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RACHS - 1 SYSTEM IN RISK STRATIFICATION FOR CONGENITAL HEART DISEASE SURGERY OUTCOME
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ABSTRACT

Background: **The Risk Adjustment in Congenital Heart Surgery (RACHS-1) system has been used as a benchmark to compare surgical results in developed countries. Its ability to stratify postoperative mortality risk has been validated in several developed countries, however, this has not been examined in a developing country.**
***Objectives*: To assess the ability of the RACHS-1 system to stratify postoperative mortality risk in a developing country.**
***Design*: Retrospective study over a five year period between 1st January 2002 and 31st December 2006.**
***Setting*: Kenyatta National Hospital, a teaching and referral hospital in Nairobi, Kenya.**
***Subjects*: Three hundred and seventeen consecutive operations were performed on 313 patients aged between 0.25 and 204 months.**
***Results*: Operations were performed in RACHS-1 categories 1, 2, 3 and 4 with hospital mortalities of 2.5%, 16.9%, 29.4% and 50% respectively. The difference in mortality between categories 1 and 2 was significant (p-value of 0.0003), however, the difference in mortality between categories 2 and 3 and categories 3 and 4 was not significant (p-values 0.193 and 0.67 respectively).**
***Conclusions*: The RACHS-1 system did not adequately stratify risk in a low case load setting. The use of the RACHS-1 method as a benchmark to compare surgical results of paediatric cardiac surgery services in developing countries may be limited.**

INTRODUCTION

Congenital heart disease(CHD) manifests as a spectrum of conditions with varying degrees of anatomical and physiological complexities. Treatment outcomes have been shown to correlate with lesion complexity(1). It has been noted that the quality of surgical care may vary between units(2). Quality-improvement efforts can be stimulated by comparing the surgical performance of different units. It is recognised that the operative mortality for complex lesions is higher than that for simple lesions(3). Surgical case mix differs between institutions hence useful comparisons of outcome require some form of risk adjustment. Risk stratification in paediatric cardiac surgery is challenging owing to wide variations in case-mix. The Risk Adjustment in Congenital Heart Surgery (RACHS-1) system was developed to enable surgical outcome comparison between institutions and surgeons (4). The RACHS-1 system groups specific operative procedures that have a similar risk of postoperative mortality into a single group. The whole system consists of six such groups designated from one to six in increasing order of risk of postoperative mortality. RACHS-1 has been validated in a number of developed countries (5). The aim of this study was to assess its ability to stratify postoperative mortality risk in a developing country.

MATERIALS AND METHODS

A five year retrospective study was carried out at Kenyatta National Hospital teaching and referral hospital in Nairobi, between January 1st 2002 and December 31st 2006. A consecutive sample was taken of all patients younger than 18 years who had undergone surgery for CHD at the study institution

during the study period. Patients records were consulted to assign (using echocardiographic reports and operation notes) a RACHS-1 category to each patient. The 30 day hospital mortality was used as the indicator of surgical outcome.The Chi-square test was used to test for significant differences in outcome between RACHS-1 categories. A p-value of less than 0.05 was considered significant.

RESULTS

Three hundred and seventeen procedures were performed consecutively on 313 patients. A summary of the procedures performed and their corresponding RACHS-1 categories is shown in Table 1. Figure 1 summarises the RACHS-1 category frequencies in our study, Table 2 summarises the RACHS-1 mortality rates and Table 3 compares mortality rates between RACHS-1 categories.

Table 1

Procedure performed and their corresponding RACHS-1 category

Procedure	RACHS-1 Category	Number Performed
PDAL	1	138
CTOF	2	46
MBTS	3	39
2ASDR	1	21
VSDR	2	17
PAB	3	14
CDORV	3	9
PAVCDR	2	8
CoAR	1	6
BDG	2	5
AS	4	3
O	1-3	11
Total	-	317

PDAL=Patient Ductus Arteriosus Ligation CTOF=Correction of Tetralogy of Fallot, MBTS= Modified Blalock-Taussig shunt, 2ASDR=Secundum Atrial Septal Defect Repair, VSDR= Ventricular Septal Defect Repair, PAB=Pulmonarv Artery Banding, CDORV= Correction of Double Outlet Right Ventricle, PAVCDR= Partial Atrioventricular Canal Defect Repair, CoAR= Coarctation of the Aorta Repair,BDG= Bidirectional Glenn Shunt, AS=Atrial Septectomy,O=Others

Table 2

Mortality according to RACHS-I category

RC	TNO	NOM	MR(%)
1	161	4	2.5
2	71	12	16.9
3	51	15	29.4
4	2	1	50.0
5	0	0	0
6	0	0	0

RC=RACHS-I Class, TNO= Total Number of Operations, NOM= Number of Mortalities, MR= Mortality Rate.

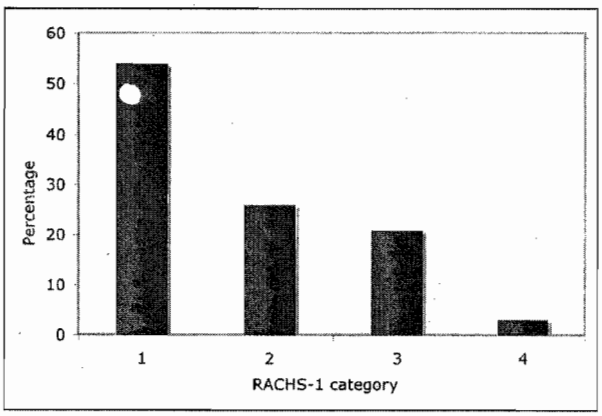
Table 3

RACHS-I category mortality comparison

RACHS-I category mortality comparison	P-value
1 vs 2	0.0003
2 vs 3	0.193
3 vs 4	0.67

Figure 1

RACHS-1 category frequency



DISCUSSION

The RACHS-1 method for risk stratification was developed by Jenkins and colleagues(4) to facilitate meaningful comparisons of in-hospital mortality for groups of children undergoing surgery for congenital heart disease. It has been validated on several occasions in developed countries(5-7) and its predicted mortality rates have been used by centres as benchmarks for comparing their own results for the purpose of quality improvement.

In our study, we only found a significant difference between RACHS-1 category 1 and category 2 patients. Although the mortality increases as one ascends the RACHS-1 categories, the increases in mortality from category 2 to 3 and from 3 to 4 were not significant. One of the most important prerequisites for any risk stratification tool is its ability to reliably place patients in different risk groups. If this ability is non existent, the tool may have limited utility. The RACHS-I method seems to work well when a large number of operations is considered. In a North American study(8), 13,138 operations were examined and the RACHS-1 method performed well. In two European studies(5,6), 2,368 and 957 patients were examined respectively, in both studies the RACHS-1 method performed well. Notably, the second European study(6) concluded that the RACHS-1 method could be used to predict hospital mortality in a small volume centre.

We examined 317 procedures which is an even smaller number than that examined by the small European study (6). The RACHS-1 method did not stratify categories 2,3 and 4 according to risk of postoperative mortality. Statistically speaking, as the number of patients examined by the RACHS-1 method decreases, the chance of getting true representations of mortality rates in the various risk categories diminishes. As this occurs, the ability of the RACHS-1 method to stratify risk also diminishes.

Sicker patients require more intense postoperative care; in paediatric cardiac surgery, this is usually administered in the intensive care unit (ICU) or its equivalent. The majority of patients in RACHS-1 category 1 did not require ICU admission whereas all of RACHS-1 category 2,3 and 4 patients did. RACHS-1 category 1 patients would be expected to convalesce well with minimal health care provider support. RACHS-1 category 2,3 and 4 patients require significant health care provider support for optimal convalescence. An ICU service is very demanding in terms of human resource and technical support. The ability of ICUs in developing countries to deliver optimal care may be hampered by resource shortages. As such, the standard of ICU could potentially blunt the ability of the RACHS-1 system to stratify postoperative mortality risk in settings with meager resources as without adequate postoperative care, patients in groups 2,3 and 4 would tend to convalesce as a single group.

If we assume that a service run by two surgeons performs two procedures every day for 250 days each year, each surgeon would perform 250 cases annually and the unit as a whole would perform 500 cases annually. The results from the small European study(6) suggest that about 1000 patients are required for a meaningful RACHS-1 analysis. This implies that most units would need to perform a RACHS-1 analysis every two years. For the surgeons in this example to compare their outcomes, each surgeon would have to carry out a RACHS-1 analysis every four years. It is customary to carry out surgical audits of this nature annually. An audit carried out every two years might expose patients to unacceptable practices for too long. Certainly, exposing patients to suboptimal care for four years does not seem justifiable.

Paediatric cardiac surgery services in developing countries are characterised by low case loads. In this setting, it would require even longer periods of time to obtain a sufficient number of cases to perform a meaningful RACHS-1 analysis. As such it would be even more difficult to appropriately apply the RACHS-1 method for an annual out come analysis in developing countries.

In conclusion, although the RACHS-I system has proved very useful in high caseload settings, it did not effectively stratify the risk of mortality when applied in one developed country. Its utility as a congenital cardiac surgery audit tool in developing countries may be limited.

REFERENCES

1. Jenkins, K. J. and Gauvreau, K. Center-specific differences in mortality:preliminary analyses using the Risk Adjustment in Congenital Heart Surgery(RACHS-1) method. *J. Thoracic. Cardio. Surg.* 2002; **124:** 97-104.
2. Aylin, P., Alves, B., Best, N. *et al.* Comparison of UK paediatric cardiac surgical performance by analysis of routinely collected data 1984-96: was Bristol an outlier? *Lancet.* 2001; **358:** 181-187.
3. Nieminen, H.P., Jokinen, E.V. and Sairanen, H.I. Late results of paediatric cardiac surgery: a population based study with 96% follow-up. *Circulation.* 2001; **104:**570-575.
4 Jenkins, K.J., Gauvreau, K., Newburger, J.W. *et al.* Consensus-based method for risk adjustment for surgery for congenital heart disease. *J. Thoracic. Cardio. Surg.* 2002; **123:** 110-118.
5. Boethig, D., Jenkins, K.J., Hecker, H. *et al.* The RACHS-1 risk categories reflect mortality and length of stay in a large German pediatric cardiac surgery population. *Euro. J. Cardio-thoracic Surg.* 2004; **26:** 12-17.
6 Larsen, S.H., Pedersen, J., Jacobsen, J. *et al.* The RACHS-1 risk categories reflect mortality and length of stay in a Danish population of children operated for congenital heart disease *Eur. J. Cardio-thoracic Surg.* 2005; **28:**877-881.
7 Kang, N., Cole T., Tsang, V. *et al.* Risk stratification in paediatric open-heart surgery. *Eur. J. Cardio-thoracic Surg.* 2004; **26:** 3-11.
8 Al-Radi, O.O., Harrell, F.E., Caldarone, C.A. *et al.* Case complexity scores in congenital heart surgery: a comparative study of the Aristotle Basic Complexity score and the Risk Adjustment in Congenital Heart Surgery (RACHS-I) system. *J. Thoracic Cardio. Surg.* 2007; **133:** 865-874.