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Verification of Heart Disease

Implications for a New Heart Transplantation Allocation System

Pejman Raeisi-Giglou, DO,[a] E. Rene Rodriguez, MD,[b] Eugene H. Blackstone, MD,[c,d,e] Carmela D. Tan, MD,[b] Eileen M. Hsich, MD[c,e]

ABSTRACT

OBJECTIVES This study sought to determine the accuracy of the pre-transplantation clinical diagnosis of heart disease in the United Network for Organ Sharing (UNOS) database.

BACKGROUND Because survival on the heart transplantation waitlist depends on underlying heart disease, a new allocation system will include the type of heart disease. Accuracy of the pre-transplantation clinical diagnosis and the effect of misclassification are unknown.

METHODS We included all adults who received transplants at our center between January 2009 to December 2015. We compared the pre-transplantation clinical diagnosis at listing with pathology of the explanted heart and determined the potential effect of misclassification with the proposed allocation system.

RESULTS A total of 334 patients had the following clinical cardiac diagnoses at listing: 148 had dilated cardiomyopathy, 19 had restrictive cardiomyopathy, 103 had ischemic cardiomyopathy, 24 had hypertrophic cardiomyopathy, 11 had valvular disease, 16 had congenital heart disease (CHD), and 13 patients had a diagnosis of "other." Pathology of the explanted hearts revealed 82% concordance and 18% discordance (10% coding errors and 8% incorrect diagnosis). The most common incorrect diagnoses were sarcoidosis (66%), arrhythmogenic right ventricular dysplasia (60%), and other causes of predominately right-sided heart failure (33%). Among the misclassified diagnoses, 40% were listed as UNOS status 2, 8% remained at status 2 at transplantation, and only sarcoidosis and CHD were potentially at a disadvantage with the new allocation.

CONCLUSIONS There is high concordance between clinical and pathologic diagnosis, except for sarcoidosis and genetic diseases. Few misclassifications result in disadvantages to patients based on the new allocation system, but rare diseases like sarcoidosis remain problematic. To improve the UNOS database and enhance outcome research, pathology of the explanted hearts should be required post-transplantation. (J Am Coll Cardiol HF 2017;5:904–13)

Using the Scientific Registry of Transplant Recipients (SRTR) database, we recently showed that survival on the national heart transplantation waitlist depends on the type of heart disease (1). Patients with the best survival have an ischemic, dilated nonischemic, or hypertrophic cardiomyopathy; those with poor survival have restrictive cardiomyopathy, congenital heart disease, or prior transplantation. What remains unknown is whether the pre-transplantation clinical diagnosis at listing is accurate. Misclassification of heart disease has become a critical issue because the heart transplantation allocation system in the United States will soon change to include type of heart disease as a separate tier (**Table 1**) (2). Therefore, using histologic data from a single center, our objectives were to: 1) determine the accuracy of pre-transplant clinical diagnosis of heart disease entered into the national

From the [a]Department of Internal Medicine, Cleveland Clinic, Cleveland, Ohio; [b]Department of Pathology, Cleveland Clinic, Cleveland, Ohio; [c]Department of Cardiology, Kaufman Center for Heart Failure, Cleveland, Ohio; [d]Department of Quantitative Health Sciences, Cleveland Clinic, Cleveland, Ohio; and the [e]Cleveland Clinic Lerner College of Medicine of Case Western Reserve University School of Medicine, Cleveland, Ohio. This study was funded by U.S. National Institutes of Health/National Heart, Lung and Blood Institute award R56HL125420. The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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database; 2) identify the heart diseases most likely to be incorrect; 3) determine whether cardiac biopsies (endomyocardial and apical core) prior to transplant improve accuracy of the pre-transplantation clinical diagnosis; and 4) determine whether misclassification of heart disease would potentially disadvantage patients in the new UNOS allocation.

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METHODS

PATIENT POPULATION. We included all adults 18 years of age and older who received heart transplantations at Cleveland Clinic between January 1, 2009, and December 31, 2015, including dual-organ transplantation recipients. Patients with prior heart transplantations were excluded because identifying heart disease by pathology depended on knowledge of medical history. The study was a quality assurance and performance improvement project and was approved by the institutional review board at our institution with a waiver of informed consent.

STUDY DESIGN. The pre-transplantation clinical diagnosis entered into the United Network for Organ Sharing (UNOS) database was compared with the pathology of the explanted hearts to determine the degree of concordance. The pre-transplantation clinical diagnosis of heart disease was divided into the following categories in the SRTR database: dilated cardiomyopathy (adriamycin, peripartum cardiomyopathy, familial, alcohol, myocarditis, viral, idiopathic, and other); ischemic cardiomyopathy, hypertrophic cardiomyopathy, restrictive cardiomyopathy (idiopathic, amyloid, endocardial fibrosis, sarcoidosis, radiation/chemotherapy-induced heart disease, other); valvular, congenital heart disease; and other (cancer, arrhythmogenic right ventricular dysplasia, muscular dystrophy, other).

Pathology of the explanted heart was considered the gold standard in this study for type of heart disease. Two pathologists, blinded to all clinical information, reviewed the pathology reports of the explanted hearts and categorized them as the following: dilated cardiomyopathy (myocarditis, other); restrictive cardiomyopathy (amyloid, endocardial fibrosis, sarcoidosis, other restrictive cardiomyopathy); ischemic cardiomyopathy, hypertrophic cardiomyopathy, valvular heart disease (defined as valve replacement), congenital heart disease; and "other" (arrhythmogenic right ventricular dysplasia, cancer, and other). Degree of correlation between the pre-transplantation clinical diagnosis was entered into the national transplantation database, and the pathologic diagnoses of the explanted hearts were compared and labeled as either concordant or discordant (misclassified) diagnoses. Those that were discordant were further categorized as coding error or incorrect diagnosis by clinician at time of listing based on data in the electronic medical records. Coding errors were listings of diagnoses that differed from the last clinical assessment that was concordant with the pathological diagnosis. Incorrect diagnosis was defined as a pre-transplantation clinical diagnosis in the electronic medical records entered by a cardiologist at the time of listing that differed from the pathology of the explanted heart. If the pathologic report did not match either the data entered or the clinician's pre-transplantation diagnosis, the discordant information was labeled incorrect diagnosis, as further training for data entry would not yield more reliable data. Pathologic reports that described more than 1 disease (i.e., coronary artery disease and prosthetic valve disease) were labeled both and deemed concordant with the pre-transplantation clinical diagnosis if the pathology supported the type of heart disease clinical diagnosis entered into the national database.

Baseline characteristics were categorized by pre-transplantation clinical diagnosis and taken from Cleveland Clinic data entered into the national transplantation database with the exception of hemodynamics. Hemodynamic data were obtained from medical chart review because we discovered in our previous SRTR heart transplantation research that there was a high degree of missing values for several variables including right atrial pressure.

Cardiac biopsy results prior to transplantation were reviewed to determine whether results of a myocardial sample would improve accuracy of the pre-transplantation clinical diagnosis of heart disease. Cardiac biopsies included right ventricular endomyocardial tissue and cardiac tissue from an apical core obtained upon implantation of a ventricular assist device.

UNOS status at time of listing and time of transplantation were compared to determine whether misclassification of type of heart disease would potentially disadvantage patients after implementation of the new heart allocation system. Medical priority for transplantation was defined by UNOS status, and documentation was supported by use of inotropes, devices, intubation, or exemptions at time of transplantation.

STATISTICAL ANALYSIS. Continuous variables for baseline characteristics were expressed as median and 25th and 75th percentiles (Q1, Q3). Categorical

ABBREVIATIONS AND ACRONYMS

CHD = congenital heart disease

DCM = dilated cardiomyopathy

HCM = hypertrophic cardiomyopathy

ICM = ischemic cardiomyopathy

RCM = restrictive cardiomyopathy

VHD = valvular heart disease