Journal of Surgery
Zhang B, et al. J Surg 8: 1782
www.doi.org/10.29011/2575-9760.001782
www.gavinpublishers.com
Research Article

Clinical Observation and Management of Neurosurgical Site Infection in Patients with and without Human Immunodeficiency Virus (HIV) Infection

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Citation: Zhang B, Wang X, Zhang J, Li M (2023) Clinical Observation and Management of Neurosurgical Site Infection in Patients with and without Human Immunodeficiency Virus (HIV) Infection. J Surg 8: 1782 DOI: 10.29011/2575-9760.001782

Received Date: 02 April, 2023; **Accepted Date:** 05 April, 2023; **Published Date:** 07 April, 2023

Abstract

Objective: To analyze the clinical difference, potential risk factors and pertinent clinical management of neurosurgical site infection (NSSI) between HIV-positive and HIV-negative patients.

Methods: A retrospective analysis was performed on 34 HIV-positive patients and 43 HIV-negative patients who underwent neurosurgical treatments in our department from May 2019 to January 2022. The status of NSSI in the HIV-positive group and the HIV-negative group was compared.

Results: There's a statistical difference in the incidence of NSSI between the HIV-positive group and the HIV-negative group. The HIV-positive group was prone to infection and poor healing at the neurosurgical sites, and the incidence of NSSI was related to low body mass index (BMI), hypoalbuminemia, and non-standard antibiotic use in the HIV-positive group. Furthermore, it is statistically different in CD4＋T cell count, serum albumin level and antibiotic use for the HIV-positive patients with and without SSI: Patients with low CD4＋T count, hypoalbuminemia, and non-standard antibiotic use were prone to SSI.

Conclusions: To reduce NSSI, perioperative CD4＋T, serum albumin level and BMI of HIV-positive patients should be increased as much as possible to enhance the immune status of patients, and the rational use of perioperative antibiotics should be strengthened.

Keywords: HIV; Neurosurgery; Neurosurgical site infection

Abbreviations: HIV: Human Immunodeficiency Virus; BMI: Body Mass Index; SSI: Surgical Site Infection; NSSI: Neurosurgical Site Infection; WBC: White Blood Cells; RBC: Red Blood Cells; CDC: Centers for Disease Control; Hemoglobin: Hb; HAART: Highly Active-Antiretroviral Therapy.

Introduction

Surgical Site Infection (SSI) is a serious complication that can occur after surgeries [1-7]. One potential risk factor for SSI is HIV infection. HIV-positive patients may be more susceptible to SSI due to immune dysfunction and other comorbidities associated with HIV [8-15]. However, research on the incidence of Neurosurgical Site Infection (NSSI) in HIV-positive patients is limited and the results have been inconsistent. NSSI [16] is a common serious postoperative complication, which not only adds to suffering of patients, prolongs hospital stay and increases healthcare costs, but also can be associated with increased morbidity and mortality. Moreover, people infected with HIV, especially AIDS patients, are often accompanied by compromised immune system and malnutrition, and prone to various opportunistic infections, often suffer from multiple acquired diseases such as tuberculosis, syphilis, and hepatitis B & C [17]. Therefore, the incidence of SSI is increasing, with previous literature report reaching 30–50%, which is significantly higher than that of HIV-negative patients [13,18,19]. At present, there is limited reports on SSI in HIV-positive patients after neurosurgery in China and abroad. In this study, HIV-positive patients and HIV-negative patients were compared to analyze the healing of surgical sites and to identify risk factors for NSSI to prevent and manage them effectively in HIV-positive patients after neurosurgery.

Information and Methods

General Information

A total of 34 HIV-positive patients who received neurosurgical treatment in our hospital from May 2019 to January 2022 were consecutively selected as the observation group by retrospective analysis. All patients were diagnosed with HIV infection through the Centers for Disease Control and Prevention by HIV antibody enzyme-linked immunosorbent assay and western blot test and followed AIDS diagnosis and treatment guidelines. The clinical stage of HIV infection and CD4+T lymphocyte classification were determined based on the CDC diagnosis of HIV in terms of clinical stage and CD4+T cell classification system. Forty-three neurosurgical patients without HIV infection matched with the observation group in gender, age and surgical grade in the same period were selected as the control group.

Exclusion Criteria: The patients complicated with severe diabetes, liver and kidney diseases and other chronic diseases that affect wound healing were excluded.

Perioperative Treatment

Patients in the observation group were routinely measured for body weight, height, and exclusion of pulmonary infection by preoperative chest CT. Peripheral blood was drawn for routine blood test, biochemistry, CD4+T cell count and viral load test. The immune status and nutritional conditions of the patients were comprehensively evaluated. The status of opportunistic infection of HIV-positive patients were comprehensively evaluated; and the clinical staging of HIV infection and CD4+T cell count classification system were used to pre-operatively evaluate the safety of the patients' surgery. In case of combined opportunistic infection, the pathogenic factors were clarified through serological tests and other methods, and the infection was controlled before reoperation if necessary. Once the SSI on a patient was identified, the department of infectious disease was consulted to formulate relevant treatment plan as necessary. Previously diagnosed HIV-positive patients would receive highly active antiretroviral therapy (HAART) regularly according to the advice of the Department of Infectious Disease before surgery. Patients with cryptococcal meningitis do not receive antiviral therapy.

In the control group, patients' body weight, height, and preoperative chest CT were routinely monitored to exclude lung infection, while peripheral blood was drawn for routine blood test and biochemistry. No preoperative CD4+T cell count and viral load was measured. The immune status and nutritional conditions of the patients were comprehensively evaluated preoperatively, and opportunistic infection was excluded after comprehensive evaluation of the patients.

NSSI Confirmation

Postoperative infection at the surgical incision site was observed. If the postoperative body temperature exceeded 38.5 °C for two consecutive days and the postoperative incision or sinus tract was inflamed with exudates, incision infection was considered. The intracranial infection was diagnosed when the patient's cerebrospinal fluid (CSF) after surgery showed the cell count and protein significantly increased, or the culture indicated bacterial growth. The implant was placed to follow-up for one year. Once infection was diagnosed, sinus tract or adhesion appeared, intensive dressing change, wet compress with alcohol, intensive use of antibiotics and withdrawal of endophyte and drainage tube were performed.

Statistical Methods

All the enrolled patients were followed one year after operation to assess the improvement of their symptoms. SPSS Statistics 22.0 was used for statistical analysis and the measurement data were subject to normal distribution and expressed as mean standard deviation (M±SD) and T-test was used. For non-measurement data, Z- test was adopted, and the test level for both sides is P=0.05.

Results

Analysis of NSSI for HIV and non-HIV Groups

There were differences in gender and age composition, and no difference in the type of surgical incision between the HIV-positive and -negative groups Table 1.

Group	Case	No infection	Infection
HIV	34	28	6
Non-HIV	43	41	2
Z/T/c^2	1.844		
P value	0.063		

Table 1: NSSI in the HIV & non-HIV groups

Comparison of perioperative relevant factors for HIV and non-HIV groups

Relevant factors	Group	Case	Mean	Standard deviation	Z/T/	P value
Preoperative RBC	HIV	34	3.863	0.6712	3.789	0
	Non-HIV	43	4.381	0.5294		
Preoperative Hb	HIV	34	119.9	26.13223	2.744	0.008
	Non-HIV	43	133.5	17.20517		
Preoperative albumin	HIV	34	39.07	5.52124	1.807	0.075
	Non-HIV	43	41.38	5.61637		
Preoperative WBC	HIV	34	7.2	3.6631	1.901	0.061
	Non-HIV	43	9.007	4.68216		
Postoperative RBC	HIV	34	3.617	0.74752	0.999	0.321
	Non-HIV	43	3.764	0.54909		
Postoperative Hb	HIV	34	115.9	24.81218	0.255	0.8
	Non-HIV	43	114.6	17.16063		
Postoperative albumin	HIV	34	37.08	5.21664	1.26	0.212
	Non-HIV	42	35.68	4.43639		
Postoperative WBC	HIV	34	7.6	4.38122	3.668	0
	Non-HIV	43	11.17	4.13066		
BMI	HIV	33	21	3.14856	6.534	0
	Non-HIV	43	25.27	2.53726		

Antibiotic use	HIV	33	8.242	6.12898	4.175	0
	Non-HIV	43	3.837	2.82784		
Incision length	HIV	34	9.691	5.87756	1.932	0.057
	Non-HIV	43	13	8.5049		

Table 2: Comparison of perioperative relevant factors for HIV & non-HIV groups.

Analysis of perioperative related factors with and without NSSI in HIV Group

Relevant factors	Group	Case	Mean	Standard deviation	Z/T/	P value
HIV viral load	A	28	75687.25	223970.9121	0.259	0.797
	B	6	100890.1667	167506.3442		
$CD4^+T$ cells	A	26	265.2308	267.54638	3.873	0.001
	B	6	47.8333	48.8484		
Preoperative RBC	A	28	3.9125	0.71099	0.934	0.357
	B	6	3.63	0.40586		
Preoperative Hb	A	28	121.1179	28.02109	0.585	0.562
	B	6	114.1667	14.81103		
Preoperative albumin	A	28	40.1464	5.29538	2.682	0.011
	B	6	34.0333	3.58367		
Preoperative WBC	A	28	6.8804	3.70118	1.102	0.279
	B	6	8.69	3.36915		
Postoperative RBC	A	28	3.6664	0.7367	0.833	0.411
	B	6	3.385	0.82398		
Postoperative Hb	A	28	118.3929	24.68969	1.303	0.202
	B	6	104	23.80756		
Postoperative albumin	A	28	38.3786	4.25879	3.699	0.001
	B	6	31	5.27864		
Postoperative WBC	A	28	7.9268	4.64562	0.938	0.355
	B	6	6.075	2.59942		
BMI	A	27	21.0515	3.39936	0.179	0.859
	B	6	20.7929	1.81418		
Antibiotic use	A	27	6.8519	5.66164	3.119	0.004
	B	6	14.5	4.03733		
Incision length	A	28	9.3393	5.7382	0.749	0.459
	B	6	11.3333	6.80196		

Table 3: Analysis of perioperative related factors with & without NSSI in HIV Group.

Analysis

There were differences in gender and age composition between the HIV-positive group and HIV-negative group. Among them, the proportion of men in the HIV-positive group was higher, and their age was younger. The NSSI of the HIV-positive and HIV-negative groups had statistical difference, and the HIV-positive group was prone to infection and poor healing at the surgical sites. For the analysis of perioperative related factors between the HIV-positive and HIV-negative groups, there were significant differences in preoperative Hb and RBC count, postoperative WBC count, BMI, and antibiotic use, but no statistical differences in serum albumin, postoperative RBC count, postoperative Hb, preoperative WBC count and incision length. There was no statistical difference in age, gender, and incision type between the NSSI group and non-NSSI group in the HIV-positive patients. In the HIV-positive group, there were no significant differences in viral load, RBC count, Hb, WBC count, BMI index and surgical incision length between the NSSI group and non-NSSI group; but significant statistical differences found in CD4+ T cell count, serum albumin and antibiotic use.

Discussion

NSSI is a serious complication in the process of neurosurgery. If it is not treated in a timely and effective manner, infection at the incision site may occur and result in poor healing of surgical incisions, and serious complications such as severe central nervous system infection and systemic bacteremia. NSSI increases the treatment burden, patient suffering, and even threatens their lives when NSSI becomes severe [20]. With gradual increase of HIV-positive patients worldwide and in China [19], the increased new infections every year, and the worldwide application of HAART, which has prolonged life span of HIV patients [21], HIV infection has been turned into chronic infectious disease. Therefore, the number of cases requiring surgical intervention in the lifetime of HIV-positive patients increases year after year [22,23]. Although some studies have analyzed the SSI of HIV patients, there is a lack of research on the NSSI of HIV patients. This retrospective cohort study aims to provide clinical references, identify potential risk factors, prevent, and effectively manage them perioperatively in neurosurgical patients with HIV infection. The results of this study showed that there were differences in gender and age composition between HIV-positive and HIV-negative patients. There were more males in the HIV-positive group, and the younger group was more likely to suffer from HIV infection. Some men in the HIV group in China have high risk factors [24]. Therefore, the proportion of men in the HIV group in China is high, and the age is becoming younger [24], which is consistent with the differences in gender ratio and age composition in the HIV group in this study. The results of this study showed that there was a significant difference for the incidence of NSSI between HIV-positive and HIV-negative patients. The incidence of NSSI in HIV-positive patients was significantly higher than that in HIV-negative patients. HIV virus mainly invades the immune system of the human body through direct or indirect killing effect of HIV virus replication to accelerate CD4+T cell apoptosis, and promote thymus progressive atrophy [25]. The number of CD4+T cells is progressively decreased [26], thus leads to immune deficiency of patients and increases the chance of infection at surgical sites [27]. Therefore, the susceptibility of patients to NSSI caused by HIV is directly related to the decrease of CD4+T cells [21,26,28]. At present, there is still controversy about the range of CD4+T cell count to assess the risk of postoperative infection. Many studies in China and abroad [19,29,30] have shown that there is no significant correlation between preoperative CD4+T cells < 200 cells/mm^3 and SSI. Therefore, low CD4+T cells are not the absolute contraindication for surgery [29]. However, there are also reports that preoperative CD4+T cells < 200 cells/mm^3 can significantly increase the probability of SSI [31], so surgery needs to be cautious. In this study, for HIV-positive group, the number of CD4+T cells in the NSSI group was significantly lower than that in the non-NSSI group, indicates that the low CD4+T cells significantly increased the risk of NSSI. When HIV positive are encountered, especially when neurosurgical emergency operation is required, the related risk factors should be explained in detail to the patients. For HIV-positive patients undergoing elective surgery, regular antiviral therapy is recommended, and the surgery should be performed with the CD4+T cells increased at the level of > 200 cells/mm^3 [15,23,32,33].

The results of this study showed the HIV-positive patients had lower Hb and BMI than that of HIV-negative patients during the perioperative period. The serum albumin level of patients with NSSI in HIV-positive group was significantly lower than that in the non-NSSI/good incision healing patients of the same group. Patients with low serum albumin [34], low BMI index and low Hb reflect decreased nutritional status and overall health during the perioperative period [15,33,35] which can be used as a reference index for incision healing [36], even better than the specificity and sensitivity of pre-surgery monitoring of CD4+T lymphocyte count [19]. Therefore, effective nutritional support during the perioperative period is necessary for patients with HIV infection. It is recommended that high nutritional support for patients to intake high proteins and cellulose nutrition, and intravenous supplement of albumin and amino acids, when necessary, to improve serum albumin of patients for a short time, and to reduce the risk of infection during the operation. Because of the low RBC and Hb could not be increased in our patients in a short period of time, when necessary, RBC should be given to patients during and after surgery to promote wound healing and reduce NSSI.

During the perioperative period we do not encourage routinely to use antibiotics for prevention of NSSI. The pre-operative preventive use of antibiotics [37] and appropriate postoperative routine extension of antibiotic use

[15,23,38] in HIV-positive patients, especially in immunodeficient patients with significantly low CD4+T cells can significantly reduce the incidence of NSSI [3,15,33]. However, the prolonged use of antibiotics may be prohibited as it may cause antibiotic resistance and further increase the risk of SSI. The duration of antibiotic use needs to be determined according to the incision [39], temperature changes, blood tests, C-reactive protein and other related infection indicators. To sum up, in the situation that HIV-positive patients need neurosurgical intervention, improving CD4+T level, serum albumin and BMI index in the perioperative period and regulating the use of antibiotics during the perioperative period can effectively reduce the incidence of NSSI.

Funding: National Natural Science Foundation of China 81800597

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