Correlation of preoperative risk factors in children having congenital heart diseases with outcome of cardiac surgery: A 1-year hospital-based observational study

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Abstract

Background and Objectives: The risk factors are associated with surgical outcomes of cardiac surgery. This study was aimed to correlate the effect of preoperative risk factors in children with congenital heart diseases (CHDs) on the outcome of cardiac surgery.

Materials and Methods: This 1-year prospective observational study was conducted in a tertiary referral hospital. A total of 200 children with congenital cardiac diseases undergoing cardiac surgery were studied pre- and post-operatively for 3 months.

Results: Cyanotic and acyanotic CHDs were noted in 33% and 67%, respectively. The most common acyanotic CHD was ventricular septal defect (35%) and the common cyanotic CHD was tetralogy of Fallot (17%). Majority of the children (75.5%) presented with risk factors. 63% of the children were under risk-adjusted classification for congenital heart surgery (RACHS)-II category while 19% were in RACHS-IV. 7.5% of the children expired.

Conclusion and Interpretation: Significantly high mortality was recorded in children aged <1 year, those who presented with cyanotic CHDs, those having a risk factor, and children with RACHS-IV criteria.

Keywords: Congenital heart disease, pediatric cardiac surgery, risk-adjusted classification for congenital heart surgery-I, risk factors

INTRODUCTION

Congenital heart disease (CHD) is known to be one of the important causes of morbidity and mortality in infancy. Indian studies have reported an incidence of CHD from 1.45 to 4 per 1000.1,2

Pediatric cardiac surgery made its foray in developing countries nearly two decades later than in developed nations, and its growth is still limited in these countries. The reason for this is the affordability by the general population.3 In India, around 1–2 million children with CHDs are waiting for surgery at any given time, and among these, around 80,000 children require very urgent surgery and only 5% or less are affording.4,5

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Nearly one-third of congenital heart surgery admissions have an associated complication at the time of diagnosis. These complications during congenital heart surgery admissions are associated with a greater than twice risk for death as to admissions without a complication. Hence, the present study was undertaken with an objective of correlating the effect of preoperative risk factors in children with CHDs on the outcome of cardiac surgery.

MATERIALS AND METHODS

This 1-year prospective observational study was conducted at tertiary care and a teaching hospital from North Karnataka, India, for 1 year. A total of 200 children diagnosed with CHD (based on echocardiography [ECHO]) and undergoing cardiac surgery were included. The ethical clearance was obtained from the institutional ethical and research committee. After obtaining written informed consent, demographic data, birth information, and presenting complaints were noted. Physical examination was conducted for anthropometry and vitals and systemic findings. ECHO findings were noted. The patients were evaluated for the presence of any risk factors which were identified by the attending pediatric cardiologist in reference to previous available literature. A total of such 19 risk factors were identified. The risk factors present in very few cases were grouped together as “others” for the ease of analysis. “Pulmonary artery hypertension”: Mean pulmonary artery pressure of more than 30 mmHg at rest and systolic pulmonary artery pressure of more than 45 mmHg at rest. “Failure to thrive”: In children less than 5 years of age, weight of the child less than 3rd percentile for the age. “Pulmonary artery structural anomaly”: Cases having structural pulmonary arterial anomaly which was diagnosed by ECHO or preferably by computed tomographic pulmonary angiography in cases where it was indicated. “Recurrent lower respiratory tract infection”: Children presenting with a history of more than six infections in the span of previous 1 year requiring hospital admission and with ongoing X-ray-proven lower respiratory. “Cyanotic spell”: Children with a classical history of cyanotic spells. “Multiple ventricular septal defects (VSDs)”: More than or equal to 2 VSDs diagnosed by color Doppler. “Others”: Risk factors which were present in very few cases (less than 5). The type of surgery was categorized under risk-adjusted classification for congenital heart surgery (RACHS)-I criteria. Immediately, after the operation, the postoperative data were collected. Further, these patients were followed at an interval of 1 and 3 months. Following parameters were assessed at these intervals – anthropometric parameters: height, weight, developmental history, and general well-being. The patients were assessed by an investigator and by an attending pediatrician who was not a part of this study, to overcome the observer bias.

Data analysis

Categorical data were expressed as rates, ratios, and percentages. Continuous data were expressed as mean ± standard deviation. Chi-square test was used to find the association between two variables, and Student’s t-test was used to compare the mean values. McNemar’s test was used to compare the pre- and post-operative data. A P < 0.05 was considered statistically significant.

RESULTS

In the present study, 55.5% of children were boys and 44.5% were girls [Table 1]. In this study, most of the children (44%) were aged ≤ 1 year. In the present study, the children having acyanotic CHDs were higher (67%) as compared to those having cyanotic CHDs (33%). VSD was the most common CHD accounting for 35.5%. In the present study, majority of the children (75.5%) presented with risk factors. Lower respiratory tract infection was the most common risk factor noted in 46% of the children. Based on the RACHS-I criteria, 63% of the children were under RACHS-II category while the least (19%) were in RACHS-IV. In the present study, 92.5% of the children improved while 7.5% children expired. The mortality in all the 7.5% cases was due to immediate postoperative complications within maximum up to 6 days postoperatively. In the present study, of the 111 boys, 90.99% improved, and of the 89 girls, 94.38% improved. Maximum mortality was recorded in the children aged 1 year or less. In this study, mortality was significantly high in the children who presented with cyanotic CHDs (15.15%) (P = 0.004). Maximum mortality was seen in children with RACHS-IV criteria (21.05%), while minimum mortality was noted in children with RACHS-I (2.63%). Mortality was significantly high among the children with risk factors (100%) compared to no risk factors group (P = 0.022). Postoperatively, significant percentage increase in weight was observed in children who presented with risk factors (P = 0.020).

DISCUSSION

In the present study, the children having acyanotic CHDs...
were higher (67%) as compared to cyanotic CHDs (33%). This finding was similar to previous Indian studies. Shah et al. have reported the incidence of acyanotic CHD to be 69% and cyanotic CHD to be 31% from a tertiary care hospital of North India.

Maximum children (89.77%) with risk factors were children aged 1 year or less, while children aged >8–12 years had the lowest (46.67%) incidence of risk factors. This difference was statistically significant (P < 0.001). In a study by Bakshi et al., it has been reported that neonatal group is particularly associated with higher percentage of risk factors.

Overall, in the study population of 200 children undergoing cardiac surgery, the mortality rate was 7.5%. Previous study from India by Vasdev et al. has reported an overall mortality rate of 6.85%. In contrast to this, western literature shows a low mortality rate. In a study by Stark et al. and Welke et al. an overall mortality rate after CHD surgery was reported to be 4% and 4.6%, respectively. This higher mortality rate in developing country like India can be explained by delayed diagnoses, poor nutritional status, low socioeconomic status of the patients, and poor-resource settings.

In this study, 90.99% boys improved as compared to 94.38% girls but this difference was statistically not significant (P = 0.366). Thus, it can be postulated that sex is not a significant risk factor for mortality. This finding is in accordance with the study done by Marelli et al., where they reported the mortality rate in both male and female group undergoing pediatric cardiac surgery to be the same. The similar findings have been reported by Vaidyanathan et al. from a tertiary pediatric cardiac center from Southern India. Maximum mortality (10.23%) was found in the age group of less than 1 year and the least in the age group of more than 12 years (0.00%). The same finding has been reported by Bakshi et al. with a mortality rate of 8.8% in this age group. The higher mortality in this age group may be because of underlying hemodynamic instability in this age group with more chances of infections due to relatively weak immune status, both of which requiring longer postoperative stays in hospitals.

Maximum mortality was seen in children with RACHS-IV criteria (21.05%) while minimum mortality was noted in children with RACHS-I (2.63%). This indicates that complexity of the surgery as per the RACHS-I criteria is a statistically significant predictor of mortality (P = 0.023). The similar findings have been shown by Boethig et al. and in the Indian context by Vasdev et al. In the present study population, 26.49% of the cases with risk factors expired, while mortality in nonrisk factor group was 0.00%. This difference was statistically significant (P = 0.022), showing that the presence of a risk factor is a significant indicator of poor outcome. The risk factors which were found to significantly affect the outcome in terms of survival were preoperative presence of cyanosis (P = 0.001) and pulmonary artery structural anomaly (P = 0.018).

Both the risk factor and nonrisk factor groups showed weight gain over the next 3 months after surgery. Interestingly, statistically significant percentage increase in weight was observed in children who presented with risk factors than those in nonrisk factor group (P = 0.020). This similar finding has been noted previously in a study conducted in South India by Vaidyanathan et al. where they also noticed a statistically significant weight gain in these children postoperatively. In western literature also, similar findings have been noted. In a study published by Toole, the prevalence of malnutrition was found to be 40% in patients with CHDs which improved significantly after the cardiac surgery. This can be explained by the fact that the presence of a CHD itself is a cause for poor feeding and malnutrition which further makes the outcome of CHD, grave. By performing early cardiac surgery in these children with risk factor, this vicious cycle is broken, and thus, they start gaining weight by rather faster velocity. In the present study, a significant improvement in the general well-being of the children after cardiac surgery was noted. As these were subjective findings, their statistical significance might be questionable. However, majority of the parents and the pediatrician noticed a dramatic improvement in general well-being of these children in terms of motor milestones attainment, general cheerfulness of the baby, the feeding habits, and the absence of complaints by the parents.

This is the first study which assessed the cumulative effects of all risk factors on the outcome of the cardiac surgery on children having CHDs. A statistically significant amount of weight gain was noted in these children postoperatively. Further, it was shown that the presence of associated risk factors and complexity of the surgery as per the RACHS-I criteria are associated with significantly high rates of mortality postoperatively. All the domains of the development were not considered as these findings being subjective are liable to bias. The children were followed up only up to 3 months, so long-term implications of these risk factors on the outcome could not be assessed.

**CONCLUSION**

The presence of preoperative risk factors is a statistically
significant determinant of postoperative outcome in terms of survival in children undergoing cardiac surgery for CHDs.

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**Conflicts of interest**
There are no conflicts of interest.

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