



Egyptian Society of Anesthesiologists
Egyptian Journal of Anaesthesia

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Research Article

Clinical features and risk assessment for cardiac surgery in adult congenital heart disease: Three years at a single Japanese center



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Received 18 July 2013; accepted 22 December 2013

Available online 31 January 2014

KEYWORDS

Adult congenital heart disease (ACHD);
Cardiac surgery;
Clinical feature;
Exercise tolerance testing;
Brain natriuretic peptide (BNP)

Abstract Purpose: The aims of our study are twofold: first, to retrospectively identify the demographic characteristics and outcomes in cardiac surgery for adult congenital heart disease (ACHD); second, to explore whether certain preoperative examinations are useful for assessing the risk of perioperative mortality and morbidity.

Methods: Ninety-two ACHD patients who underwent cardiac surgery from 2009 to 2011 were enrolled in the study. The subjects were classified into three groups based on the complexity of the ACHD. We retrospectively collected data on demographics, operations, and postoperative courses. We also collected the results of examinations performed in the three months leading up to the cardiac surgery, including exercise tolerance testing and measurement of brain natriuretic peptide (BNP).

Results: The 30-day mortality was 3.3%. A remarkable discrepancy was found between subjective assessment and the severity of exercise intolerance by exercise tolerance testing. The NYHA class was 1 or 2 in all but one of 13 patients with moderate-severe exercise intolerance and a high mortality/major complication rate (53.8%). Patients with BNP ≥ 100 pg/ml had a significantly higher mortality/major complication rate than patients with BNP < 100 (34.8% vs. 11.5%, $p < 0.05$), but the sensitivity (53.3%) and positive predictive value (34.8%) were not high enough in themselves to identify patients at high risk of poor outcome.

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Peer review under responsibility of Egyptian Society of Anesthesiologists.



Conclusion: Cardiac surgery could be safely performed in most ACHD cases. Exercise tolerance testing can be useful in identifying patients at high risk of mortality or major complications. BNP can be valuable in predicting poor outcomes after cardiac surgery.

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1. Introduction

The population of patients with adult congenital heart disease (ACHD) in Japan has skyrocketed over the last four decades [1]. The number of ACHD patients surpassed the number of pediatric CHD patients more than a decade ago, in 1997, and today it surpasses 400,000 [1]. The distribution of ACHD complexity has also dramatically changed over the same period [1]. A Task Force of the American College of Cardiology (ACC) categorized ACHD in three types, simple, moderate, or complex [2]. Nowadays, cases with moderate to complex ACHD make up one-third of all ACHD cases in Japan [1]. The same trends in the number of ACHD patients and distribution of ACHD complexity are taking place in other developed countries, as well [3–7]. For these reasons, anesthesiologists will be expected to provide anesthetic management for a growing number of ACHD patients, especially patients with moderate to complex CHD, who undergo cardiac surgery, non-cardiac surgery, and delivery.

Meanwhile, care facilities for ACHD in Japan are still far from ideally established. A nationwide survey revealed that half of Japan's training hospitals for board-certified cardiologists perform cardiac surgery, but only on small numbers of patients [8]. The hospitals that performed the surgery generally do so on less than 10 patients per year, and only 6 of them nationwide have conducted more than 20 cardiac surgeries per year [8]. This naturally limits the opportunities for training in the field for anesthesiologists. As a first step to provide better training, we should recognize the demographic characteristics and outcomes of cardiac surgery for ACHD and gather sufficient knowledge on risk assessment for perioperative mortality and morbidity. Our hospital has conducted an average of 30–40 cardiac surgeries per year, which makes it one of Japan's most-experienced hospitals in cardiac surgery for ACHD. As such, knowledge of the demographic characteristics and outcomes of cardiac surgery for ACHD at our hospital may be useful for recognizing the same characteristics and outcomes on a larger scale, for all of Japan or other developed countries. The aims of this study are twofold; first, to retrospectively identify the demographic characteristics and outcomes in cardiac surgery for ACHD performed at our hospital over the three-year period; second, to explore whether certain preoperative examinations are useful for assessing the risk of perioperative mortality and morbidity.

2. Methods

2.1. Patients

The study subjects were consecutive CHD patients who underwent cardiac surgery under cardiopulmonary bypass (CPB) at the age of 15 years or older at Tokyo Women's Medical University Hospital over the period from January 1, 2009 to December 31, 2011. Patients undergoing aortic valve replacement for

bicuspid aortic valve lesion were excluded from this study. The patients were classified into three groups based on the complexity of the CHD according to the definition established by the ACC Task Force. This study was approved by the institutional ethics committee with a waiver of the requirement to obtain written informed consent from patients older than 20 years old and from the parents of younger patients.

2.2. Data collection

Medical charts, anesthetic records, and operative records were retrospectively reviewed. Data on demographics (age, gender, height, body weight, diagnosis, history of previous operations, history of previous sternotomies, type of surgery, and type of procedure), preoperative status (New York Heart Association [NYHA] class and American Society of Anesthesiologists physical status [ASA-PS]), operation (operation time, CPB time, aortic cross-clamp [Ao-clamp] time, and the amount of bleeding), and postoperative course (postoperative ventilation time, length of ICU stay, length of hospitalization, mortality, and morbidity) were collected. Morbidity consists of major and minor complications. The major complications consist of mechanical ventilatory support for longer than 7 days, mechanical circulatory support, lethal ventricular arrhythmia, bleeding requiring surgical hemostasis, cardiac tamponade requiring drainage, permanent neurological deficits, and heart blocks requiring permanent pacemaker implantation. Minor complications included temporal neurological deficits, atrial arrhythmia, pleural effusion, and pneumothorax.

2.3. Preoperative examinations

The results of the following examinations were collected if the examinations were performed in the three months leading up to cardiac surgery: exercise tolerance testing (cardiopulmonary exercise testing [CPET] and 6-minute walk test [6MWT]), myocardial perfusion imaging (MPI), and measurement of brain natriuretic peptide (BNP), hemoglobin (Hb), and glomerular filtration rate (GFR).

2.4. Statistics

Data are shown as means plus-minus standard deviations or medians with ranges (minimum to maximum). The chi-square test and Mann–Whitney *U* test were used for comparisons between two groups and one-way ANOVA was used for comparisons among three groups. A *p* value of less than 0.05 was considered as statistical significance.

3. Results

Ninety-two cases underwent cardiac surgery for ACHD during the study period: 31 simple cases, 33 moderate cases, and 28 complex cases. [Table 1](#) summarizes the demographic data of

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