patients were followed for 1 to 48 months (22.7±17.7 months). In 2 patients, neurological deficits had not improved on last follow-up. Deficits had completely or partly improved in the other patients, including the one who had not accepted the operation.

Central cord injury had a significantly better prognosis than other types (p=0.0019). Age, cervical canal diameter, and motor and sensory scores of the American Spinal Injury Association scale, type of trauma, and level of spinal cord injury were not significantly different in the patients with good and worse prognosis.

Conclusion: The rate of asymptomatic patients before trauma was very high in patients with spinal cord injury associated with cervical spinal canal stenosis. Therefore, the treatment decision must be carefully assessed in asymptomatic cervical spinal stenosis patients.

Catastrophic consequences of spinal trauma may be seen in patients with cervical spinal canal stenosis even in asymptomatic patients. Central cord syndrome had a good prognosis in these patients. Other types of injuries such as transverse and motor types had a worse outcome.

Keywords: cervical spinal canal stenosis, spinal cord injuries, spinal cord trauma

ÖZET

Servikal dar kanal hastalarında radyolojik travma bulgusu olmaksızın servikal omurilik yaralanması: Ardışık 15 olgunun değerlendirilmesi

Amaç: Servikal spinal dar kanal omurilik yaralanması için iyi bilinen bir risk faktörüdür. Bazı olgularda kanal darlığının ilk belirtisi omurilik yaralanması olabilir. Bu nedenle bazı yazarlar kanal darlığı olan belirtisiz olgularda önleyici amaçla dekompresyon önermektedir. Bu çalışmada servikal dar kanalın eşlik ettiği omurilik yaralanmalı olguların son durumunu ve travma öncesi belirtisiz olan olguların oranını saptamayı amaçladık.

Yöntem ve Gereçler: Ardışık 15 hasta değerlendirildi. İzlemde nörolojik belirtilerin düzelmesi iyi son durum, düzelmemesi ya da ölüm kötü son durum olarak kabul edildi.

Bulgular: Bütün olgular erkekti ve 44-85 yaşları arasındaydı. Olguların 7'sinde yüksek enerjili, diğerlerinde düşük enerjili travma vardı. Dokuz olguda santral omurilik sendromu, diğerlerinde diğer omurilik yaralanma tipleri saptandı. Travmadan önce 2 olguda servikal dar kanala ait hafif belirtiler vardı, diğerleri belirtisizdi.

Bir hasta ameliyatı kabul etmedi, 2 hasta genel durumlarının kötü olması nedeniyle ameliyat edilemedi, bu iki olgu kaybedildi. Diğer 12 olgu travmadan 0-40 gün sonra ameliyat edildi. Bu olguların ağır transvers tipte omurilik yaralanması olan 2'si ameliyat sonrası kaybedildi. Diğer olgular 1-48 ay (22.7±17.7) izlendi. İki olguda travmadan 31 ay ve 1 ay sonra nörolojik bulgular hala düzelmemişti. Diğer olgularda, ameliyatı kabul etmeyen de dahil olmak üzere, nörolojik bulgular kısmen ya da tamamen düzeldi.

Santral tipte omurilik yaralanması olan olgularda son durum anlamlı olarak daha iyiydi (p=0.0019). Yaş, servikal kanal çapı, Amerikan Spinal Yaralanma Derneği skalası motor ve duysal puanları, travma tipi ve omurilik yaralanmasının düzeyi son durumda etkili bulunmadı.

Sonuç: Servikal dar kanalın eşlik ettiği omurilik yaralanmalı olgularda travma öncesi dar kanala ait belirtisi olmayan hasta oranı çok yüksek bulundu. Bu nedenle belirtisiz servikal dar kanal olgularında tedavi kararı verirken çok iyi düşünülmelidir. Servikal dar kanal olgularında hata belirtisiz olanlarda bile spinal travma çok ağır sonuçlara yol açabilir. Bu olgularda santral tipte omurilik yaralanması daha iyi gidişlidir, diğer tip yaralanmalarda son durum daha kötüdür.

Anahtar kelimeler: omurilik yaralanması, servikal spinal kanal darlığı, spinal travma

[1]Health Sciences University, Bagcilar Training and Research Hospital, Department of Neurosurgery, Istanbul-Turkey
[2]Health Sciences University, Kanuni Sultan Suleyman Training and Research Hospital, Department of Neurosurgery, Istanbul-Turkey

Corresponding author:
Burak Eren,
Health Sciences University, Bagcilar Training and Research Hospital, Department of Neurosurgery, Istanbul - Turkey
Phone: +90-0212-440-4000
E-mail address: drburakeren@hotmail.com

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Introduction

It is well known in the literature that cervical spinal canal stenosis (CSCS) is an important risk factor for spinal cord injury (SCI) after trauma (1). Traumatic SCI in adults with CSCS is usually seen in elderly patients, and it may be seen even after minor trauma (2). The patients may be asymptomatic or may have mild symptoms and signs before trauma. The frequency of asymptomatic CSCS is increasing today because of an aging population (3) and widespread use of imaging modalities, especially magnetic resonance imaging (MRI). There is controversy about preventive decompression of relevant patients in the literature, because neither rate of SCI after trauma in those patients nor incidence of asymptomatic cases with CSCS in the population is exactly known. On the other hand, prognosis of cases with SCI-based CSCS was reported to be worse in some studies (1), especially in patients with complete tetraplegia on admission (3).

In this retrospective study, we aimed to determine the outcome of patients with SCI associated with CSCS and the rate of previously asymptomatic patients.

Material and Methods

Adult patients (>40 years) with SCI associated with CSCS and without radiographic evidence of trauma treated in our department between January 2013 and February 2017 were included in the study. There were 15 consecutive patients matching the study inclusion criteria. Their informed consent was obtained.

Demographic data, cause and severity of trauma, presence or absence of previous symptoms of cervical spinal canal stenosis, initial neurological status on admission, type of SCI, grade of American Spinal Injury Association (ASIA) scale on admission, treatment type, operation time after trauma, if present, complications, follow-up time and status on last follow-up in the outpatient files were recorded. Severity of trauma was classified as high- (motor vehicle accidents, pedestrian accidents and fall from a height of more than 2 m) or low- (others) energy traumas. Type of SCI was classified as central cord injury (with more severe dysfunction of upper extremities than lower extremities), motor type (anterior cord) injury (only motor dysfunction of the extremities without distinct sensorial dysfunction), transverse type injury (with distinct bilateral motor and sensorial dysfunction below the lesion), and Brown-Sequard-type injury (dysfunction of one hemicord). Improvement of the neurological deficits on follow-up was accepted as good outcome and mortality and unchanged neurological deficits were accepted as worse outcome.

The most stenotic level was recorded and the cervical spinal canal anteroposterior diameter at this level was measured in mm on the axial MRI section. In one patient, MRI could not be performed because of his cardiac pacemaker, and the canal diameter was measured on an axial cervical computerized tomography (CT) section. Presence or absence of spinal cord hyperintensity and its level were recorded, and this level was accepted as SCI level.

Demographic data, initial ASIA scale scores, spinal canal diameter, and level of SCI were compared between patients with good and worse outcome.

Statistical Analysis

Mean and standard deviations were calculated for countable variables, and Student's t-test was used to compare them. Chi-square test or Fisher exact test was used to compare nominal variables according to their subject number. The p value was accepted as significant if <0.05.

Results

There were 15 consecutive patients aged 44 to 85 years (mean±SD: 67±12 years). All the patients were male. High energy traumas had caused the injury in 7 of the cases and low energy traumas in the others.

Nine cases had a central cord injury, 3 had a transverse type injury, and 3 a motor-type. Only one patient, a 73-year-old male, had a complete transverse injury on the C3-4 level after fall from one step, and others had incomplete lesions. Most frequent level of SCI was C3-4 (5 cases), and most frequent cause of stenosis was ossification of posterior longitudinal ligament (OPLL) (9 cases). In another 6 cases, cervical degenerative disease was responsible (Table 1).

The most important finding was that only 2 patients had shown any symptoms of CSCS before SCI, while the others were asymptomatic. The symptom duration was 32 months in one of these 2 cases and 10 years in the other.

One patient did not accept the operation and two others could not be operated because of their general status. These 2 patients died in the intensive care unit 7 days and 1 month after trauma, respectively. The other 12 patients were operated

Table 1: Patients' clinical and radiological characteristics.

No	Age	Trauma Type	ASIA score on admission	Injury type	SCI level on MRI	Cause of Stenosis	SC diameter (mm)*	ASIA score on follow-up	Outcome
1	61	HE	D	Central	C4-5	OPLL	6.5	D	Good
2	73	HE	C	Central	C4-5	CSDD	7.5	D	Good
3	77	LE	B	Central	C3-4	CSDD	5.4	D	Good
4	60	HE	D	Central	C3-4-5	CSDD	7.1	D	Worse
5	82	LE	D	Motor	C3-4	OPLL	7.5	E	Good
6	61	HE	C	Central	C3-4	OPLL	7.4	D	Good
7	68	HE	B	Transverse	C5-6	OPLL	7.5	EX	Worse
8	85	LE	C	Motor	C4-5	CSDD	5.8	EX	Worse
9	49	HE	B	Transverse	C6	CSDD	5.5	EX	Worse
10	77	LE	C	Motor	C2-4	OPLL	4.4	EX	Worse
11	69	LE	C	Central	C5-6	OPLL	5.2	D	Good
12	60	HE	C	Central	C3-4	OPLL	7.1	E	Good
13	73	LE	A	Transverse	C3-4	OPLL	4.5	A	Worse
14	44	LE	C	Central	C5-6	CSDD	7.9	D	Good
15	61	LE	B	Central	NA	OPLL	7.8	C	Good
p[&]	0.6	1	0.23	***0.0019***	1	0.62	0.08		NA

*AP diameter of the spinal canal at the most stenotic level, [&]Comparison of patients with good versus worse outcome, HE: High energy, LE: Low energy, ASIA: American Spinal Injury Association, SC: Spinal cord, OPLL: Ossified posterior longitudinal ligament, CSDD: Cervical spinal degenerative disease, NA: None available, Statistically significant p value is shown with bold and italic character

0 to 40 days after trauma. In 5 patients, only posterior decompression was performed, while 7 cases underwent posterior decompression and stabilization.

Two more patients died 3 weeks and 1 month after operation with sepsis and multiple organ failure during their ICU treatment. The other patients were followed for 1 to 48 months (22.7±17.7). In 2 patients, neurological deficits had not improved 31 months and 1 month after operation. With these patients, a total of 6 patients had a worse outcome, whereas the others had a good outcome. Deficits were completely or partially improved in other patients, including the one who did not accept operation.

Central cord injury had a significantly better prognosis than other types of SCI (p=0.0019) in our patients. Age (p=0.6), trauma type (p=1), cervical canal diameter (p=0.08), cause of stenosis (p=0.62), ASIA score on admission (p=0.23), and SCI level (p=1) were not significantly different between patients with good and worse outcomes.

Discussion

It is known that SCI in elderly patients with CSCS is increasing because of an increase of the rate of aged people in the community (4). In some studies, the percentage for the presence of CSCS in patients with cervical SCI was reported to be as high as 32% to 37% (5,6). Nakae et al. (7) reported a 10.2-fold increase of risk of SCI in patients with CSCS after head injury. Possibly, loss of the buffer effect of cerebrospinal fluid in the stenotic spinal canal is responsible for the development of SCI even during minor traumas. Especially during hyperextension, bony spurs anteriorly and the bulging of the yellow ligament posteriorly can cause impingement of the spinal cord (8).

There are numerous studies to investigate the role of CSCS for the development of traumatic SCI in the literature. Yoo et al. (9) reported that the risk of developing SCI after trauma is higher in cases with a more stenotic spinal canal. In addition, the rate of improvement of neurological deficits after decompression is lower in patients with a more stenotic spinal canal. In 2 studies, Aebli et al. identified a Torg-Pavlov ratio of less than 0.7 and a spinal canal diameter of less than 8 mm as risk factors for the development of SCI after trauma (10,11).

Traumatic SCI may be the first symptom of CSCS in these patients. Yoo et al. (9) reported that new myelopathy developed without preexisting symptoms in 18 out of 63 cases with SCI associated with CSCS. The most striking finding in our series was that only 2 out of 15 patients had some minor symptoms before trauma, while others were asymptomatic for CSCS.

It is also known that the outcome of patients with SCI-associated CSCS may not be good, especially for those with complete tetraplegia. In a prospective study consisting of 20 patients reported by Lamothe et al. (3), the motor recovery rate was 49.5%. In other words, about half of the patients did not

recover. In a series by Shigematsu et al. (1) consisting 32 cases, only 3 patients (9.3%) recovered to their preinjury levels. Mortality rates reported in the literature vary between 3.6% and 9.3% (1,12,13). In our series, 4 patients out of 15 died, and 2 other patients did not recover; therefore, the worse outcome rate was 40%. This is a very high rate for a condition that is potentially preventable if diagnosed and treated before trauma.

It is a routine procedure for a spinal surgeon to consult an asymptomatic patient with CSCS diagnosed coincidentally with MRI or CT in daily practice today. The management of these patients is controversial. Some authors preferred to follow them without any treatment (14), while others recommended preventive decompression surgery to avoid catastrophic consequences of spinal trauma (1). Results of our study showed that most of the patients with SCI-associated CSCS are asymptomatic before injury, and rates of mortality and morbidity are very high. Therefore, it may be a logical decision to offer decompression to asymptomatic patients with CSCS. Well-designed studies are required to determine the absolute rate of risk of SCI development in this patient group.

In our study, all the patients were male. This is not a surprising finding, because a male predominance as high as 72% to 96% was also reported in other series (1,7,10,11,14). This is probably due to male dominance in both spinal cord injury and cervical canal stenosis, especially in OPLL.

There are controversial findings for the prognosis of patients with SCI-associated CSCS in the literature. Shigematsu et al. (1) reported that most of the patients could not return to their preinjury functional status. In their series consisting of 32 cases with SCI-associated CSCS, only 3 (9.3%) could return to their previous condition. In our series, this rate was 13.3% (2 out of 15 patients). It was reported that patients with central cord injury and Brown-Sequard-type injury had a better outcome (3). In our series, the sole factor to predict good recovery was a concurrent presence of central cord injury. Other variables such as age, trauma type, cervical canal diameter, cause of stenosis, ASIA score on admission, and SCI level did not affect the outcome.

Benefits of early decompression of the spinal canal in this patient group are also controversial. Some authors reported that early decompression did not provide a better outcome; besides, it can more frequently cause complications (3,15). Therefore, they recommended a "watch and wait" strategy in patients without cervical instability. Other authors recommended early surgery because it led to rapid neurological recovery and shorter hospitalization (16) or because the more stenotic canal caused a worse outcome (17). We prefer to perform early decompression if the general status of the patient allows. Reason for our preference for this strategy is not only the necessity (as we believe) of decompression of a contused spinal cord but also the fear of potential future medicolegal issues.

The limitations of our study are its retrospective nature and the small patient number. No doubt, well-designed prospective studies are required for both prediction of prognosis and to compare advantages and disadvantages of conservative and surgical treatments of these patients. In Japan, a study was conducted in 2013 (18), but it has not yet been concluded.

Conclusions

Our study shows that the rate of asymptomatic patients before trauma was very high in patients with SCI associated with CSCS, and others had minor symptoms. Therefore, the choice of conservative treatment without decompression of the spinal cord in patients with minor symptoms or without symptoms should be carefully considered.

In this small series, we found that the sole factor affecting the outcome of patients with SCI associated with CSCS was the SCI type. In patients with central-type injury, the outcome was statistically better.

Contribution Categories	Name of Author
Development of study idea	B.E., F.K.G., A.T., E.C.
Methodological design of the study	F.K.G., A.T., E.C., O.Y.A.
Data acquisition and processing	I.G., A.T., A.b.T, E.C.
Data analysis and interpretation	B.E.,O.Y.A, E.D., M.S.V.
Literature review	E.D., M.S.V., A.b.T, O.Y.A.
Manuscript write-up	F.K.G., B.E., I.G., E.D.
Manuscript review and revision	I.G., A.b.T, M.S.V.

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