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Analysis of Influencing Factors of Major Depression After Spinal Cord Injury

ABSTRACT

Objective: To analyze the risk factors of major depressive disorder (MDD) after spinal cord injury (SCI).

Methods: Patients with SCI in our hospital from February 2020 to February 2023 were selected as the study objects. According to the Hamilton Depression Scale (HAMD) score, patients with 36~75 points were included in the major depression group, and 0~35 points were included in the non-major depression group. The general sociological characteristics (age, gender, educational level, place of residence, family economic status, payment method of medical expenses, marital status) and disease-related characteristics (course of disease, cause of injury, neurological level of injury, type of injury, degree of pain) of all patients were collected, and the items with differences were selected for logistic regression analysis to analyze the risk factors for major depression in patients with spinal cord injury.

Results: Totally 216 patients were enrolled in our study, including 45 patients (18.98%) had moderate-to-severe depression and 175 patients (81.02%) had non-severe depression. Univariate analysis showed that gender (χ^2 = 11.865, P < .001), course of disease (χ^2= 12.967, P < .001), family economic status (χ^2= 8.610, P = .003), educational level (χ^2=15.287, P < .001), neurological level of injury (χ^2= 9.013, P = .003) and pain level (χ^2= 16.673, P < .001) were statistically significant differences between the 2 groups. Multivariate logistic regression analysis showed that gender [odds ratio (OR) (95 % CI) = 3.986 (1.743~9.116), P = .001], course of disease [OR (95 % CI) = 4.033 (1.818~8.947), P = .001], family economic status [OR (95 % CI) = 3.136 (1.449~6.785), P = .004], educational level [OR (95 % CI) = 4.332 (1.998~9.388), P = .000], neurological level of injury [OR (95 % CI) = 2.848 (1.414~5.734), P = .003], and pain level [OR (95 % CI) = 5.767 (2.309~14.404), P < .001] were risk factors for major depressive disorder in SCI patients.

Conclusion: Gender, disease duration, family economic status, education level, level of nerve injury, and pain level may be the independent risk factors of MDD incidence in patients with spinal cord injury.

Keywords: Spinal cord injury, major depression, risk factors, neurological level of injury

Introduction

In recent years, with the increasing number of traffic accidents, workplace accidents, and sports injuries, the incidence of spinal cord injuries has also been on the rise, causing a huge burden on patients, families, and society. Spinal cord injury (SCI) is considered to be one of the most serious traumatic diseases of the central nervous system. It is caused by various pathogenic factors (contusion, compression, tumor, deformity, etc.), which destroy the connection between the brain and peripheral organs, resulting in permanent loss of sensory and motor functions below the affected area and even permanent paralysis.[1] According to the National Spinal Cord Injury Statistics Center, there are about 17 900 new cases of SCI each year.[2]

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Spinal cord injury can cause a range of chronic complications that can reduce the quality of life of patients. Some patients who suffer from deterioration of physical function, chronic pain, loss of function, and physical rehabilitation stress due to intertwined physical, psychological, and social factors are more prone to mood disorders, leading to SCI combined with major depressive disorder (MDD). A meta-analysis found that approximately 18.7%-26.3% of patients after SCI met the criteria for MDD, which is much higher than the general population.[3] The disability rate of SCI patients is high, and serious patients need to adhere to long-term rehabilitation in the later stage, so it increases the economic and ideological burden of the patient's family. Complications can cause abnormalities in the patient's psychology and mood, and the patient's motivation to rehabilitate will be affected, leading to a worse recovery from the disease, which puts the user in a vicious circle and ultimately causes the patient to develop depression.

It has also been reported that the incidence of emotional deficits in patients with SCI is as high as 40%-60%.[4-6] Spinal cord injury patients with combined MDD may experience physical symptoms such as touching and sweating, as well as adverse emotions such as low mood, depression, and irritability. Severe patients may even experience alcohol and drug abuse, self-indulgence, loss of confidence in life, and even suicidal impulses, which may negatively affect patients' treatment compliance and rehabilitation difficulties.[7] In foreign countries, there are more studies on the influencing factors of SCI and depression;[8-10] however, similar studies are still rare in China.

For these reasons, it is clinically important to explore the risk factors for depression after SCI. In this study, we retrospectively analyzed the clinical diagnosis and treatment of patients with spinal cord injuries treated in our hospital from February 2020 to February 2023 to help understand the risk factors for MDD in Chinese SCI patients.

Material and Methods

Data Sources

This is a cross-sectional study of SCI patients admitted to our hospital between February 2020 and February 2023. This study has been approved by the ethics committee of Xiantao First People's Hospital (Approval Number: 2022-02-002). All participants have given their informed consent to participate in the study and publish their data.

Inclusion criteria: (1) Meet the diagnostic criteria of the *International Standard Examination List for the Classification of Neurology of Spinal Cord Injury 2019 edition*;[11] (2) age: 18-70 years old;[12] (3) patients with clear consciousness, normal cognition, and communication; (4) the condition is stable.

Exclusion criteria: (1) patients combined with organic brain disease; (2) patients who had major mental trauma before; (3) patients who use any medication that affects the state of depression; (4) patients who had a history of mental illness and related family history; (5) patients with incomplete clinical medical records.

Research Design

Following the above inclusion and exclusion criteria, suitable study subjects were selected, and the hospital's Hospital Information System (HIS) medical record system was used to obtain information on all patients' consultations during hospitalization. For post-discharge follow-up data, questionnaire forms were filled out by specialized follow-up staff by telephone or accompanied by community staff; the data collected mainly included the following:

General Sociological Characteristics and Disease-Related Characteristics

The evaluation indicators include age,[12] gender, education level, place of residence, family economic status (family monthly income ≥ 5000 yuan is considered good; < 5000 yuan is considered poor), mode of payment for medical expenses, marital status and disease-related characteristics, including duration of the disease, cause of the injury, degree of nerve injury, and type of injury.

Pain Level Visual Analog Pain Scale

Patients were assessed using the pain level Visual Analog Pain Scale (VAS).[13] The basic method is to use a vernier scale of approximately 10 cm with 10 scores on one side and 0 and 10 scores on both ends. The larger the score, the greater the pain. Where 0 to 6 is no pain or mild pain and 7 to 10 is severe pain. The VAS scale has a Cronbach's alpha coefficient of 0.865, alpha coefficients for all dimensions are greater than 0.85, and the shattered semicollision coefficient is 0.883.

The Hamilton Depression Scale Questionnaire

All patients were administered the Hamilton Depression Scale (HAMD)[14] Questionnaire developed by the Hamilton Company, with 3 versions: 17 items, 21 items, and 24 items. The 24-item version was used in this study. The 24 questions were grouped into 7 factor structures including anxiety/somatization, weight, cognitive impairment, circadian variation, slowness, sleep disturbances, and hopelessness, each of which was also divided into sub-items. A total score of 0-75 was used, with higher scores being associated with more severe depressive symptoms. The scores were obtained from patient observation and self-report by 2 trained professionals and were averaged. Scores of 0-35 scores were included in the non-severe depression group, and scores of 36-75 scores were included in the severe depression group. The overall Cronbach's alpha coefficient of the HAMD scale was 0.871. The alpha coefficients of the dimensions

MAIN POINTS

- *The study aims to analyze the factors affecting major depressive disorder (MDD) after spinal cord injury (SCI) and is more comprehensive by using a combination of the Hamilton Depression Scale and a self-made scale.*
- *The study included 216 SCI patients and found that 18.98% had major depression while 81.02% had non-major depression. The research design included the evaluation of general sociological characteristics and disease-related characteristics, such as age, gender, education level, family economic status, neurological level of injury, and pain level, among others.*
- *Key findings revealed that gender, disease duration, family economic status, education level, neurological level of injury, and pain level were significant risk factors for MDD in SCI patients.*
- *The research highlighted the importance of understanding the factors contributing to depression in SCI patients to improve patient care and outcomes.*

were greater than 0.85, and the half-reliability coefficient was 0.847, which is good for evaluating SCI patients and is suitable for evaluating the psychological state of SCI patients.

Statistical Analysis

We observed the current status of MDD complications in all SCI patients, statistically analyzed the HAMD scores, compared the clinical data between the major depression group and the non-major depression group, calculated the differences by logistic regression analysis, and analyzed the influencing factors of MDD complications in SCI patients. Statistical analysis was performed using IBM SPSS Statistics for Windows, version 27.0 (IBM SPSS Corp.; Armonk, NY, USA). Counting data were represented by percentage and tested by chi-square, including age, place of residence, method of payment of medical expenses, cause of injury, surgery history, type of injury, marital status, gender, course of disease, family economic status, educational background, neurological level of injury, and degree of pain. The measurement data conforming to the normal distribution were represented by mean (SD). The variables that did not conform to the normal distribution were converted to the normal distribution for statistical analysis, and *t* test was adopted. Multivariate logistic regression was used to analyze multifactor. The homogeneity of variance test was used to calculate the data, and the test level was $\alpha = 0.05$. If $P > \alpha$, *t* test was adopted, and if $P < \alpha$, *t'* test was performed. $P < .05$ was considered a statistically significant difference.

Results

Occurrence of Major Depressive Disorder in All Patients

A total of 216 patients with SCI were included in this study, among which 41 patients with scores ranging from 36 to 75 were included in the major depression group, accounting for 18.98%; 175 patients with 0~35 scores were included in the non-major depression group, accounting for 81.02% (Figure 1).

Comparison of Clinical Data of Each Group

Compared with clinical data, there were no significant differences in age, place of residence, payment method of medical expenses, cause of injury, surgery history, injury type, and marital status ($P > .05$). There were significant differences between the major depression group and the non-major depression group in gender, disease course, family economic status, educational level, neurological level of injury, and pain level ($P < .05$), as shown in Table 1.

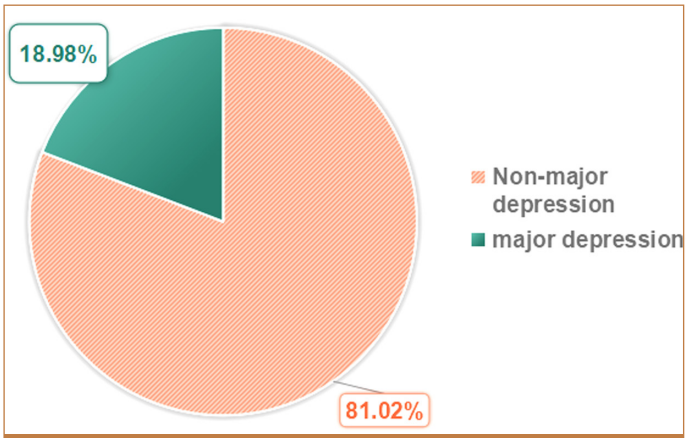

Figure 1. Occurrence of major depressive disorder in patients.

Multivariate Analysis of Major Depressive Disorder in Spinal Cord Injury Patients

Gender, family economic status, educational level, course of disease, neurological level of injury, and pain level were assigned as shown in Table 2.

Multivariate logistic regression analysis showed that gender, family economic status, education level, course of disease, injury plane, and pain level were all independent risk factors for MDD in SCI patients ($P < .05$), and the odds ratio values were all > 1, as shown in Table 3.

Discussion

Spinal cord injury is a serious and disabling condition that can lead to varying degrees of paralysis. Currently, more than 20 million people worldwide suffer from spinal cord injuries, with an increase of about 700 000 people each year.[15] Patients with SCI are prone to negative emotions such as inferiority, irritability, and tension due to physical pain caused by the disease, the long course of the disease, the worry about the disease and the fear of the prognosis. The negative emotions such as depression often lead to patients not cooperating with treatment, affecting the recovery of patients, prolonging the hospital stay, increasing the mortality and hospitalization costs, and seriously affecting the prognosis of patients. Zhao MC et al[16] found that timely and professional psychological intervention can eliminate the psychological disorders of SCI patients and significantly improve their clinical symptoms, neurological function, and quality of life.

Therefore, finding out the influencing factors of depression in SCI patients can help to take effective psychological intervention measures in clinical nursing work. In this paper, the patients with SCI were observed, and it was found that there were significant differences between the major depression group and the non-major depression group in terms of gender, disease course, family economic status, educational level, neurological level of injury, and pain level. Using the logistic regression equation, it was found that the above indexes were all factors affecting MDD in SCI patients.

The results of this study show that females are a risk factor for MDD in SCI patients, and previous relevant studies have come to the same conclusion.[17] Adhikari S P et al[18] found in their study that compared with men, the Beck Depression Inventory (BDI) score of female participants with Traumatic Spinal Cord Injury (TSCI) was significantly higher by 4.2 units, indicating that the incidence of depression in women with TSCI was significantly higher than that in men. The reason is that women have lower levels of serotonin, a neurotransmitter that regulates mood, than men. Low levels of serotonin in the brain have been linked to depression and suicide attempts. In addition, women have a faster ability to recognize negative emotions and react to negative events more quickly than men. They are more likely to suffer from stress due to major life events; so they are more likely to develop MDD.[19]

This study proposed that disease duration was also a high-risk factor for depression in patients after SCI, consistent with the study conducted by Gautam.[20] They mentioned in their research that long-term disease may cause depressive symptoms, suicidal tendencies, and drug abuse. Patients with a longer course of the disease may have a longer bedtime compared to those with a shorter course of the disease. As the duration of the illness increases, their activity

Table 1. Comparison of Clinical Data in Each Group (n = 216; %)

Clinical Data		n	Non-Major Depression Group (n = 175)	Major Depression Group (n = 41)	χ^2	*P*
Gender	Male	94	86 (91.49)	8 (8.51)	11.865	< .001
	Female	122	89 (72.95)	33 (27.05)		
Age (years)	18~50	93	74 (79.57)	19 (20.43)	0.223	.637
	50~70	123	101 (82.11)	22 (17.89)		
Place of residence	Urban	68	52 (76.47)	16 (23.53)	1.335	.248
	Rural	148	123 (83.11)	25 (16.89)		
Course of disease (years)	< 1	102	93 (91.18)	9 (8.82)	12.967	< .001
	≥1	114	82 (71.93)	32 (28.07)		
Family economic status	Good	98	88 (89.80)	10 (10.20)	8.610	.003
	Poor	118	87 (73.73)	31 (26.27)		
Payment method of medical expenses	Self-financing	109	92 (84.40)	17 (15.60)	1.640	.200
	Public expense or medical insurance	107	83 (77.57)	24 (22.43)		
Educational level	Below high school	104	73 (70.19)	31 (29.81)	15.287	< .001
	Junior college or above	112	102 (91.07)	10 (8.93)		
Cause of injury	Trauma	95	72 (75.79)	23 (24.21)	3.015	.083
	Non-trauma	121	103 (85.12)	18 (14.88)		
Neurological level of injury	Cervical segment	87	62 (71.26)	25 (28.74)	9.013	.003
	Thoracolumbar segment	129	113 (87.60)	16 (12.40)		
Surgery or not	Yes	82	68 (82.93)	14 (17.07)	0.313	.576
	No	134	107 (79.85)	27 (20.15)		
Pain level	Severe	123	88 (71.54)	35 (28.46)	16.673	< .001
	Moderate or mild	93	87 (93.55)	6 (6.45)		
Injury type	Complete injury	104	81 (77.88)	23 (22.12)	1.284	.258
	Incomplete injury	112	94 (83.93)	18 (16.07)		
Marital status	Married	122	97 (79.51)	25 (20.49)	0.416	.519
	Unmarried or divorced	94	78 (82.98)	16 (17.02)		
Smoking history	Yes	76	62 (81.58)	14 (18.42)	0.024	.877
	No	140	113 (80.71)	27 (19.29)		
Bladder management	No	120	98 (81.67)	22 (18.33)	0.074	.786
	Indwelling catheter	96	77 (80.21)	19 (19.79)		

Table 2. Study the Assignment of Variables

Variable	Assignment
Gender	0 = male, 1 = female
Family economic status	0 = good, 1 = poor
Educational level	0 = junior college or above, 1 = below high school
Course of disease	0 = course of disease < 1, 1 = course of disease ≥ 1
Neurological level of injury	0 = thoracolumbar injury, 1 = cervical spinal cord injury
Pain level	0 = moderate or mild pain, 1 = severe pain

function decreases, and they need to rely on others for daily life support, resulting in restrictions on their daily activities. This situation leads to psychological imbalance, loss of autonomy and independence, a sense of dependence and powerlessness, and they may begin to doubt their value and ability. Long-term drug treatment of repeated illness is also likely to induce depression.

Furthermore, the results of this study highlighted the impact of family economic status on patients. The results are similar to previous relevant studies below. A survey of the financial status of cancer patients by Itani Y et al[21] found that those with a sense of financial burden reported a higher incidence of major depression and an increase in stress-related complications among family members, as did those

Table 3. Multivariate Analysis of Major Depressive Disorder in Spinal Cord Injury Patients

Influence Factor	β	SE	Wald χ^2	*P*	Odds Ratio	95% CI
Gender	1.383	0.422	10.732	.001	3.986	1.743-9.116
Family economic status	1.143	0.394	8.420	.004	3.136	1.449-6.785
Educational level	1.466	0.395	13.796	.000	4.332	1.998-9.388
Course of disease	1.394	0.407	11.762	.001	4.033	1.818-8.947
Neurological level of injury	1.047	0.357	8.592	.003	2.848	1.414-5.734
Pain level	1.752	0.467	14.077	< .001	5.767	2.309-14.404

whose financial situation had changed since the patient's death. Compared with good family economic status, poor people have a higher incidence of MDD. The reason may be that SCI often requires long-term medication treatment, patients and their families need to bear greater economic pressure, and many patients are prone to depression due to insufficient self-regulation ability. Lim S W et al[22] showed that the lowest and median income levels were associated with a higher risk of anxiety or depression (adjusted hazard ratio of 1.93 and 1.70, respectively) compared with the higher income levels.

It is suggested that the incidence of MDD among those with higher education is significantly lower than that of those with less than high school education. The data in the study of Tzanos I A et al[23] showed that compared with the 9-item Patient Health Questionnaire (PHQ-9) score of college graduates, those who graduated from primary school with a PHQ-9 score or high school with a PHQ-9 score were higher. It shows that the lower the education level, the more prone they are to depression. In response to the findings of our study, the reasons may be that those with lower education have poor understanding of disease knowledge and treatment plans, while those with higher education have stronger learning abilities, easier access to SCI-related knowledge, more correct cognition of diseases and treatment methods, and better communication with doctors. It can fully prevent complications, and they are more confident in their recovery.

Besides, this study proposed that the neurological level of injury may be the independent risk factor of MDD incidence in patients with SCI. The SCI plane is usually the thoracolumbar segment and the neck segment. Thoracolumbar segment injury refers to the injury below the thoracic vertebra or lumbar vertebra, which may lead to lower body paralysis, lower limb paralysis, urinary incontinence, etc. Neck injury refers to injuries below the cervical spine and is the most serious disease of SCI, which may lead to quadriplegia, respiratory paralysis, and other serious consequences, as well as damage to the respiratory nerve circuit required for diaphragm contraction, resulting in respiratory insufficiency, muscle atrophy and weakness, and pneumonia.[24] In addition, cervical SCI leads to no antagonistic parasympathetic nerve activity, resulting in cardiovascular instability. According to statistics,[25] 11%-16% of patients with complete cervical spine SCI need cardiac resuscitation, which is seriously life-threatening and prone to pessimism and despair, affecting normal rest and social activities and increasing the risk of depression.

Last but not least, the MDD of those with moderate or severe pain was significantly higher than those with moderate or mild pain in this study. Our findings suggested that pain level is an influential factor in severe depression after SCI, consistent with the previous relevant study. Relevant studies have shown[26] that neuropathic pain and its duration are positively correlated with the intensity of mood disorders. Riddle D L et al[27] also found that there is a causal relationship between pain level and depressive symptoms, so pain is one of the influencing factors for MDD in SCI patients. Pain is a common complication in patients with SCI, with 65% to 85% of SCI patients reporting pain symptoms.[28] The pain will continue and worsen over time. One-third of patients with severe pain, musculoskeletal pain, and neuropathic pain can affect the quality of sleep of patients.

The shortcomings of this study are as follows: the small sample size of this study, concentration on certain areas, sample selection bias and information bias, and lack of follow-up in the later period. All these limitations require us to include more samples in future studies and to conduct multicenter studies in order to obtain more objective and credible findings and to provide more valuable information to the clinic.

In summary, patients with SCI have a higher incidence of MDD. Females, a longer course of the disease, poor family economy, lower education level, cervical SCI, and severe pain were all risk factors for MDD. In view of the above risk factors, how to develop an effective intervention program and advance clinical intervention to avoid the occurrence of MDD, improve the clinical outcome and prognosis of patients, and improve the quality of life is an important clinical research direction in the future.

Availability of Data and Materials: *Data to support the findings of this study are available on reasonable request from the corresponding author.*

Ethics Committee Approval: *This study was approved by the Ethics Committee of Xiantao First People's Hospita (approval number: 002; date: February, 2022).*

Informed Consent: *Informed consent was obtained from the participants who agreed to take part in the study.*

Peer-review: *Externally peer-reviewed.*

Author Contributions: *Concept – Z.T., X.Y.; Design – Z.T., X.Y.; Supervision – Z.T.; Resources – Z.T., X.Y.; Materials – Z.T., X.Y.; Data Collection and/or Processing – Z.T., X.Y.; Analysis and/or Interpretation – Z.T., X.Y.; Literature Search – X.Y.; Writing – Z.T., X.Y.; Critical Review – Z.T.*

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