Targeted surveillance and infection-related risk factors of nosocomial infection in patients after neurosurgical operation

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Abstract: The purpose of this study was to investigate the risk factors of nosocomial infection in patients after neurosurgical operations, so as to provide reasonable, effective preventative measures in the future. A total of 1,600 patients with brain tumors, hydrocephalus, craniocerebral trauma and vascular disease treated in the neurosurgery room were chosen for targeted surveillance; and through analysis on the clinical data of patients, the incidence of nosocomial infection, the site of infection and the distribution of pathogens, we investigated the infection-related risk factors. After operation, there were 128 cases with nosocomial infection, with the infection rate of 8.0%; among the several diseases, the postoperative infection rate of brain tumors was 28.13%, the postoperative infection rate of hydrocephalus was 21.88%, and the susceptible sitesin the first three places were lower respiratory tract, intracranial, urinary tract; a total of 69 pathogens were separated from 128 cases with nosocomial infection, and the first three pathogens were *Acinetobacter baumannii, Klebsiella pneumoniae, Staphylococcus aureus*, accounting for 21.74%, 17.39%, 11.59% respectively. The incidence of nosocomial infection was higher in patients with invasive operation during the procedure, with significant difference ($P<0.05$). By targeted surveillance on the nosocomial infection in patients after neurosurgical operations, the nosocomial infection rate was high after neurosurgical operations. By strictly implementing the aseptic operation, it could reduce the invasive operation; effectively reduce the infection rate of patients, to facilitate the healing of patients and early rehabilitation.

Keywords: Neurosurgical operation, targeted surveillance, infection-related risk factors.

INTRODUCTION

As problem of serious population aging is increasing and with the increased bacterial drug resistance caused by basic disease, invasive operation and irrational use of drugs, the nosocomial infection rate is increasing (Wu *et al.,* 2014), especially in clinic practices. Often, infection is a complication of neurosurgery. In the neurosurgery, the major patients are the middle-aged and elderly population suffering from brain disorders and serious multiple organ diseases (Zheng *et al.,* 2014); and compared with young patients, they are more prone to nosocomial infection and more likely to produce serious consequences and more coma (Geng *et al.,* 2012; Qian *et al.,* 2012). Patients with severe craniocerebral injury are associated with the consciousness obstacle, surgical trauma and long hospitalization cycle and time. The hypothalamic pituitary - adrenal axis and other nerve regulation functions disorder, so that the body secretes a large number of catecholamines, corticosteroids and glucagon, etc., to reduce immune function, increase the incidence of infection (Zhu *et al.,* 2012; Wu *et al.,* 2015; Wang *et al.,* 2013), and reduce or disappear normal physiological reflex (swallowing, cough), not easy to discharge sputum and vomits, etc.. With the repeated invasive operations for the respiratory tract with new medical equipment and the use of antimicrobial drugs, the body's natural immune barrier is damaged, and respiratory tract infections occur. The dysfunctions occur more and their cognition, movement, swallowing function, urine and feces are prone to have disorders, and increasing number of patients are lying in beds, receiving urinary tract intubation and enteral nutrition through the nasogastric tube, which increases the risks of nosocomial infection, therefore, it has an obvious nosocomial infection in neurosurgery, seriously affecting the prognosis of patients (Yuan *et al.,* 2013). At present, the risk factors of neurosurgery with nosocomial infection have been reported. In this study, we performed targeted surveillance of neurosurgery patients and investigated the risk factors of nosocomial infection to lay a foundation for the timely control.

MATERIALS AND METHODS

General information

1,600 cases of patients receiving operations of brain tumors, hydrocephalus, traumatic brain injury, vascular disease enrolled in our hospital from February 2015 to December 2016 were used as subjects, including 943 males and 657 females, aged 11 to 81 years and mean age of (53.7±7.4) years, with hospital stay of 6-60 days. Patients with infection were diagnosed according to the diagnosis results of surgical infection in the Diagnostic criteria for nosocomial infection.

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Table 1: Results of nosocomial infection in patients after neurosurgical operations

Infection site	Number of cases	Infection rate (%)
Incision	5	3.3%
Lower respiratory tract	57	38%
Blood	3	2%
Intracranial	51	34%
Urinary tract	31	20.67%
Gastrointestinal tract	3	2%

Table 2: The infection rate of different types of diseases after neurosurgical operations

Disease	Number of nosocomial infection	Infection rate (%)
Brain tumor	36	28.13%
Hydrocephalus	28	21.88%
Cerebrovascular disease	20	15.63%
Craniocerebral trauma	16	12.5%
Others	24	18.75%

Table 3: Distribution of pathogens in neurosurgical operations

Strain	n	Infection rate (%)
Gram-negative bacteria	44	63.77%
Acinetobacter baumannii	15	21.74%
Klebsiella pneumoniae	12	17.39%
Citrobacter	8	11.59
Escherichia coli	9	13.04%
Gram-positive bacteria	18	26.09%
Staphylococcus aureus	10	14.49%
Coagulase-negative staphylococci	8	11.59%
Fungi	7	10.14
Candida albicans	7	10.14%

Table 4: Correlation between invasive operations and nosocomial infection

Factor	Number of cases	Number of infective cases	Infection rate (%)
Tracheal intubation			
Yes	980	33	3.37
No	620	6	0.97
Ventilator			
Yes	1189	243	20.44
No	411	15	3.65
Urinary catheterization			
Yes	842	126	14.96
No	758	4	0.53
Drainage tube placement			
Yes	1230	120	9．76
No	370	3	0.81

Method

The surgical data of patients were collected by questionnaires in a unified way. A total of 2000 questionnaires were issued, take back 1894 questionnaires, among them, there were 1752 valid questionnaires. The statistical analysis of the factor data such as general clinical data, the incidence of infection, the location, the distribution of pathogens and the amount of invasive operation drainage devices, etc. was performed. In accordance with the Standard on surveillance on nosocomial infection, professionals and physicians shall observe the patient's conditions after neurosurgical operations and record the surveillance questionnaires, and summarize and report them every day.

STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS 14.0 statistical software. $\chi 2$ test was used for the count data, and t test was used for the measurement data, $P<0.05$ was considered statistically significant difference.

RESULTS

The nosocomial infection rate of patients after surgical operations

According to the results, there were 128 patients with nosocomial infection among 1600 patients after neurosurgical operations, with an infection rate of 8.0%, 150 cases of infection, with infection rate of cases of 9.37%. The main sites with infections included respiratory tract, intracranial and urinary tract.

The infection rate of different types of diseases after neurosurgical operations

The infection rates of patients with brain tumors, hydrocephalus and cerebrovascular diseases after neurosurgical operation were 28.13%, 21.88% and 15.63% respectively (table 2).

Distribution of pathogens in neurosurgical operations

By testing the bacteria, 69 strains f pathogens were detected from patients, including 44 strains of gram-negative bacteria, accounting for 63.77%, 18 strains of Gram-positive bacteria, 7 strains of fungi, accounting for 10.14%. The top three strains were *Bacteroides baumannii, Klebsiella pneumoniae* and *Staphylococcus aureus,* accounting for 21.74%, 17.39% and 11.59%, respectively (table 3).

Correlation between invasive operations and nosocomial infection

The nosocomial infections were caused by invasive operations during operation, including tracheal intubation, ventilator, urinary tract intubation and drainage device. The incidence of nosocomial infections was significantly increased, showing significant difference ($P <0.05$).

DISCUSSION

The surgical infection is always a major problem of invasive operations which is a key research project for modern hospitals and reflects the overall quality of the hospitals and nursing staffs. Infections of patients are caused by a variety of factors. The operation room is the environment for surgeons to implement operations, which can directly cause the incidence of infections. The infection during the operations is one of the common complications occurring in the perioperative period and the most common nosocomial infectious disease, with high incidence. Since the incisions are invaded by bacteria and many people involve in the operations in the bacterial environment with a long duration, the body trauma is great and the resistance is reduced (Zhang, 2011; Rong *et al.,* 2014). Incision infection will not only affect the healing rate of surgical incisions, delay the healing time, but also cause surgical incision rupture once again, leading to sepsis, systemic inflammatory response diseases and even death due to systemic infection. The infections may prolong the hospital stay of patients, result in treatment failure, increased medical costs and economic burden. Thus, the quality of surgical infection control is directly related to the patient's surgical efficacy and infection rate. Therefore, it is necessary to control surgical incision infection through effective measures, to ensure smooth discharge of patients (Chen *et al.,* 2013).

With the rapid development of modern medical technologies, the medical technology is increasingly improving. The neurosurgery, as a key department of a hospital, has increasing number of critically ill patients. The elderly weak patients are the vulnerable groups, with decreased body immunity and resistance and often accompanied by chronic underlying diseases such as hypertension, diabetes, heart diseases, etc.. Patients in the neurosurgery have high risk factor of nosocomial infections during the invasive operations, and frequent invasive operations may cause damage to the mucosal tissues and normal body defense barrier, and pathogens will invade to human body, resulting in the dysbacteriosis (Fang *et al.,* 2013). When infections occur in the neurosurgery, the patients' hospital stay will be prolonged and medical costs will be increased, therefore, it is important to implement control and prevention of nosocomial infections in the neurosurgery.

This study showed that, after operation, there were 128 cases with nosocomial infection, with the infection rate of 8.0%; among the several diseases, the postoperative infection rate of brain tumors was 28.13%, the postoperative infection rate of hydrocephalus was 21.88% and the susceptible sites in the first three places were lower respiratory tract, intracranial, urinary tract, similar to other studies (Rong *et al.,* 2014); a total of 69 pathogens were separated from 128 cases with

nosocomial infection, and the first three pathogens were *Acinetobacter baumannii, Klebsiella pneumoniae, Staphylococcus aureus*, accounting for 21.74%, 17.39 %, 11.59% respectively. The incidence of nosocomial infection was higher in patients with invasive operation during the procedure (Zhang, 2011), with significant difference ($P < 0.05$).

CONCLUSION

In summary, in order to effectively control the incidence of infections in neurosurgery, a key department for nosocomial infection control, it is necessary to strengthen the monitoring and management of factors of nosocomial infection in the neurosurgery. By taking targeted, effective interventions, the incidence of nosocomial infections in the neurosurgery can be reduced significantly. So it has very important reference value in clinical practices.

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