CONG

Postoperative tricuspid regurgitation after adult congenital heart surgery is associated with adverse clinical outcomes

Matthew J. Lewis, MD, MPH,[a] Jonathan N. Ginns, MD,[a,b] Siqin Ye, MD,[c] Paul Chai, MD,[d] Jan M. Quaegebeur, MD,[d] Emile Bacha, MD,[d] and Marlon S. Rosenbaum, MD[a]

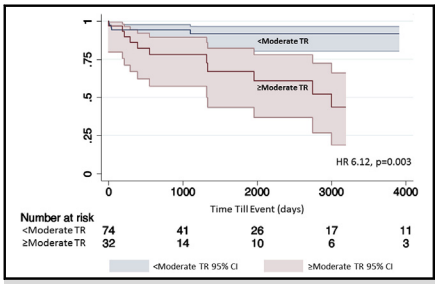
ABSTRACT

Objective: Many patients with adult congenital heart disease will require cardiac surgery during their lifetime, and some will have concomitant tricuspid regurgitation. However, the optimal management of significant tricuspid regurgitation at the time of cardiac surgery remains unclear. We assessed the determinants of adverse outcomes in patients with adult congenital heart disease and moderate or greater tricuspid regurgitation undergoing cardiac surgery for non–tricuspid regurgitation-related indications.

Methods: All adult patients with congenital heart disease and greater than moderate tricuspid regurgitation who underwent cardiac surgery for non–tricuspid regurgitation-related indications were included in a retrospective study at the Schneeweiss Adult Congenital Heart Center. Cohorts were defined by the type of tricuspid valve intervention at the time of surgery. The primary end point of interest was a composite of death, heart transplantation, and reoperation on the tricuspid valve.

Results: A total of 107 patients met inclusion criteria, and 17 patients (17%) reached the primary end point. A total of 68 patients (64%) underwent tricuspid valve repair, 8 patients (7%) underwent tricuspid valve replacement, and 31 patients (29%) did not have a tricuspid valve intervention. By multivariate analysis, moderate or greater postoperative tricuspid regurgitation was associated with a hazard ratio of 6.12 (1.84-20.3) for the primary end point ($P = .003$). In addition, failure to perform a tricuspid valve intervention at the time of surgery was associated with an odds ratio of 4.17 (1.26-14.3) for moderate or greater postoperative tricuspid regurgitation ($P = .02$).

Conclusions: Moderate or greater postoperative tricuspid regurgitation was associated with an increased risk of death, transplant, or reoperation in adult patients with congenital heart disease undergoing cardiac surgery for non–tricuspid regurgitation-related indications. Concomitant tricuspid valve intervention at the time of cardiac surgery should be considered in patients with adult congenital heart disease with moderate or greater preoperative tricuspid regurgitation. (J Thorac Cardiovasc Surg 2016;151:460-5)



Survivor function for the primary end point by degree of postoperative TR.

Central Message

TV intervention at the time of cardiac surgery should be considered in adults with CHD with moderate or greater preoperative TR.

Perspective

Approximately half of all patients with congenital disease will require repeat cardiac surgery in moderate or greater preoperative TR undergoing cardiac surgery for non–TR-related indications. TV intervention at the time of surgery may decrease the probability of death, TV reoperation, or heart transplant.

See Editorial Commentary page 466.

Approximately 1 in 5 adults with congenital heart disease (CHD) will require cardiac surgery during their lifetime, with reoperations accounting for approximately 40% of these surgeries.[1] Many of these patients will have concomitant tricuspid regurgitation (TR) before surgery.[2] The frequent need for cardiac surgery and presence of concomitant tricuspid valve (TV) disease in this population underscore the importance of establishing guidelines addressing the management of TR at the time of cardiac surgery.

The cause of TV disease in adult patients with CHD is variable and includes annular dilation, congenital abnormalities of the TV, iatrogenic leaflet damage from prior

From the [a]Division of Cardiology, Department of Medicine, Schneeweiss Adult Congenital Heat Center, Columbia University Medical Center, New York, NY; [b]Division of Thoracic Imaging, Department of Radiology, Columbia University Medical Center, New York, NY; [c]Department of Medicine, Center for Behavioral Cardiovascular Health, Columbia University Medical Center, New York, NY; and [d]Division of Cardiac, Thoracic and Vascular Surgery, Columbia University Medical Center, New York, NY.

Received for publication April 27, 2015; revisions received Aug 28, 2015; accepted for publication Sept 3, 2015; available ahead of print Oct 26, 2015.

Address for reprints: Matthew J. Lewis, MD, MPH, Herbert Irving Pavilion, 161 Fort Washington Ave, Suite 627, New York, NY 10032 (E-mail: ml3329@cumc.columbia.edu).

0022-5223/$36.00

http://dx.doi.org/10.1016/j.jtcvs.2015.09.028

Abbreviations and Acronyms
CHD = congenital heart disease
CI = confidence interval
PVR = pulmonary valve replacement
TR = tricuspid regurgitation
TV = tricuspid valve

surgical procedures, and pacemaker lead placement.[3-5] Because TR in adults with CHD is often thought to be secondary to other cardiac pathology, intervention on the TV is often deferred when cardiac surgery is performed for other indications, with the belief that improved ventricular remodeling will lead to a reduction in TR over time.[6] However, given that TR is associated with increased mortality in the general population[7] and that TV surgery can be performed with low mortality,[8,9] it is unclear whether this less aggressive approach to TV repair at the time of cardiac surgery represents an optimal strategy. Furthermore, the risk associated with persistent TR may be even greater in adult patients with CHD, in whom right ventricular dysfunction is more common.[10] Because of the inherent risk of residual TR and the morbidity conferred by multiple sternotomies,[11,12] defining a strategy to manage TR at the time of cardiac surgery is crucial in this population. To address this question, we sought to describe the determinants of mortality, heart transplantation, and repeat TV intervention in adult patients with CHD and moderate or greater TR undergoing cardiac surgery for non–TR-related indications.

MATERIALS AND METHODS

Study Design

We performed a retrospective cohort study of all patients at the Schneeweiss Adult Congenital Heart Center at Columbia University with moderate or greater TR who underwent cardiac surgery for non–TV-related indications between January 1994 and January 2015. The main exposure variable of interest was the type of TV intervention at the time of surgery, defined as no TV intervention, concurrent TV repair, and concurrent TV replacement. The primary end point of interest was a prespecified composite of death, orthotropic heart transplant, and reoperation of the TV. The secondary end point of interest was degree of postoperative TR up to 3 years after surgery. Because we were interested in non-Ebsteinoid TR of the subpulmonic ventricle, patients with congenitally corrected transposition of the great arteries, D-transposition of the great arteries with Mustard or Senning repair, Ebstein's anomaly, and single ventricles were excluded from the study. The Columbia University Medical Center institutional review board approved this study before the onset of study procedures.

Clinical Variables of Interest

Demographic and clinical data including patient diagnoses and prior surgical procedures were determined through review of electronic and written medical records. Two-dimensional transthoracic echocardiograms performed closest to the time of cardiac surgery were used to define the degree of preoperative TR. Degree of preoperative TR was classified as mild, moderate, moderate-severe, or severe from echocardiographic assessment based on visual assessment performed by 2 cardiologists (JNG and MSR) with years of expertise in congenital echocardiography. Only patients with moderate or greater TR were included in the study. The degree of postoperative TR was classified as mild or less or moderate or greater using the same methodology and using the last echocardiogram available within a 3-year window from each patient's surgery. Likewise, preoperative echocardiographic right ventricular function was classified as normal or abnormal on the basis of visual echocardiographic assessment by the same readers. Patient-specific data including preoperative heart failure and functional status were ascertained from the patient's clinical visit closest to the time of surgery.

Primary End Point

The primary end point of interest was prespecified as a composite of death, heart transplant, or reoperation on the TV. Death was determined via review of the medical record and through the Social Security Death Index. Reoperation on the TV was determined via review of the medical records and included any surgeries that were performed for TR. Patients were contacted to assess their current clinical status and to confirm whether cardiac surgery had occurred since the time of last follow-up. In the event that cardiac surgery had been performed, medical records were obtained to adjudicate the primary end point. If a patient was unable to be contacted, follow-up was censored at the time when status of the patient was last known.

Statistics

Data were expressed as frequency (%), median (interquartile range), or mean ± standard deviation as appropriate. Univariate and multivariate testing were performed for the primary end point using a Cox proportional hazard model. Multivariate models for the primary end point were prespecified to contain moderate or greater postoperative TR, age, and concomitant TV intervention based on prior literature. Additional variables reaching P less than .20 in the univariate analysis were subsequently added. Assumption of proportional hazards was verified using a formal significance test based on scaled and unscaled Schoenfeld residuals. Univariate and multivariate testing were performed for the predictors of postoperative TR using logistic regression. Multivariate models for postoperative TR were prespecified to contain age, concomitant TV intervention, and degree of preoperative TR, and any additional variables reaching P less than .20 in the univariate analysis were subsequently added. A Kaplan–Meier survivor function was performed for the primary end point by degree of postoperative TR. Statistical analysis was performed using STATA statistical software (Version 13.1, StataCorp LP, College Station, Tex).

RESULTS

Patient Characteristics

Of the 1457 adult patients with CHD who underwent surgery at the Schneeweiss Adult Congenital Heart Center at Columbia University from January 1991 to January 2015, 107 (7%) met inclusion criteria. The median time to the primary end point was 2.96 years (interquartile range, 6.5 years). Patient characteristics are delineated in Table 1. Forty-five (42%) of 107 patients were male, and the median age at the time of surgery was 41 years (interquartile range, 14 years). Before cardiac surgery, 55 patients (51%) had moderate TR, 21 patients had moderate-severe TR (19%), and 31 patients (30%) had severe TR. Primary surgeries included 44 pulmonary valve replacements (PVRs) (41%), 26 atrial septal defect repairs (24%), 7 ventricular septal defect repairs (7%), 6 mitral valve replacements (6%), 6 Rastelli procedures or conduit replacements (6%), and 18 other procedures (17%).