Risk Factors for Infection After Cardiovascular Surgery in Children in Argentina

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Infections after cardiovascular surgery are an important cause of morbidity and mortality. This paper described the study of risk factors associated with development of infections. This is a prospective study, setting in a Hospital JP Garrahan, a tertiary and referral center of Buenos Aires, Argentina. All patients with cardiac surgeries between 1/ 11/01 to 1/1/ 2002 were included. The median age of p was 30 months (r: 1-212 m), 184 p (53%) were boys, 21% (75) had underlying disease, being the genetic disorders or undernutrition the most frequent, 56 p (16%) had previous surgery, 36 p (10%) had received previous antibiotics and 30 (9%) of them had previous infection, An ASA score higher than or equal to 3 was found in 308 p (88%). Median hospital stay before surgery was 1 day (r1-120 d), 88 p (25%) nedeed inotropic support with epinephrine, 147 p (42%) needed mechanical ventilation during a median time of 4 days (r: 1-66d).Drainage with thorax opened was done in 339p (97%) for a median time of 2 days (r:1-7d). Total hospital stay was between 1 and 120 days (median 5 days). Postsurgical infections developed in 38 of 350p (11%). Superficial wound infection in 4 p (1%), 5 p (1.5%) had deep infection, 3p (1%) had mediastinitis and 26 p (7.5%) had other nonsurgical infections Eleven p (3%) died. By multivariate study underlying diseases (p<0.012) OR 4.22 (CI 1.38-12.8), inotropic support with epinephrine (p<0.027) OR 4.04 (CI 1.17-13.9) and postoperative stay longer than 12 days were found to be risk factors for infections. We concluded that presence of underlying diseases, longer hospitalization and inotropic support were risk factors for infections.

Key-Words: Infections, cardiovascular surgery, children.

Postoperative infections are an important cause of morbidity and mortality in children undergoing cardiovascular surgery [1-5]. In adults the risk factors reported were diabetes mellitus, the use of internal mammary artery grafts for bypass conduits and other factors clearly related to age and the nature of the performed operations [6].

There are very few reports in pediatric patients about risk factors for infections after cardiovascular surgery. Many of them only evaluate the risk of infection related with the surgical site [1,6-8]. Identification of risk factors would help to reduce morbidity and mortality and to implement special preventive measures in high risk patients.

This study was undertaken to determine incidence, pathogens and risk factors associated with the development of infections after cardiovascular surgery in children.

Material and Methods

Prospective chart review was done for all cardiac surgeries performed in children less than 18 years of age at Hospital Nacional de Pediatria J. P. Garrahan (a tertiary and referral center) between November 2001 and December 2002.

Demographic and clinical variables were recorded for all children including age, sex., congenital heart defect (CHD), underlying diseases, preoperative antibiotic use and previous cardiovascular surgery.

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American Society of Anesthesiologyst´s score (ASA) (9) was determined in every patient. ASA score is an index to asses preoperatively the overall physical status of the patients and ranges from 1 to 5 [9]. We also studied type and time of surgery, bypass time, duration of postoperative, inotropic support with epinephrine and ventilatory support, presence of fever, microorganisms and outcome. We do not evaluated levels of glucose or hypothermia as a risk factors.

Postsurgical infections were defined according to Centers for Disease Control(CDC) [10]. All patients were included in the analysis of infection regardless of the type.

Statistical Analysis

The Mann-Whitney Rank Sum test was used to assess differences between groups for two continuos variables. Dichotomous variables were analyzed using the Chi- square test (with Yates correction). To estimate the multivariate predictive value of independent covariates a stepwise multiple logistic regression model was used, Degree of fit of the data to model was estimated by the Hosmer- Lemeshow test, and the percentage of the variance was obtained. The predictive value for each covariant was expressed as the odds ratio (OR), a 95% confidence interval was derived as the standard error of these beta coefficients. Receiver Operating Characteristics curve (ROC curve) was used for cutoff point in continuous variables. Data distribution is expressed as mean +/- standar deviation. A p value of p< or = 0.05 was, considered significant for both extremes. The software used was CSS/ Statistical, 5.1 (Statsoft Corp. Tulsa, Okla, USA) and True Epistat v. 5, 1995 (Richardson, Texas, Usa) [11].

Results

Three hundred and fifty patients were evaluated in the study. Most frequent CHD were: ventricular septal defects,

tetralogy of Fallot, atrial septal defect transposition of great vassels 266 p (76%) and others 84 p (24%).

The median age of patients was 30 months (r: 1-212), 53% (184p) were boys, 21% (75p) had underlying disease, being the genetic disorders (30 p) or undernutrition (45 p) the most frequent. Sixteen percent (56p) had previous surgery, 10% (36p) had received previous antibiotics and 9% of them (30 p) had had previous infection. An ASA score ≥ 3 was found in 88% (308 p), Median hospital stay before surgery was 1 day (r:1-120), the median time of bypass was 69 minutes (r:13-300), 25% (88) needed postoperative epinephrine for inotropic support, 42% (147) needed mechanical ventilation during a median time of 4 days (r:1-66). Ninety seven percent (339) of the patients required chest tube drainage for a median time of 2 days (r:1-7). Length of hospital stay was between 1 and 120 days (median 5 d) (Table 1).

Table 1. Characteristics of patients.

Variable	n	%
Age (median in months)	30 (R: 1-212)	
Male sex	184	53
Underlying diseases	75	21
Previous surgery	56	16
Previous antibiotics	36	10
ASA > or =3	308	88
Inotropic support	88	25
Death	11	3

Postsurgical infections developed in 38 patients (11%). Four of them (1%) were superficial wound infections, 5 patients (1.5%) developed deep infections, 3 patients (1%) had mediastinitis and 26 of them (7.5%) had other nonsurgical infections, being sepsis the most common one. Gram positive cocci were the most frequent pathogens in surgical site infections and Gram negatives bacilli in non surgical infections (Table 2).

Eleven patients (3%) died. By univariate analysis risk factors for infection were younger age, presence of underlying disease, higher American Society of Anesthesiologist score (ASA), previous infection, postoperative inotropic support with epinephrine, requirement for mechanical ventilation and a postoperative stay in intensive care unit (PICU) stay ≥ 12 days ($p<0.05$) (Table 3).

By multivariate analysis only underlying disease ($p<0.012$) OR 4.22 (CI 1.38-12.8), inotropic support with epinephrine ($p<0.027$) OR 4.04 (CI 1.17-13.9) and postoperative PICU stay ≥ 12 days ($p<0.003$) OR 1.08 (1.03-1.14) significantly continued as risk factors for infections (Table 4).

Table 2. Type of infections and microorganisms (n: 38).

Type of infections	Total (p)	Microorganisms
Surgical site	12	*S aureus* (5p), Coagulase negative *Staphylococcus* (1p),*Pseudomonas aeruginosa* (1p) *Salmonella spp* (1p) Negative cultures (4p)
Sepsis	17	*Pseudomonas aeruginosa* (3p) Nonfermenter Gram negative rods (1p) *Candida albicans* (1p) Negative cultures (12p)
Pneumonia associated with mechanical ventilation	5	*H,influenzae* non b (2p) *Acinetobacter* spp (1p) Negative cultures (2p)
Urinary tract infections	3	*Pseudomonas aeruginosa* (2p) *Proteus spp* (1p)
Catheter associated bacteremia	1	Coagulase negative *Staphylococcus* (1p)

Table 3. Univariate analysis.

Variable	Presence of infections (38 p)	NO infections (312 p)	p
Age	21.6±34.6	56.7±68.2	<0.0005
ASA score (> or = 3)	37	271	<0.001
Underlying diseases	24	51	<0.00001
Previous infection	10	20	<0.0005
Inotropic support	31	57	<0.00001
Hospital stay (> 12d)	33	41	<0.00001
Ventilation (days)	18.2±17.3	3.9±4.012	<0.00001

Table 4. Multivariate analysis.

Variable	Coef. β ± ES	p value	Odds ratio (LC 95%)
Underlying diseases	1.440 ± 0.567	< 0.012	4.22 (1.38-128)
Inotropic support	1.397 ± 0.628	<0.027	4.04 (1.17-13.9)
Hospital stay more 12 days	0.081± 0.027	< 0.003	1.08 (1.03-1.14)

Discussion

Infections after cardiovascular surgery in pediatric patients are an important cause of morbidity and mortality. Overall rate of infections in our serie was 11%. Other reported series showed an overall incidence between 10 and 18% of infections after cardiovascular surgery [3].

Nonwound infections occurred in 7.5% of our patients, fewer than that observed by others (Mehta: 11% and Pollock: 18%) [3-5].

The worldwide incidence of infections related with surgical site is between 0.5 and 7.5%. However we report an incidence of 3.5% which is lower than the one found by Pollock et al. (7.5%) [5] and Mehta et al. (5%) [3] but higher than Edwards et al. who reported 0.5% [12]. Various risk factors have been proposed for cardiovascular infections Edwards et al. [12] showed that bypass time higher than one hour, postoperative bleeding, need for a new surgery and low cardiac output state persisting > 24 hours postoperatively, were risk factors for sternal wound infections. They proposed inadequate antibiotic prophylaxis as a risk factor as well.

Pollock et al. [5] associated ocurrence of sternal wound infection to a high PRISM score (Pediatric Risk of Mortality Score).

Mehta et al. [3] showed that younger age, underlying diseases and higher ASA score were risk factors for infections. In some papers prolonged mechanical ventilation was associated with sternal wound infections however Hehrlein et al. [13] did not considered it a significant risk factor.

Postoperative inotropic support was considered an independent risk factor for deep sternal wound infections by Parisian Mediastinitis Group [14].

A longer stay in the PICU after surgery is also associated with sternal wound infections [3]. However it is not clear whether infection might be the cause rather than the consequence for this situation [3]. In our serie postoperative PICU stay ≥ 12 days was related with all type of infections.

Alpress et al. [1] in a retrospective study showed that age less than 1 month and longer time of surgery were risk factors. It is remarkable that the majority of the above mentioned studies evaluated the risk of infections related with the surgical site only.

Risk factors associated with non surgical site infections were previous infections, emergency surgery, prolonged time of surgery or bypass time, bleeding, postoperative blood transfusion requirements or deferred sternal closure [3]. Alpress et al. [1] reported not correlation between type of cardiopathy and type of infections similar to our findings.

Analyzing the risk factors with logistic regression analysis only the presence of an underlying disease, postoperative inotropic support with epinephrine and postoperative stay in PICU > 12 days were found to be significantly associated with infection at any site.

In summary, infections are an important cause of morbidity and mortality in cardiac surgery patients. The identification of factors for infections could be useful in designing strategies to prevent them.

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