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CASE REPORT

Early Acute Graft Rejection in a Heart Transplanted Child with Dilated Cardiomyopathy

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ABSTRACT

Dilated cardiomyopathy (DCM) is the most common type of cardiomyopathy in children. Heart transplantation is considered standard therapy in dilated cardiomyopathy with end-stage heart failure. We present a case of a 15-year-old patient diagnosed with DCM in the neonatal period, who underwent heart transplantation for end-stage heart failure. Despite the use of induction therapy, the endomyocardial biopsy performed at two weeks post-transplant revealed mixed moderate cellular (2R) and humoral (pAMR2) allograft rejection. Aggressive rejection treatment was initiated with good outcome. Besides endomyocardial biopsy, advanced echocardiography can also be a valuable noninvasive tool for rejection assessment.

Keywords: heart transplantation, acute rejection, dilated cardiomyopathy, advanced echocardiography, children

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INTRODUCTION

Pediatric cardiomyopathies are a rare heterogeneous group of heart muscle diseases with small incidence worldwide, but with a major impact on mortality and morbidity in the pediatric population.[1] In children, dilated cardiomyopathy (DCM) is the most common type of cardiomyopathy, accounting for almost 60% of cases, and the most frequent cause of heart transplantation.[2] According to the International Society for Heart and Lung Transplantation (ISHLT), DCM was the cause of pediatric heart transplants in almost 38% of infants and 54% of children between the ages of 11 and 17 years.[3] Post-transplant, there are still numerous challenges.

Despite significant progress in immunosupression therapy, ISHLT data reports that almost 40% of recipients experience acute rejection in the first months after transplant, with a smaller survival rate.[4] In most cases, acute graft rejection is caused by cellular rejection with a T lymphocyte-mediated response. Humoral rejection occurs

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when the immune system of the recipient starts to produce antibodies directly against the allograft tissue. Even though antibody-mediated rejection occurs months or even years post-transplant, in some cases, acute humoral rejection can occur within hours or days.

CASE PRESENTATION

We present a case of a 15-year-old patient diagnosed with DCM in the neonatal period, who underwent heart transplantation for end-stage heart failure.

On review of his medical history, at two months of life, the patient underwent cardiac surgery for atrial septal defect closure. At 1.5 years of age, he was diagnosed with DCM, and anticongestive treatment was started. Over the years, despite maximal medical treatment, his clinical condition continued to deteriorate, with severe limitation of physical activity, weight loss (BMI: 14.1; percentile: 0.1; z-score: −3.8), and the appearance of non-sustained ventricular tachycardia documented on 24-hour Holter monitoring. At this point, the patient was listed for heart transplant. Prior to the transplant, cardiac catheterization revealed a normal pulmonary vascular resistance index of about 0.97 Woods units/m^2.

A matching donor (same blood group and comparable weight) was found, and orthotopic heart transplantation was performed using the bicaval technique. Post-transplant, initial management included induction therapy with thymoglobulin (R-ATG) and high-dose corticosteroids, and maintenance immunosupression therapy was based on a triple association with calcineurin inhibitor (tacrolimus), antiproliferative agent (Mycophenolat Mofetil, MMF), and corticosteroids. The immediate postoperative course was favorable, and the patient was extubated on day 2 after the transplant.

Subsequently, a progressive deterioration of the patient's clinical condition was noted, with fatigability, progressive enlargement of the abdomen with positive fluid wave test, hepatomegaly, mild pedal edema, and absent breath sounds over the lower right chest. SaO_2 (100%) and blood pressure (111/64 mmHg) were normal. The laboratory analysis revealed elevated BNP levels (2,419 pg/mL) and marked anemia (8 g%). Chest radiography showed a right-sided pleural effusion and right diaphragmatic paralysis, and the abdominal ultrasound demonstrated a large amount of ascites (Figure 1). Echocardiography was also performed and revealed pericardial effusion, left ventricular diastolic dysfunction (restrictive type) with normal ejection fraction, but impaired longitudinal strain indices (AP4-LS: −16%, AP3-LS: −10%, AP2-LS: −12%, global LS: −13%) (Figure 2). The echocardiography also revealed thickened myocardium, hyperechogenic, granular aspect of the interventricular septum, and elevated LV mass (154.45 g/m^2). The electrocardiogram showed low QRS voltage with signs of myocardial injury.

In this context, we suspected early graft rejection, and cardiac catheterization with endomyocardial biopsy was performed 17 days after the heart transplant. The hemodynamic assessment of the right heart showed elevated right arterial pressure (27/31/22 mmHg), with elevated pulmonary arterial pressure (43/20/29 mmHg) and pulmonary wedge pressure (16 mmHg). The histopathological examination described focal lymphocyte infiltration in perivascular areas, with myocardial necrosis and active

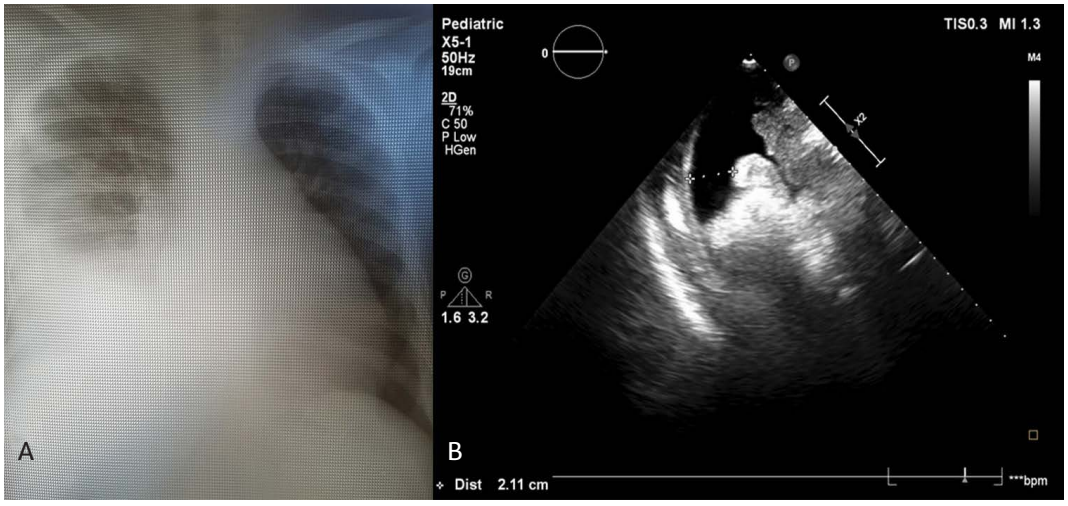

FIGURE 1. Chest radiography revealing right-sided pleural effusion and right diaphragmatic paralysis (**A**); abdominal ultrasound demonstrating a large amount of ascites (**B**)

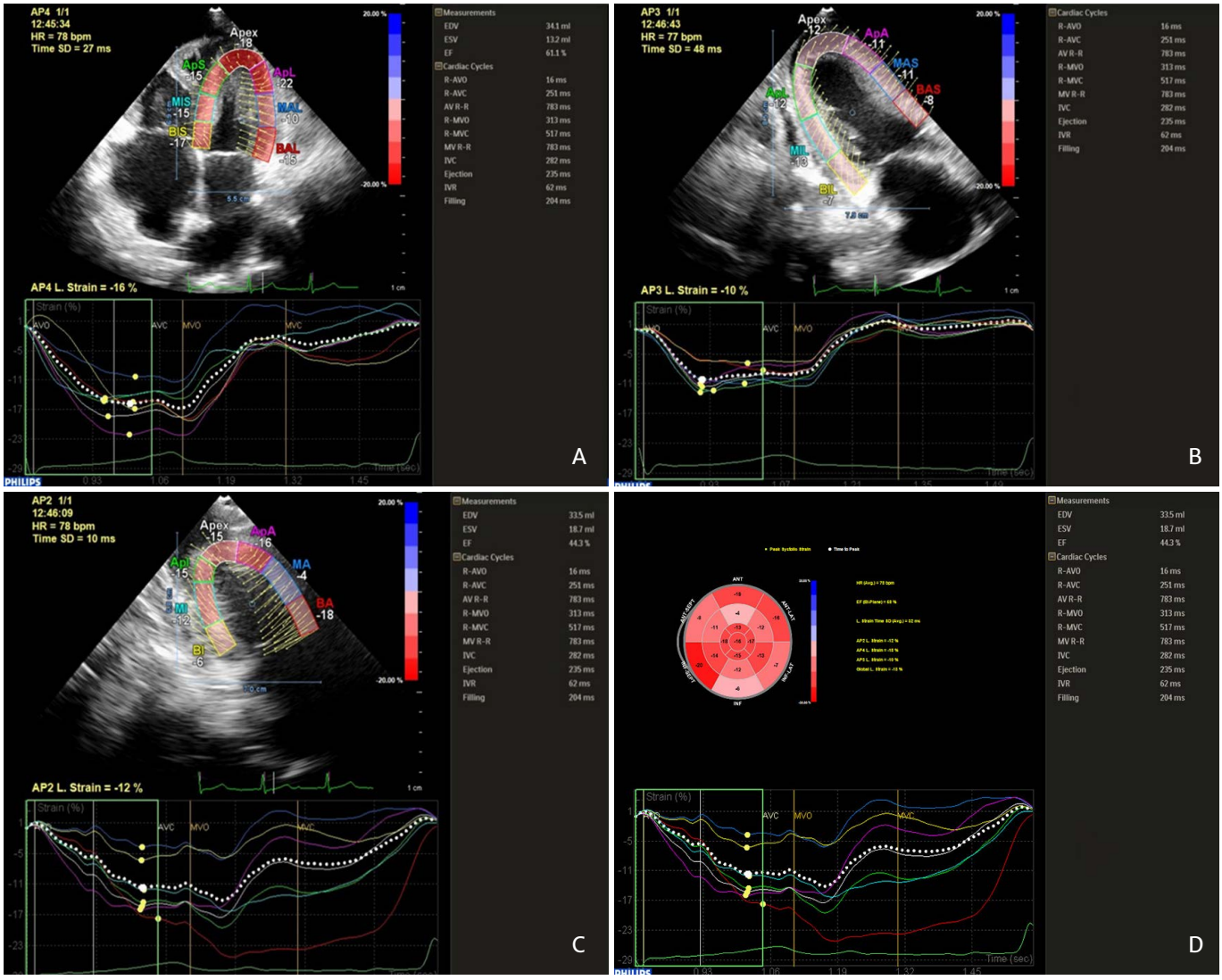

FIGURE 2. Speckle-tracking analysis showing impaired LV longitudinal strain indices at the time of endomyocardial biopsy, suggestive for rejection: AP4-LS: −16% (**A**), AP3-LS: −10% (**B**), AP2-LS: −12% (**C**), global LS: −13% (**D**)

inflammatory changes. The immunohistochemistry was positive for CD34 and CD31. Therefore, according to ISHLT criteria, the patient was diagnosed with mixed moderate cellular (2R) and humoral (pAMR2) allograft rejection. Aggressive rejection treatment was initiated with thymoglobulin (R-ATG), pulse corticosteroid therapy, and intravenous immunoglobulin. Also intravenous milrinone and deleukocyted blood transfusion have been added. Following the rejection treatment, tacrolimus, MMF, and oral prednisone were continued. After several days, the patient presented acute abdominal pain with subocclusive syndrome. Consequently, MMF was replaced with mycophenolic acid, and the patient's general condition improved, his BNP level decreasing to 52.1 pg/mL. The ST segment and T wave were present on the ECG, and echocardiography showed decreased LV mass (104.46 g/m^2), normal LV diastolic function, and slightly increased longitudinal strain parameters (AP4-LS: −18%, AP3-LS: −14%, AP2-LS: −12%, global LS: −15%). Endomyocardial biopsy was repeated and showed regression of the lesions (ISHLT 0). The patient's legal guardian agreed to the publication of his data, and the institution where the patient had been admitted, approved the publication of the case.

DISCUSSIONS

In this article, we presented a clinical case of early graft rejection in a patient with DCM and progressive, severe heart failure with life-threatening arrhythmia, who received a heart transplant at the age of 15 years.

DCM is one of the most common types of cardiomyopathy in the pediatric population, with an annual inci-

dence of almost 0.6 cases per 100,000. Despite maximal medical treatment, heart transplant is considered standard therapy. Based on multicenter observational studies, recent guidelines were developed in order to use cardiac transplant in patients with DCM. Waitlist mortality is still high, and studies report that almost 40% of patients with end-stage heart failure due to DCM have significant complications with an increased risk of morbidity and mortality while on waitlist.[5] Efforts are still ongoing in order to assess the proper time for heart transplant listing and to identify risk factors that can be involved in waitlist mortality.[6] According to the Pediatric Cardiomyopathy Registry Study Group, patients with decompensated heart failure with severe dilatation of the LV and low ejection fraction have a higher risk of mortality.[7] Singh *et al*. found that the degree of LV dilatation is associated with a poor prognosis and an increased risk of death while on the waiting list and 6 months after heart transplant.[8] Furthermore, the risk of death is greater in patients diagnosed with severe DCM in the first months of life. Another factor associated with a worse outcome is the severity of heart failure signs and symptoms at cardiac evaluation.[8] In the case we presented, the patient was considered high-risk due to the fact that prior to transplant he showed signs and symptoms of end-stage heart failure, with life-threatening arrhythmias and severe dilatation of the LV. In this context, due to irreparable cardiac disease, a transplant was considered the only remaining therapeutic choice, with a better survival rate post-transplant.

After heart transplant, the patient received immunosuppression therapy divided into two parts: induction therapy and maintenance therapy. In our transplant center, induction therapy is given in order to prevent early graft rejection. The role of induction therapy is still debatable between transplant centers because of higher risk of post-transplant infectious complications and lymphoproliferative disorders, and every transplant center uses its own induction protocol.[9] Despite the fact that there is no direct association between higher graft survival and induction therapy, ISHLT data suggests that induction therapy is widely used, with almost 70% of cardiac recipients receiving induction therapy in the last years. Regarding maintenance therapy, the ISHLT reports that most pediatric heart transplant centers use the association of tacrolimus as the centerpiece and adjuvant therapy (MMF/mycophenolic acid and corticosteroids) due to a series of studies in adults that showed an improved long-term prognosis and fewer adverse effects compared with other drugs regimens.[10] In our case, despite the use of induction therapy and studies showing that tacrolimus-treated patients have a lower rate of rejection in the first year post-transplant (compared with other immunosuppressive drugs),[10] after two weeks post-transplant, the endomyocardial biopsy revealed mixed cellular and humoral rejection.

Endomyocardial biopsy is considered the gold standard for the diagnosis of graft rejection. Nevertheless, due to the potential risks of cardiac catheterization, the role of noninvasive imaging in assessing pediatric patients after orthotopic heart transplantation has increased lately. Echocardiography is a noninvasive, fast, and widely available imaging method, with remarkable developments lately in terms of myocardial deformation, 3D echocardiography, and also intrauterine diagnosis.[11,12] Regarding orthotopic heart transplantation, some authors suggested that LV mass increases and tissue Doppler indices decrease during rejection episodes.[13–15] Serial myocardial perfusion imaging (MPI) measurements can be used for the detection of rejection.[13,16] Also, multiple scoring methods have been proposed using M-mode parameters or tissue Doppler measurements. Furthermore, several studies have emphasized the utility of strain in diagnosing rejection, describing a worsening of longitudinal and circumferential strain in patients with rejection.[13,18–20] In our heart transplanted child, the echocardiographic assessment revealed increased LV mass, restrictive-type LV diastolic dysfunction, and decreased LV longitudinal strain at the time of endomyocardial biopsy, suggesting rejection. These echocardiographic parameters improved after rejection treatment.

CONCLUSIONS

Heart transplantation is considered standard therapy in DCM with end-stage heart failure. Early graft rejection is a severe, life-threatening complication in heart transplanted children. Prompt diagnosis and treatment is mandatory. Besides endomyocardial biopsy, advanced echocardiography can also be a valuable noninvasive tool for rejection assessment.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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