

REPORT

Analysis on pathogen distribution and drug-resistance of incision infection caused by vascular operation

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Abstract: To investigate pathogen distribution and drug resistance of incision infection caused by vascular operation to reduce postoperative incision infection, this paper retrospectively reviewed and analyzed 635 in-hospital patients taking vascular operation during Jan. 2008 and Dec. 2012. Analyzed data were statistically processed by SPSS 13.0 software, which resulted in 16 infected cases with 2.52% infection rate. A total of 27 pathogens was isolated from specimens submitted for inspection, including 17 strains of Gram positive bacteria (62.96%) and 10 Gram negative bacteria (37.04%). Besides high sensitivity to imipenem, all bacteria were able to resist antibacterial drugs. Incision infection is proved in this research to be reduced effectively by some means, like complication correction before operation and reasonable application of antibacterial drugs after operation. While during a operation, it is necessary to operate strictly in a bacterium-free environment and wash incisions thoroughly.

Keywords: Vascular surgery, incision infection, pathogen, drug-resistance.

INTRODUCTION

Postoperative incision infection, a complication after operation, is common in hospitals, which is easy to slow down incision healing. For patients with worse conditions, infection is expanded with larger incisions. Vascular operation is widely applied in various transplants without postoperative application of regular antibacterial drugs, thus operation success will be greatly influenced once incision infection occurs in perioperative period.

Wanchun did study on pathogen distribution and drug resistance of incision infection caused by vascular operation, concluding that incision infection rate occupied 8%~40.0% of infections in surgical hospitals (Wanchun, 2013). Guangcheng and Li also pointed out that incision infection prolonged the time of hospital stay, which made patients bear pains and economic losses, even resulted in sequelae (Guangcheng and Li, 2012). While in the opinion of Yu Ying and Chen Zhiyong, to reduce infections and guide clinicians in reasonable application of antibacterial drugs, it was necessary to improve fungal culture for patients who took antibacterial drugs for a long duration, went to coma, performed long-term bed and possessed poor immune functions. Preventive adoption of anti-fungal drugs is also taken into consideration (Ying and Zhijiyong, 2012).

This study analyzed pathogen distribution and drug resistance of incision infection caused by vascular operation to prevent incision infections.

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MATERIALS AND METHODS

Research objective

A total of 635 in-hospital patients including 392 males and 243 females taking vascular operation from Jan. 2008 to Dec. 2012 were observed and analyzed. The age of patients differed from 18 to 82 years with mean age of (53.6±5.4) years. Postoperative incision healing with infection was under close observation, which was collected as specimens for the isolated bacterial culture in time (Sujian *et al.*, 2014).

Specimen collection

Bacteria-free normal saline was taken to clean bacteria in focus of infections. If an incision found with purulent secretion, a sterile cotton swab was used to collect specimens and a bacteria-free injector was used to obtain pus and secretion deeply located in lesions.

Drug sensitivity test

Having classified bacteria cultured and separated as Gram positive and Gram-negative bacteria, bacterial culture, drug sensitivity test was performed using kirby-bauer method as per criteria recommended by National Committee for Clinical Laboratory Standards (2007) of US.

STATISTICAL ANALYSIS

SPSS 12.0 software was used for statistical analysis. Enumeration data presenting in the form of rate was

examined by x2 test. Difference was considered to have statistical significance if P<0.05.

RESULTS

Incision infection rate

Among 635 cases, 16 cases (2.52%) were detected with infection. On the whole, when operation cases increased, infection case and infection rate decreased; but from 2009 to 2010, infection case and rate were slightly raised, which is presented in table 1. From table 2 performing incision infection rates in class I and II, class I with 377 operation cases witnessed 1.33 infection cases, while class II with 258 cases were found with 11 infections. This proves higher infection rate of class II incision infection (Zhiteng *et al.*, 2014).

Table 1: Incision associated infection of vascular operation from 2008 to 2012

Year	Operation case No.	Infection cases	Infection rate (%)
2008	85	5	5.88
2009	101	3	2.97
2010	129	4	3.10
2011	148	2	1.35
2012	172	2	1.16
Total	635	16	2.52

Table 2: Incision associated infection of vascular operation in class I and II

Incision class	Operation case No.	Infection cases	Infection rate (%)
I	377	5	1.33
II	258	11	4.26
Total	635	16	2.52

Table 3: Pathogen percentage of incision infection caused by vascular operation (%)

Pathogen	No. of strain	Percentage (%)
Gram positive bacteria	17	62.96
Coagulase negative <i>Staphylococcus</i>	6	22.22
<i>Staphylococcus aureus</i>	5	18.51
<i>Staphylococcus epidermidis</i>	2	7.41
<i>Enterococcus faecalis</i>	2	7.41
<i>Staphylococcus haemolyticus</i>	2	7.41
Gram negative bacteria	10	37.04
<i>Escherichia coli</i>	4	14.81
<i>Pseudomonas aeruginosa</i>	3	11.11
<i>Enterobacter cloacae</i>	1	3.71
<i>Acinetobacter</i>	1	3.71
Other pseudomonas	1	3.71
Total	27	100.00

Results of pathogen screening

Examined specimens lead to the separation of 27 pathogens including 17 Gram-positive bacteria (62.96%) and 10 Gram-negative bacteria (37.04%). For Gram-positive bacteria, the main pathogens included coagulase negative *Staphylococcus* and *Staphylococcus aureus*; while for Gram negative, main pathogens included *Escherichia coli* and *Pseudomonas aeruginosa* (table 3).

Drug-resistance rate of pathogen

Though sensitive to imipenem, Gram-positive and negative bacteria especially *Pseudomonas aeruginosa* were able to resist common antibacterial drugs. Table 4 and table 5 show resistance of common pathogens causing incision infections on antibacterial drugs.

DISCUSSION

Incision infection resulting from vascular operation is connected to complicated reasons including patients' conditions, regulation of bacteria-free operations and blood loss in operations. Besides, operative site, the surface of incision, patients' immune system and in-hospital period also influence incision infection. On the other hand, sanitary conditions and nursing are closely related to the infection (Lihong and Jianwei, 2011; Xianghong and Liang, 2011). For elder patients, when they ages, their decreased immune functions combined with preoperative diseases like heart disease, hypertension, hypoproteinemia and diabetes slow down incision infection healing. Some patients who were transferred from other departments in severe conditions and different complications had worse incision infections resulting from vascular operation (Lairong and Liang, 2011). Since vascular operation is free from bacteria, incision protection and preventive measurements are of great importance; once infection prevails, patients' lives are in risk. However, some surgical doctors blindly demand speed, easily causing secondary infection of incisions. To be in details, preoperative disinfection around a incision is not done thoroughly; operation is carried out roughly with poor awareness about bacteria-free environment; and incisions are not under sterile condition in peri-operative period. Meanwhile, environment of operation room and conduit room directly impact the occurrence of incision infection. Without proper and strict management, for example, visitors and internships do not take bacteria-free measurements, incisions will be infected when dust and droplets get into incisions (Chunyan, 2012). Especially in conduit room where numerous visitors come in and out frequently, the load of bacteria in air varies greatly.

Vascular operation, as an incisive operation, radically cures diseases and breaks immune protections. Wound or operation inducing blood and humor loss make incisions open to various infections; while with poor conditions and

Table 4: Resistance rate of Gram-positive bacteria on antibacterial drugs (%)

Antibacterial drugs	<i>Staphylococcus aureus</i> (n=5)		Coagulase negative <i>Staphylococci</i> (n=6)	
	Strains	Drug resistance rate	Strains	Drug resistance rate
Cefepime	3	60.00	2	50.00
Ceftazidime	1	20.00	2	33.33
Levofloxacin	2	40.00	1	33.33
Ampicillin	1	20.00	2	66.67
Imipenem	0	0.00	0	0.00

Table 5: Resistance rate of Gram-negative bacteria on antibacterial drugs (%)

Antibacterial drugs	<i>Escherichia coli</i> (n=6)		<i>Pseudomonas aeruginosa</i> (n=3)	
	Strains	Drug resistance rate	Strains	Drug resistance rate
Cefepime	2	33.33	2	66.67
Ceftazidime	1	16.67	2	66.67
Levofloxacin	2	33.33	1	33.33
Ampicillin	1	16.67	2	66.67
Imipenem	0	0.00	0	0.00

decreased immune, patients have to be treated by antibacterial drugs and hormones, which is prone to induce endogenous and exogenous pathogen infection (Youlin, 2012). Once infection prevails, patients need to be in hospital for a longer time and are likely to be in hospital again or even to die, thus making patients' spiritual pressure and economic burden more serious. Because incision infection caused by vascular operation acts vitally in medical qualities and medical disputes, doctors in clinic pay great attentions to it (Jing *et al.*, 2011).

This research showed 5 out of 85 incision infections in 2008 with 5.88% infection rate and 2 out of 172 in 2012 with 1.16% infection rate, indicating that overall infection was decreased. In addition, year 2010 witnessed higher infection rate than 2009 with slight fluctuation, which revealed that, incision infections caused by vascular operation is always a focus of relevant people. To date, infections are not eliminated completely, but the efforts distributed obtain remarkable achievements.

Manifested specimens led to the isolation of 27 pathogens including 17 Gram positive bacteria (62.96%) and 10 Gram negative bacteria (37.04%), among which coagulase negative staphylococci, *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa* suggest significant percentage; therefore, this study analyzed resistance rate of antibacterial drugs. To be explained in details, this study experimented drug-resistance rate of coagulase negative *Staphylococcus*, *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa* by five antibacterial drugs, such as cefepime, ceftazidime, levofloxacin, ampicillin and imipenem. The result showed Gram positive and negative bacteria produced a certain degree of drug resistance to antibacterial drugs but were highly sensitive to imipenem. *Pseudomonas aeruginosa* with various drug-resistance mechanism could be induced

to produce enzymes, which increased its resistance to multiple antibacterial drugs year after year (Yuanyuan and Wanfei, 2009).

In term of specific resistance rate, cefepime reached 66.67%, ceftazidime 66.67%, levofloxacin 33.33%, and ampicillin 66.67%. *Staphylococcus aureus*, a common pathogen causing surgical infections, shows higher resistance to cefepime with 60.00% and levofloxacin with 40.00% than other pathogens, while coagulase negative staphylococci is found with high drug resistance rate to cefepime (50%) and ampicillin (66.67%). Moreover, vancomycin enzyme was the first choice to effectively treat severe infections caused by *staphylococcus aureus* with multiply drug resistance (Feng, 2012). What mentioned above should be highly concerned by clinicians.

Based on above statements, several interventions pointing at reducing vascular operation induced incision infection are proposed.

Improvement of preoperative preparations

Besides emergency operation, patients who take selective operations should improve their conditions to enhance strength; and in operation, patients' blood sugar should be controlled in regular levels with any possibility. For hybrid operation, point of puncture usually is located in groin area where is easy to break skins to infect local tissues, thus patients must be informed to have showers (Taihui and Zhonghua, 2014) one day before operation. Furthermore, groin area with more bacteria, is hard to preserve skins, so it should be cautious to prepare the proper knife. Shaver is suitable in hard skin preservation for avoiding epidermis damages. Before operation starts, operating field must be disinfected thoroughly to ensure enough range and make sterile materials cover the whole surface.

Enhancement on business qualities of medical staff

Medical personnel are required to master operation skills as much as possible and handle operation duration. Besides, hand hygiene is one of the most effective way to control nosocomial infections; usually, hygienic hand washing is able to get rid of 80% of disposable bacteria in skin epidermis. That explains why medical staff have to take hand disinfection. According to principles of hand washing for operations, the time is more than 3 minutes to reduce pollution, and hands should be monitored to restrain bacteria less than 5 CFU/m² after disinfection. (Shuhui, 2014).

Reasonable application of antibacterial drugs

In 2012, the general office of Ministry of Health emphasize in the plan for Concentrative Management on Clinical Application of National Antibacterial Drugs to enhance specimen test of clinical microbes and drug-resistance monitoring of bacteria. Besides, medical institutions must select antibacterial drugs according to the test of microbial specimen in clinic. If an in-hospital patient needs to take restricted drugs, his test rate of microbial specimen must be over 50% and when treated, the rate is supposed to exceed 80% before drug delivery (Yaoqin, 2012). Medical institutions are required to update relevant data and information of antibacterial drugs' clinical application on the monitoring network, including the report of drug-resistant bacterial distribution and resistance status. With test and warning of drug resistance, it is more convenient for medical institutions to take solutions based on drug resistance of different bacteria.

REFERENCES

- Chunyan H (2012). Nursing intervention for preventing abdominal operation induced infection in operating room. *Chin. General Practic. Nursing*, **10**(11): 2951-2952.
- Feng Z (2012). Pathogen distribution and drug-resistance analysis of incision infection of 165 case. *Seek Med. and Ask the Med.*, **10**(11): 37.
- Guangcheng S and Li S (2012). Distribution of pathogens causing surgical site infections and analysis of antimicrobial resistance. *Chin. J. of Nosocomiology.*, **22**(4): 843-844.
- Jing G, Xiumian S and Xin D (2011). Prevention and control of incision infections in hybrid vascular surgery. *Chin. J. of Nosocomiology.*, **21**(21): 4474-4475.
- Lairong W and Liang X (2011). Hazard analysis of incision infection caused by common surgery. *Shanxi. Med. J.*, **40**(3): 243-245.
- Lihong T and Jianwei S (2011). Investigation on antimicrobial resistance of pathogens from surgical operative incision. *J. of Clini. Hemat.*, **24**(2): 83-85.
- Shuhui W (2014). Status and controlling measurement of in-hospital infection. *Chin. J. of Urban and Rural. Enterprise. Hygie.*, **29**(5): 26-28.
- Sujian L, Caixia Y, Mingchao D and Yizhong W (2014). Distribution and drug resistance of pathogens causing surgical incision infections in vascular surgery department. *Chin. J. of Nosocomiology.*, **24**(17): 4295-4297.
- Taihui Z and Zhonghua H (2014). Investigation and analysis of surgical incision infection in general surgery department. *Chin. Modern Doctor*, **52**(260): 5-7.
- Wanchun Z (2013). Distribution of species of pathogens causing surgical incision infections and drug resistance. *Chin. J. of Nosocomiology.*, **23**(3): 692-694.
- Xianghong X, Changqiong Y, Jianying B, Wei C and Jianli Z (2012). Pathogens causing surgical site incision infections and drug resistance. *Chin. J. of Nosocomiology.*, **22**(19): 4387-4389.
- Yaoqin H (2012). Factor analysis and strategy of incision infection caused by bacterium-free operation. *J. of Nanchang Univer. (Med. Sci.)*, **52**(6): 69-71.
- Ying Y and Zhiyong C (2012). Hospital surgical incision infections: Distribution of pathogens and detection of drug resistance. *Chin. J. of Nosocomiology.*, **22**(6): 1282-1284.
- Youlin P (2012). Distribution of pathogenic bacteria causing surgical incision infections and analysis of risk factors. *Chin. J. of Nosocomiology.*, **22**(4): 840-842.
- Yuanyuan Z and Wanfei L (2009). Hospital postoperative infection: Distribution of pathogens and detection of drug resistance. *Chin. J. of Health Lab. Tech.*, **19**(6): 1315-1317.
- Zhiteng L, Jinggang L and Xianfei H (2014). Distribution and drug resistance of pathogens causing surgical incision infections. *Chin. J. of Nosocomiology.*, **24**(10): 2517-2516.