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Commentary on Case Report

Old Dog, New Tricks – Usefulness of the ECG in Monitoring Acute Rejection Post Cardiac Transplantation

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Abstract

Electrocardiographic abnormalities have been described in the setting of acute rejection following orthotopic cardiac transplantation. The following is a brief commentary related to an interesting case report by Goldraich et al. which was recently published in the VAD Journal.

Keywords

Heart failure; Heart transplantation; Rejection

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It has long been recognized that cases of acute rejection following orthotopic heart transplantation are associated with electrocardiographic abnormalities, and that these abnormalities are reversible when the episode of rejection has resolved (1). In this issue of the VAD Journal, Goldraich and colleagues present another such example of a heart transplant patient with hemodynamically significant acute rejection requiring mechanical circulatory support (MCS) with extracorporeal membrane oxygenation (ECMO) and a percutaneous Impella left ventricular assist device (LVAD) (2). They note several electrocardiographic abnormalities associated with the acute presentation of severe rejection and discuss how these abnormalities resolved as the patient recovered. The resolution of the electrocardiographic abnormalities coincided with the hemodynamic improvement observed in the patient as the patient was undergoing weaning from MCS, and the authors suggest that the dynamic nature of the electrocardiographic findings could be useful in informing physicians on the

suitability of weaning from MCS.

In their report, the ECG presented during acute rejection showed several abnormalities. First, there is a tachyarrhythmia which on close inspection is likely atrial flutter at 300 bpm with 2:1 conduction to the ventricles yielding a ventricular rate of exactly 150 bpm. Sinus tachycardia, however, cannot be definitively excluded. Rhythm abnormalities ranging from sinus tachycardia and atrial arrhythmias to ventricular arrhythmias can be associated with acute cardiac transplant rejection (11). The ECG also demonstrates diminished voltage of the QRS complex present in the limb leads which is not present on the reference ECG. Diminished QRS voltage, or microvoltage, defined by the QRS amplitude not exceeding 0.5 mV (5 mm) in the limb leads or 1 mV (10 mm) in the precordial leads, is typically observed with the "damping" effect of fluid (e.g. pleural or pericardial effusion), fat (e.g. obesity) or air (e.g. pneumothorax) between the heart and the recording electrode (12). However, it can also be seen with a loss of viable myocardium or when there is diffuse infiltration of the heart such as in cases of ischemic or infiltrative cardiomyopathy, myocarditis, or acute rejection. The ECG further shows a dramatic alteration in the pattern of depolarization as well as dispersion of the QTc interval. These and other ECG abnormalities are attendant to the episode of acute rejection. Their significance, however, must be based on an understanding of the electrocardiographic features of the normal transplanted heart.

Alterations in the electrocardiogram (ECG) of the transplanted heart have been described including supraventricular arrhythmias, intraventricular conduction disturbances, and repolarization changes (3-5). The most common of these is the incomplete or complete right bundle branch block (3-5). Generally, no other significant changes in the ECG amplitude or intervals are appreciated under normal circumstances. While the presence of a right bundle branch block in and of itself is not associated with adverse future cardiovascular outcomes, other changes may be seen in response to conditions which directly affect the transplanted heart such as transplant-associated vasculopathy and acute rejection (5). These changes include reduced QRS amplitude, reduced T wave amplitude, QTc interval widening, QTc dispersion, and ST segment abnormalities (6-11). None of these electrocardiographic abnormalities are specific to acute rejection, but in the proper clinical setting, these abnormalities can provide clues to the underlying etiology and be useful to guide further evaluation and treatment. Acute cardiac rejection is characterized by cardiac infiltration by mononuclear cells, macrophages, and lymphocytes with subsequent myocardial inflammation (13). Importantly, while ECG changes such as reduced QRS amplitude have been well described in the literature surrounding cases of acute rejection following orthotopic heart transplantation, evidence suggests that QRS amplitude changes are unreliable to consistently diagnose acute rejection (14). In other words, there is no single electrocardiographic feature that can be used to reliably diagnose acute rejection. Consequently, diligent clinical evaluation, hemodynamic measurements, and non-invasive cardiac imaging may all play an important role in these cases.

The present case illustrates how serial ECGs in a heart transplant patient with cardiogenic shock attributable to acute rejection evolved over the course of treatment and subsequent weaning of the patient from MCS. Although the electrocardiograms were not used to guide weaning from mechanical circulatory support, the observations made by Goldraich et al are important in that they focus attention on the potential usefulness of a readily available and inexpensive technique, the electrocardiogram, to assist in the monitoring of patients with acute rejection who are requiring MCS. While it is unlikely that the ECG features will be the sole criteria used to guide weaning from MCS, it may allow for a more judicious use of more sophisticated tools such as echocardiography for such purposes.

References

1. Schroeder JS, Popp RL, Stinson EB, et al. Acute rejection following cardiac transplantation: phonocardiographic and ultrasound observations. Circulation 1969, 40: 155-164.

2. Goldraich LA, Rao V, Billia F, et al. Old school still has merit: ECG as a marker of cardiac recovery at weaning from mechanical circulatory support. VAD Journal, 2015, in press.

3. Pickham D, Hickey K, Doering L, Chen B, Castillo C, and Drew BJ. ECG abnormalities in the first year after heart transplantation. Journal of Electrophysiology 2014, 47(2): 135-139.

4. Gao SZ, Hunt SA, Wiederhold V, and Schroeder JS. Characteristics of serial ECGs in heart transplant recipients. American Heart Journal. 1991, 122: 771-774.

5. Golshayan D, Seydoux C, Berguer DG, et al. Incidence and prognostic value of ECG abnormalities after heart transplantation. Clinical Cardiology. 1998, 21(9): 680-684.

6. Richartz BM, Radovancevic B, Bologna MT, and Frazier OH. Usefulness of the QTc interval in predicting acute allograft rejection. Thoracic Cardiovascular Surgery. 1998, 46(4): 217-221.

7. Mueller J, Warnecke H, Cohnert T, Hetzer R. Electrocardiographic detection of rejection. Editorial Annals of Thoracic Surgery. 1993, 6(1): 1593-4.

8. Irwin ED, Bianco RW, Clack R, et al. Use of epicardial electrocardiograms for detecting cardiac allograft rejection. Annals of Thoracic Surgery. 1992, 54(4): 669-674.

9. Regueiro-Abel M, Crespo-Leiro MG, Muniz J, et al. Value of QT Dispersion analysis for noninvasive detection of cardiac allograft rejection. Transplantation Proceedings. 2002, 34(1): 168-170.

10. Valentino VA, Ventura HO, Abi-Samra FM, et al. The signal averaged electrocardiogram in cardiac transplantation. A noninvasive marker of acute allograft rejection.

11. Cui G, Tung T, Kobashigawa J, Laks H, Sen L. Increased incidence of atrial flutter associated with the rejection of heart transplantation. Am J Cardiol. 2001, 88(3): 280-284.

12. Madias JE. Low QRS voltage and its causes. J Electrocardiol. 2008, 41(6): 498-500.

13. Eisen, HJ. Heart transplantation: graft rejection basics. Johns Hopkins Advanced Studies in Medicine Proceedings 174. Vol. 8, No. 6, May 2008.

14. Costanzo MR, Dipchand A, Starling R, Anderson A, Chan M, Desai S, Fedson S, Fisher P, Gonzales-Stawinski G, Martinelli L, McGiffin D, Smith J, Taylor D, Meiser B, Webber S, Baran D, Carboni M, Dengler T, Feldman D, Frigerio M, Kfoury A, Kim D, Kobashigawa J, Shullo M, Stehlik J, Teuteberg J, Uber P, Zuckermann A, Hunt S, Burch M, Bhat G, Canter C, Chinnoc R, Crespo-Leiro M, Delgado R, Dobbels F, Grady K, Kao W, Lamour J, Parry G, Patel J, Pini D, Towbin J, Wolfel G, Delgado D, Eisen H, Goldberg L, Hosenpud J, Johnson M, Keogh A, Lewis C, O'Connell J, Rogers J, Ross H, Russell S, Vanhaecke J; International Society of Heart and Lung Transplantation Guidelines for the care of heart transplant recipients. J Heart Lung Transplant. 2010(8): 914-56.