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The use of prophylactic antibiotics in transcatheter therapy during perioperative period of congenital heart disease in childhood.

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Abstract

It is aimed to explore whether the Catheter-Related Infection (CRI) related transcatheter therapy of congenital heart disease in childhood. A total number of 616 cases children with congenital heart disease interventional operation were performed and the intravascular catheters were removed immediately after the operation. Postoperative body temperature, leukocyte count, CRP and clinical symptoms were observed and blood of suspected cases of infection was cultured. Short-term use of corticosteroids was used according to the patients' conditions for arrhythmia after ventricular septal defect interventional closure. The postoperative fever occurred in 55 cases, among which 37 cases were diagnosed as nosocomial infection. There were no signs of systemic and puncture site infection, fever due to dehydration, allergic reactions, traumatic stress found in the remaining 18 cases. After the children were performed with congenital heart disease transcatheter surgery, the CRI incidence is very low, and the exit-site infection is relative common.

Keywords: Catheter-related Infection, Transcatheter therapy, Exit-site infection.

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Introduction

The incidence of Congenital Heart Disease (CHD) ranges from 4 to 75 per 1000 live births, about 1/3 of which consist of moderate to severe disease that will require neonatal surgery [1]. About 150000 children with CHD were born every year in China [1]. Vascular circulating load and stress load increase in patients with congenital heart defects because of abnormal blood stream channels [2].

With the increasing of vascular pressure, cardiac atrium-ventricular load changes, cardiac function and cardiac geometry significantly transform subsequently [3,4]. Transcatheter interventional therapy with occlude devices for congenital heart diseases is safe, easy and effective [5,6]. Transcatheter surgery is an important means of treatment for CHD, and it was less invasive than conventional surgery and has a low risk of infection [7]. However, once the CRI occurred, it may prolong the hospitalization time, increase patients' suffering severe pain or even threaten life [7].

There were different views in clinic about whether transcatheter surgery needed prophylactic use of antibiotics, especially in pediatric patients with CHD [8,9]. In our study, childhood patients with CHD underwent transcatheter therapy were involved and divided into prevention group and control group to explore the occurrence of CRI after prophylactic use of antibiotics and aimed to provide the reference for the treatment of CHD.

Materials and Methods

Object

Based on the guidelines of congenital heart disease transcatheter treatment in 2004, a total number of 616 patients were chosen in our hospital from January to December 2012, and they were all children with CHD with surgical indications, which were successfully implemented the catheter interventional surgery. Among them, there were 247 male cases, 369 female cases, aged 9 days -18years, and the mean age was 55.8 ± 40.7 months. There were 243 patients underwent ventricular septal defect (VSD) closure operation, 219 patients accepted patent ductus arteriosus (PDA) interventional closure operation, 105 patients accepted the interventional closure of atrial septal defect (ASD), 36 patients accepted the percutaneous balloon pulmonary stenosis (PS) valvuloplasty operation, 4 patients accepted the coronary artery fistula closure operation and 9 patient accepted complex operation. Before surgery, all patients accepted the clinical interrogation, physical examination, chest X-ray, echocardiography, electrocardiograph, blood, urine and feces examination. Ethical approval for this study was obtained from the ethics committee.

Criterion

The standard of intravascular CRI based on the American Society of Infectious Diseases, "Clinical Practice Clinical

practice guidelines for the diagnosis and management of intravascular catheter-related infection (2009 Amendment) [10]. Intravascular CRI is divided into the following six classes: (1) catheter pathogen engraftment; (2) phlebitis; (3) exit site infection; (4) tunnel infection; (5) pocket infection; (6) catheter - related bloodstream infection, CR-BSI.

Table 1. *616 cases of nosocomial infection after surgical intervention.*

Group	Infection result		total	infection rate
	nosocomial infection	no nosocomial infection		
Prevention group	15	202	217	0.0691
Control group	23	376	399	0.0576
total	38	578	616	0.0616
Using the chi-square test of fourfold table data.χ^2=0.320, p=0.572				

Grouping method and application of antibiotics

The 616 patients who underwent interventional surgery were divided into prevention group and the control group. A total number of 217 patients that accepted prophylactic use of antibiotics were divided into prevention group from January to May. And from June to December, a total of 399 patients that unaccepted prophylactic use of antibiotics were divided into control group. Before surgery, prevention group was intravenously injected with 0.9% saline and cefazolin sodium for half an hour. After surgery, patients in prevention group were intravenously injected with 0.9% saline and cefazolin sodium for 48 h. The antibiotics were not used in control group.

Glucocorticoids application methods

On the first day, the third and sixth day after surgery, patient's electrocardiograph were obtained. After surgery, glucocorticoids treatment (Dexamethasone 0.5 mg/kg. d or prednisone 1.5 mg/kg. d) was used for arrhythmia patients. If the cardiac rhythm was recover to normal level detected using electrocardiograph, drugs were no longer needed. The treatment was performed for five days to 30 days.

Table 2. *40 cases of postoperative follow-up of positive patient outcomes (38 cases of hospital infection and two cases of infection outside the hospital).*

Group	Age	Gender	Diagnose	nosocomial infection	fever	Infection 1week before surgery	Ventilator	Pacemaker	follow-up (up to a month)		
									Hormone	CRI	Other infection
Control Group 1	12	M	PDA	upper respiratory tract	Y	Y	N	N	N	N	N
Control Group 2	28	F	VSD	upper respiratory tract	Y	Y	N	N	5	N	N
Control Group 3	30	F	VSD	upper respiratory tract	Y	N	N	N	7	N	N
Control Group 4	36	F	ASD	upper respiratory tract	Y	Y	N	N	N	N	N
Control Group 5	28	F	VSD	lower respiratory tract	Y	Y	N	N	10	N	N
Control Group 6	72	F	VSD	upper respiratory tract	Y	Y	N	N	N	N	N
Control Group 7	221	F	ASD	upper respiratory tract	Y	Y	N	N	N	N	N
Control Group 8	31	M	ASD	upper respiratory tract	Y	N	N	N	N	N	N
Control Group 9	30	F	VSD	lower respiratory tract	Y	Y	N	N	5	N	N
Control Group 10	28	F	PDA	upper respiratory tract	Y	N	N	N	N	N	N
Control Group 11	6	F	PDA	upper respiratory tract	Y	Y	N	N	N	N	N
Control Group 12	91	M	VSD	lower respiratory tract	Y	N	Y	N	21	N	N

Control Group 13	36	M	PDA	upper tract	respiratory	Y	N	N	N	N	N	N
Control Group 14	36	F	PDA	upper tract	respiratory	Y	N	N	N	N	N	N
Control Group 15	102	M	VSD	upper tract	respiratory	Y	N	N	N	10	N	N
Control Group 16	8	F	PDA	lower tract	respiratory	Y	Y	N	N	N	N	N
Control Group 17	26	F	PS	lower tract	respiratory	Y	N	Y	N	N	N	N
Control Group 18	40	F	ASD	urinary tract infection		Y	Y	N	N	N	N	N
Control Group 19	14	F	PDA	urinary tract infection		Y	N	N	N	N	N	N
Control Group 20	15	F	PDA	upper tract	respiratory	Y	N	N	N	N	N	N
Control Group 21	49	F	PDA	upper tract	respiratory	Y	Y	N	N	N	N	N
Control Group 22	11	F	PDA	upper tract	respiratory	Y	N	N	N	N	N	N
Control Group 23	26	M	ASD	exit-site infection		N	Y	N	N	N	N	N
Control Group 24	90	F	PDA	N		N	N	N	N	N	N	viral encephalitis
Prevention Group 1	60	M	PS	lower tract	respiratory	Y	Y	N	N	N	N	N
Prevention Group 2	33	F	ASD	lower tract	respiratory	Y	Y	N	N	N	N	N
Prevention Group 3	40	F	PDA	lower tract	respiratory	Y	Y	N	N	N	N	N
Prevention Group 4	72	F	VSD	lower tract	respiratory	Y	N	N	Y	10	N	N
Prevention Group 5	108	M	VSD	upper tract	respiratory	Y	N	N	N	14	N	N
Prevention Group 6	115	F	VSD	upper tract	respiratory	Y	N	N	N	N	N	N
Prevention Group 7	108	M	VSD	upper tract	respiratory	Y	Y	N	N	N	N	N
Prevention Group 8	40	F	PDA	upper tract	respiratory	Y	N	N	N	N	N	N
Prevention Group 9	10	M	PDA	lower tract	respiratory	Y	N	N	N	N	N	N
Prevention Group 10	10	F	PDA	lower tract	respiratory	Y	N	N	N	N	N	N
Prevention Group 11	8	M	PDA	upper tract	respiratory	Y	N	N	N	N	N	N
Prevention Group 12	32	M	Coronary artery fistula	upper tract	respiratory	Y	N	N	N	N	N	N
Prevention Group 13	13	F	PDA	upper tract	respiratory	Y	N	N	N	N	N	N
Prevention Group 14	25	F	PS	upper tract	respiratory	Y	N	N	N	N	N	N
Prevention Group 15	50	F	PDA	lower tract	respiratory	Y	Y	N	N	N	N	N

Prevention Group 16		85	F	PDA	N	N	N	N	N	N	N	bronchopneumonia

Surgery background

All patients underwent surgery in digital subtraction angiography intervention chamber in West China Second Hospital, Sichuan University. Digital subtraction room indoor temperature was 20-25°C, and the relative humidity was 40-60%. And we used of disposable devices in aseptic surgery.

Observation method

After surgery, clinical symptoms, signs and puncture site were comprehensively observed. For the emergence of (1) the puncture site with pus discharge or diffuse erythema (cellulitis performance); (2) Exclusion of physical and chemical factors, subcutaneous tissue along the catheter appeared painful diffuse erythema; (3) After vascular intervention operations, patients whose fever>38°C and had local tenderness were detected for the white blood cell count, percentage of neutrophil cells and CRP. The blood bacteria were cultured and all patients were followed up for a month.

Statistical methods

Data are processed using SPSS13.0 statistical software. Variable data are presented as mean ± SD. Count data between two groups in hospital infection rates are evaluated with fourfold table chi-square test, and the infection rates among multiple groups are compared using the RC table chi-square test. Values of $P<0.05$ are considered statistically significant.

Table 3. *The incidence of CRI in prevention and control groups.*

Group	cases	un-infection	infection rate	chi-square value	p value
Prevention Group	217	217	0	-	-
Control Group	399	398	0.25%	0	0.983
Using the chi-square test of fourfold table data $\chi^2=0.00$, $p=0.983$					

Results

General results

A total number of 616 cases were successfully implemented transcatheter surgery. There were 55 cases of postoperative fever including 21 cases were in prevention group and 34 cases in the control group. The abnormal increase number of white blood cell, neutrophil percentage of cells and CRP occurred in 42 cases, 17 cases in which were from the prevention group and 25 cases were in control group. The results of blood bacteria culture were all negative. Among all fever patients, 37 cases were diagnosed as nosocomial infections, including 15 cases in prevention group, 22 cases in control group, and they were treated with antibiotics for 3-12 days. The other 18 cases were found no signs of infection or puncture site. The fever was because of the dehydration, allergic reactions and post-traumatic stress, and the patients were improved after postoperative use of antibiotics. In control group, there was one case of puncture site swelling, exudate performance and secretions culture negative, which was diagnosed as CRI for hospital infections. A total number of 38 cases (38/616, 6.16%) in two groups were diagnosed as nosocomial infection, 15 cases of which were in prevention group (15/ 217, 6.91%), 23 cases of which were in control group (23/399, 5.76%), and the results of blood cultures were negative (Table 1).

Table 4. *The occurrence of postoperative arrhythmias in ventricular septal defect transcatheter closure.*

classify	Prevention group (92cases)	Control group (151cases)	Total (243 cases)
normal	70	109	179 (73.6%)
I stage AVB	1	2	3 (1.2%)
II stage AVB	0	0	0
III stage AVB	0	1	1 (0.4%)
CLBBB	1	3	4 (1.6%)
Intraventricular block	1	3	4 (1.6%)
LAFB	3	6	9 (3.7%)
CRBBB	2	1 (1case with junctional escape)	3 (1.2%)
IRBBB	8	11 (1 case with junctional escape)	19 (7.8%)
CRBB&LAFB	1	0	1 (0.4%)
IRBB&LAFB	1	2	3 (1.2%)
Junctional tachycardia	1	2	3 (1.2%)
junctional escape	0	4	4 (1.6%)
Accelerate junctional escape	1	7 (1 case ventricular premature beat)	8 (3.3%)
ventricular premature beat	2	0	2 (0.8%)

There were 23 cases of upper respiratory tract infection, 12 cases of lower respiratory tract infections, urinary tract infection in 2 cases, and there was one case of CRI. The incidence of nosocomial infection groups was not statistically significant ($p>0.05$). Among these upper respiratory tract infection patients, 11 cases of which used oral antibiotics for 3-5 days to cure and 12 cases underwent intravenously injection with antibiotics for 3-7 days to cure, and there was no emergence of new infections. There were 12 cases of lower respiratory tract infections, two cases of anesthesia in surgery

endotracheal intubation and mechanical ventilation, and postoperative mechanical ventilation were using for 6h and 8h. There was 1 cases of intraoperative placement of a temporary pacemaker and intravenous antibiotics were used for 5-12 days to cure. There was no emergence of new infections. 7 days and 10 days of oral antibiotics were used for two cases of urinary tract infection patients. Povidone-iodine solution was used three days in CRI patients. Antibiotic was not used, and 1 month follow-up showed no abnormalities. In the post follow-up process, one case of PDA patients (no history of hospital infection) 28 days after the surgery were diagnosed as viral encephalitis, and he was hospitalized for two weeks with treatment; one case of PDA patients 15 days after surgery was diagnosed as bronchial pneumonia, which was hospitalized for 7 days to cure. There were no new infections in the remaining cases during the follow-up. No phlebitis, tunnel infection or catheter-related bloodstream infection was found (Table 2).

Table 5. 11 cases of hospital infection cases.

Classify	Group				
	Prevention with hormone	Prevention without hormone	Control with hormone	Control without hormone	total
nosocomial infection	1	3	2	5	11
no nosocomial infection	20	68	52	92	232
the chi-square test use of row of list, χ^2=1.000, p=0.721					

Intravascular catheter-related infections

No cases occurred CRI in prevention group. There was 1 case of CRI diagnosed of exit site infection. No tunnel infection, phlebitis or catheter-related bloodstream infections occurred in two groups and the CRI rate was 0.16%. No CRI was detected in postoperative follow-up for one month and there was no significant difference between prevention and control groups (P>0.05) (Table 3).

The prevalence of catheter-related infection in patients treated with or without glucocorticoid

Total 243 cases of postoperative transcatheter closure of ventricular septal defect, and there were 64 cases (26.3%) with different types of arrhythmias, 42 cases of which were in control group and 22 cases in prevention group, especially in IRBBB (19/243,7.8%) and LAFB (9/243,3.7%) (Table 4). There were 11 cases of nosocomial infection including 1 case (1/21) with glucocorticoid and 3 cases (3/71) without glucocorticoid in prevention group, 2 cases (2/54) with glucocorticoid and 5 cases (5/97) without glucocorticoid in control groups. Hospital infection rates between the groups showed no statistically significant difference (P>0.05) (Table 5). There was no CRI in postoperative follow-up observation of a month.

Discussion

The advantages of children with CHD transcatheter surgery is minimally invasive and less risk of infection, however, once the CRI occurs, the consequences could be very serious [11-13]. Currently, studies of CHD after surgical intervention occurred CRI situation remains lacking of large sample size and researchers reported interventional endovascular surgery prophylactic use of antibiotics mostly on the specific study of a disease instead of a large-scale prospective randomized control study [14,15]. Whether perioperative antibiotic prophylaxis still required was based on the surgical theory and inference information [16,17]. Prophylactic used of antibiotics was recommended in atrial septal defect, ventricular septal defect and patent ductus arteriosus occluder implantation in congenital heart Disease transcatheter Treatment Guidelines, however, it was not required in pulmonary valve balloon dilatation [18].

The Prophylactic Antibiotic Use Guidelines for Adult Interventional Radiology Vascular Surgery recommends that interventional endovascular surgery does not require routine prophylactic use of antibiotics, including diagnostic angiography, percutaneous angioplasty, thrombolysis, vascular closure set release, stent placement, the inferior vena cava filter placement [12]. If the same site several times repeated punctured or cathetered in short term, or longer retention intracardiac catheter could increase the risk of infection and the prophylactic use of antibiotic was recommended [14,19,20]. In the present study, all transcatheter surgeries were infection-free status of elective surgery. Disposable instruments were used and the operative time was shorter, and the intravascular catheters were removed immediately after surgery. There is only one case of getting local infection in the control group and no channel infection, phlebitis and CR-BSI occurrence. The incidence of CRI was 0.16% and the difference was not statistically significant.

Our study was the first time to analyze the prophylactic use of antibiotic in transcatheter therapy during perioperative period of CHD in childhood. In the present study, the transcatheter surgery was carried out under the condition of non-infection with small skin entrance and shorter operative time. The intravascular catheter was immediately removed after surgery and disposable equipment.

Conclusion

This is a prospective study of CHD transcatheter perioperative prophylactic use of antibiotics. Children with CHD after transcatheter surgery had a very low risk of CRI. Therefore,

perioperative prophylactic use of antibiotics is not necessary. Postoperative arrhythmias in patients with ventricular septal defect intervention short-term use of corticosteroids would not increase the incidence of hospital infection and CRI.

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