REPORT

Prevention infection of newborn nosocomial and distribution of multiple drug resistant organism of the medicinal

Caiyan Deng, Wei Zhang, Yuxiao Yuan, Aimei Yao, Yulian Hu, Fengqin Yu, Zhanmin Ma and Shuling Xu

Neonatal Department, Maternal and Child Health Hospital of Zhengzhou City, Henan Zhengzhou, China

Abstract: 2124 neonates were monitored from February 2013 to August 2014, among which 1119 were admitted from outpatient department (outpatient group), 782 were transferred from other departments (other department group), and 223 were from other hospitals (other hospital group). Through it we explore the distribution of multidrug resistant organism in neonates, which were admitted to the hospital through various ways, and therefore analyze the risk factors of nosocomial infection to avoid cross infection of multi drug resistant organism in neonatology department. The results showed that 105 strains of multi drug resistant bacteria were detected in the neonatal department. Among them, there were 57 strains from the outpatient group, 27 from the other department group, and 21 from the other hospital group. Neonates with the hospitalization time of more than 14 days and low birth weight infants (1500 g) were the high-risk groups of drug-resistant strains in nosocomial infection. So the infection in neonates from other departments or hospitals should be strengthen, especially the prevention and control in neonates with the hospitalization time than 14 days and low birth weight infants (1500 g) in order to reduce the occurrence of multiple drug-resistant strains cross infection.

Keywords: Admission ways; drug-resistant strain; nosocomial infection; prevention and control.

INTRODUCTION

Multi drug resistant bacteria mainly refer to bacteria that are resistant to 3 kinds of antibiotics or more in clinical use at the same time (Wang *et al*., 2015). The low immunity of newborn, a great deal of susceptible factors, long hospitalization time, and the irrational use of antibiotics all contributed to the increase of drug-resistant infections (Gul Ruhsar Yilmaz, 2007). In recent years, multi drug resistant bacteria have gradually been the important pathogenic bacteria of nosocomial infection (Gul Ruhsar Yilmaz, 2007). Therefore, the effectively and corresponding prevention and control of neonatal drug-resistant infection have been the primary task for prevention and control of neonatal infection to avoid cross infection in the hospital.

The hospital children of neonatal department mainly come from three groups described as follows: infants come from obstetrics, children transferred from the other hospitals and emergency clinics (Meremikwu *et al*., 2005). In this study, the results showed that the children from other hospitals were the high-risk population that to be infected with the drug resistant bacteria. While the irrational use of antibiotics in the hospital with lower level might be a proper explain for the fact (Caselli *et al*., 2010). Besides, the colonization or infection of the large amount of extended-spectrum β-lactamase bacteria was closely related to the widespread use of antimicrobial drugs in primary and community hospital and also the spread of multi drug-resistant bacteria (J. Mugalu, 2006), which would be a severe test for the prevention and control against infection (Ansari *et al*., 2014). In order to prevent the occurrence of cross infection in hospital effectively, the specimens were collected and cultured separately for the infection neonatal who mainly come from the other hospitals and emergency clinics. Meanwhile, the infected children were also placed in relatively isolated area and all treatment, contacts of children were strictly to the real hand hygiene, and yellow garbage bags were also used for the collecting of medical waste (Shailaja *et al*., 2014). The identification of the isolate and multiple drug resistant strains were hanged out for the first time for children diagnosed with multi-drug resistant which aimed to remind the staff that be strictly to the real hand hygiene to avoid cross infection.

In this study, to reduce the incidence of nosocomial infection, we aimed to find out the key infants for Neonatal prevention and control by explore the main distribution characteristics of multiple drug resistant organism in neonates admitted to Maternal and Child Health hospital of Zhengzhou City by different ways.

MATERIAL AND METHOD

Materials

The specimens of newborn drug resistance for total of 2124 neonates which were admitted to the hospital from February 2013 to August 2014 were investigated.

**Corresponding author:* e-mail: zmabc2015@sina.com

According to admission ways, there were 1119 cases admitted from outpatient department (outpatient group), 782 cases transferred from other departments (other department group), and 223 cases from other hospitals (other hospital group). Among these infants, most premature infants and neonatal asphyxia were found in other departments; the children admitted to hospital with pneumonia, neonatal jaundice, neonatal diarrhea were outpatient department; and the newborns with severe pneumonia, severe neonatal aspiration were mainly in the other hospital group.

Methods

All neonatal specimens was detected by bacterial culture and the drug resistance bacteria found in the neonatal specimens were reported to the department of hospital infection management for the first time. The data were collected according to the date of admitted to the hospital, admission type, admission diagnosis, name, age, body mass, the collection date of specimen, specimen type, specimen monitoring result, hospitalization time, disease prognosis and other items which were recorded by the department of hospital infection management through the electronic medical record system. At the same, the monitoring table of bacterial resistance was registered for every drug-resistant bacterial. For the purpose of rational use of antimicrobial agents, the full-time staff of infection management department carried out the investigation of the bed next to the department and also analyzed the infection type of drug resistant bacteria. The bed isolation measures were taken for the infants infected with the multiple drug resistant strains and effective quarantine measures were also taken by the full-time staff of Infection management department to prevent cross infection.

STATISTICAL ANALYSIS

All data were assessed by SPSS 15.0 program. The correlation between the factors and the course was analyzed with chi-square criterion. Test level was $\alpha = 0.05$.

RESULTS

Monitoring results of newborns admitted to the hospital through different ways

A total of 105 multiple drug resistant strains were found among the 2124 neonates and the positive rate of drug resistant strains was 4.94%. The main types of specimens studied were as follows: 19 strains of blood, 51 strains of sputum,16 strains of catheter residue,9 strains of gastric juice,4 strains of defecate and 6 strains of urine.

According to admission ways, there were 57 drug resistant strains in outpatient group (1119 cases) and the positive rate of drug resistant strains was 4.94%; 27 drug resistant strains were found in other department group (782 cases) and the positive rate was 3.45%; for the other hospital group ,there were 21 drug resistant strains and the positive rate was 9.42%. The results showed that there was significant difference in the positive rate of drug resistant strains in all the groups (χ^2=13.250, P□0.001), and the highest positive rate was found in the other hospital group. However, the occurrence rate of nosocomial infections caused by drug resistant bacteria in each group have no statistical significance (χ^2=3.156, P =0.206). The results were shown in table 1

Monitoring results of newborns with different body weight

The results revealed that there were statistically significant (χ^2=13.250, P□0.001) in the infection rate of nosocomial infants with different body weight. among the infants, the highest infection rate which almost up to 3.66% was found in the children whose weight were less than 1500g; But the positive rate of drug resistant strains in infants with different body mass had no statistical significance (χ^2=2.102, P=0.350). The results were listed in table 2.

Monitoring results of Neonates with different hospitalization time

The results showed that there were statistically significant both in the infection rate (χ^2=134.257, P□0.001) and the positive rate (χ^2=51.553, P□0.001) of drug resistant strains in infants with the different length of hospital stay. For the positive rate of drug resistant strains, it was 19.87 % when the length of hospital stay was over 14 days. As for the infection rate, the highest rate (3.21%) was found in infants whose hospitalization time was more than 14 days. The data was in table 3. Besides, the average length of hospital stay had difference owing to the newborns admitted to the hospital through different ways. The results were listed in table 4 and length of hospital stay for other hospital group was longest compared with other groups.

Distribution of 4 kinds of drug resistant bacteria in Neonates admitted to the hospital through different ways

The distribution of 4 kinds of drug resistant bacteria in Neonates admitted to the hospital through different way was as follows: 28 strains of Escherichia coli bacteria, 32 strains of *Klebsiella pneumoniae*, 16 strains of staphylococcus and 15 strains of Staphylococcus. The data was shown in table 5.

DISCUSSION

In this paper, our results revealed that the positive rate of drug resistant strains in infants with the length of hospital stay than 14 days were highest. Moreover, there were 5 cases with the average hospitalization time than 14 days in the total 6 cases of infected children caused by drug resistant strains. It indicated that with the increase of the

Table 1: Monitoring results of newborns admitted to the hospital through different ways

Groups	Cases	Drug-resistant strain	Infection cases	Positive rate (%)	Infection rate (%)
Other department group	782	27	4	3.45	0.51
Other hospital group	223	21	1	9.42	0.44
Outpatient group	1119	57	1	5.09	0.09
Total	2124	105	6	4.94	0.28

Table 2: Monitoring results of newborns with different body weight

Groups	Cases	Drug-resistant strain	Infection cases	Positive rate (%)	Infection rate (%)
≤1 500 g	82	4	3	4.88	3.66
Other department group	66	2	2	3.03	3.03
Other hospital group	9	2	1	22.22	11.11
Outpatient group	7	0	0	0.00	0.00
1501-2500g	525	33	3	6.29	0.57
Other department group	317	17	2	5.36	0.63
Other hospital group	60	9	0	15.00	0.00
Outpatient group	148	68	1	4.73	0.68
2 500 g	1517	68	0	4.48	0.00
Other department group	399	8	0	2.01	0.00
Other hospital group	154	10	0	6.49	0.00
Outpatient group	964	50	0	5.19	0.00

Table 3: Monitoring results of Neonates with different hospitalization time

Groups	Cases	Drug-resistant strain	Infection cases	Positive rate (%)	Infection rate (%)
1-7d	1445	23	0	2.01	0.00
Other department group	467	8	0	1.71	0.00
Other hospital group	95	0	0	0.00	0.00
Outpatient group	883	15	0	1.70	0.00
8-14d	523	51	1	9.75	0.19
Other department group	186	10	1	5.38	0.54
Other hospital group	116	11	0	19.48	0.00
Outpatient group	221	30	0	13.57	0.00
14 d	156	31	5	19.87	3.21
Other department group	129	9	3	6.98	2.33
Other hospital group	12	10	1	83.33	8.33
Outpatient group	15	12	1	80.00	6.67

length of hospital stay and use of the antibacterial drugs, the incidence of drug resistant bacteria and infection rate caused by drug resistant strains also increased correspondingly despite of the children with different admission ways (Jyothi *et al*., 2013; Shah *et al*., 2012). So, the decrease of hospital stays, selection of appropriate antimicrobial drugs, dose and duration of treatment is the key factor for reducing the nosocomial infection resulted from the drug resistant bacteria (Omoregie REgbe CA, 2009).

The average length of hospital stay was the longest in our hospital. On the one hand, the children in the hospital have been undergo invasive operation, emergency treatment or antimicrobial drug treatment for several days, coupled with the newborns especially preterm infant 's defense function is not perfect, the bacteria, virus were easily penetrated which all contributed to difficulty of treatment and the relatively prolonged hospitalization; On the other hand, since the children has a history of treatment in the other hospital, their families had higher adherence to treatment and could cooperate actively with the doctors to achieve effective treatment.

We also studied the relation between infection rate and nosocomial infants with different body weight, the results demonstrated that the positive rate of drug resistant strains in infants with different body mass had no statistical significance but the highest infection rate was found in the children whose weight were less than 1500g. So, we could conclude that the high risk population of nosocomial infections was mainly caused by the premature infants and low birth weight infants (Anderson *et al*., 2008). Because they had poor ability to adapt to the

Table 4: length of hospital stay of the newborns admitted to the hospital through different ways

Groups	Cases	Time (d)	Average Time (d)
Other department group	27	330	12.22
Other hospital group	21	364	17.33
Outpatient group	57	688	12.07

Table 5: Distribution of 4 kinds of drug resistant bacteria in Neonates admitted to the hospitalthrough different ways

Groups	Escheric-hia coli	Klebsiella pneumoniae	S. Hae-molyticus	S. Epid-ermidis
Other department group	6	7	4	5
Other hospital group	2	3	7	2
Outpatient group	19	20	4	7

external environment owing to the immaturity of their body systems. Moreover, the use of the incubator environment contributed greatly to the growth and reproduction of pathogenic bacteria (Seale and Millar, 2014). There were study reported that children who had low body weight and advanced use of third-generation cephalosporins were a major risk factor for the infection caused by extended-spectrum β-lactamase bacterial (S Rahman, 2001). In addition, the low body weight infants and premature infants do not have enough IgG and poor ability to synthesis antibody due to the premature delivery, which could result that they were prone to suffer from hypogammaglobulinemia and infection. According to the clinics study, the birth rate of premature infants and term infants increased with the increase of the obstetrics risk factors, which resulted in children admitted to the hospital had low body weight. To reduce the incidence of hospital infection in premature infants with low body mass, the attention should be strengthened in the treatment and nursing activities to reduce the occurrence of invasive operation. Besides, the clean of skin should be maintained daily and use of antimicrobial drugs would be rational. And standard hand washing was the most effective way to cut off the spread of pathogenic bacteria.

CONCLUSIONS

The monitoring of drug resistance strains mainly from the outpatient department. To avoid the occurrence of nosocomial infection that result in the hospital infection outbreaks, we should focus on the monitoring of high risk newborns especially prevent and control of infants who had low body weight or long hospitalization time during the diagnosis and treatment. Moreover, we should also be strict with all the preventive system and operation process.

REFERENCES

Anderson B, Nicholas S, Sprague B, Campos J, Short B and Singh N (2008). Molecular and descriptive epidemiologyof multidrug-resistant Enterobacteriaceae in hospitalized infants. *ICHE,* **29**: 250-255.

Ansari S, Nepal HP, Gautam R, Shrestha S, Neopane P, Rimal B, Mandal F, Ansari SR and Chapagain ML (2014). Childhood septicemia in Nepal: Documenting the bacterial etiology and its susceptibility to antibiotics. *IJM,* **32**: 452-458.

Caselli D, Cesaro S, Ziino O, Zanazzo G, Manicone R, Livadiotti S, Cellini M, Frenos S, Milano GM, Cappelli B, Licciardello M, Beretta C, Arico M, Castagnola E and Infection Study Group of the Associazione Italiana Ematologia Oncologia P (2010). Multidrug resistant Pseudomonas aeruginosa infection in children undergoing chemotherapy and hematopoietic stem cell transplantation. *Haematologica,* **95**: 1612-1615.

Gul Ruhsar Yilmaz MAC, F Sebnem Erdinc, Serap Ucler1 (2007). The risk factors for infections acquired by cerebral hemorrhage and cerebral infarct patients in a neurology intensive care unit in turkey. *Jpn. J. Infect Dis.,* **60**: 87-91.

J. Mugalu MKN (2006). Aetiology, risk factors and immediate outcome of bacteriologic ally confirmed neonatal septicaemia in Mulago hospital, Uganda. *African Health Sciences,* **1**: 120-126.

Jyothi P, Basavaraj MC and Basavaraj PV (2013). Bacteriological profile of neonatal septicemia and antibiotic susceptibility pattern of the isolates. *Journal of Natural Science, Biology and Medicine,* **4**: 306-309.

Meremikwu MM, Nwachukwu CE, Asuquo AE, Okebe JU and Utsalo SJ (2005). Bacterial isolates from blood cultures of children with suspected septicaemia in Calabar, Nigeria. *BMC Infectious Diseases,* **5**: 110-115.

Omoregie REgbe CA OH, Igbarumah I and Omijie RE (2009). Effects of gender and seasonal variation on the prevalence of bacterial septicemia among young children in Benin City. Nigeria. Pp.107-109.

S Rahman AH, MT Roghani and Z Ullah (2001). Multidrug resistant neonatal sepsis in Peshawar, Pakistan. Arch Dis Child Fetal Neonata lEd, 87: 52-54.

Seale J and Millar M (2014). Perinatal vertical transmission of antibiotic-resistant bacteria: A systematic review and proposed research strategy. *BJOG.,* **121**: 923-928.

Shah AJ, Mulla SA and Revdiwala SB (2012). Neonatal sepsis: High antibiotic resistance of the bacterial pathogens in a neonatal intensive care unit of a tertiary care hospital. *JCN,* **1**: 72-75.

Shailaja VV, Reddy AK, Alimelu M and Sadanand LN (2014). Neonatal meningitis by multidrug resistant Elizabethkingia meningosepticum identified by 16S ribosomal RNA gene sequencing. *IJP,* **37**:1-4.

Wang S, He X, Yu JY, Neely M, Zhang L, Peng L, Shi X, Li X, Wang S, Cao H, Gai Z and Huang SH (2015). Characterisation of a multi drug-resistant meningitic Escherichia coli strain (O75: K1: H5) isolated from an infant that is sensitive to memantine, a newly identified host-directed antimicrobial drug. *IJAA,* **46**(5): 598-600.