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Case report

Tachycardia-induced cardiomyopathy: Recovery of systolic ejection fraction after sinus rhythm restoration

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Abstract This case report presents a 63-year-old patient who presented with symptoms of palpitations, skipped heartbeats, fatigue, and shortness of breath. The patient had been experiencing these symptoms for a year, with recent exacerbation. After the diagnostic workup, a diagnosis of tachycardia-induced cardiomyopathy (TIC) was established, where atrial fibrillation (AF) was the arrhythmia that induced the cardiomyopathy. Initial attempts to convert the patient's rhythm to sinus using Amiodarone were unsuccessful. Therefore, electrical cardioversion was performed, resulting in the successful restoration of sinus rhythm. The patient's ejection fraction (EF) was closely monitored post-cardioversion, and a remarkable improvement in systolic function was observed. The stability of sinus rhythm was maintained during the follow-up period, highlighting the importance of terminating the tachycardia that led to cardiomyopathy in the restoration of EF. This case report underscores the critical role of interventions aimed at managing and resolving tachycardia-induced cardiomyopathy, emphasizing the significance of restoring normal cardiac rhythm to achieve improved systolic ejection fraction. Early recognition and appropriate management of tachycardia-induced cardiomyopathy are essential in preventing long-term cardiac dysfunction and enhancing overall patient outcomes.

Kew words tachycardia-induced cardiomyopathy, atrial fibrillation, electrical cardioversion , ejection fraction

Introduction

Tachycardia-induced cardiomyopathy (TIC) is a condition characterized by impaired cardiac function resulting from prolonged periods of elevated heart rate. One potential consequence of TIC is a decrease in systolic ejection fraction (EF)[1,2]. While the primary focus is on restoring sinus rhythm, in some cases, pharmacological interventions may prove unsuccessful. In such instances, electrical cardioversion can be an effective option[3]. This article presents a case study where electrical cardioversion successfully converted atrial fibrillation (AF) to sinus rhythm, leading to the recovery of systolic ejection fraction in a patient with TIC.

Case preseentation

A 63-year-old patient presented to the Emergency Department with complaints of palpitations, skipping heartbeats, fatigue, and shortness of breath. The symptoms have been present for a year but have intensified over the past few days. Electrocardiography (ECG) during the examination revealed atrial fibrillation with a ventricular rate of approximately 105 beats per minute. An attempt was made to pharmacologically convert the patient to sinus rhythm using intravenous Amiodarone, but without success. The patient was started on Acenocoumarol and Amiodarone tablets and discharged for home treatment with instructions to return for a follow-up visit in a few days and to undergo an echocardiogram (ECHO) of the heart. After two weeks, an outpatient ECHO was performed, which showed an enlarged left ventricle with normal wall thickness, globally impaired kinetics, without clear kinetic abnormalities, and a significantly reduced ejection fraction (EF) of 20%. The left atrium was enlarged (4.4) with mitral regurgitation 2+. Atrial fibrillation with a ventricular rate of 95 beats per minute was still observed on the electrocardiogram. Subsequently, a Holter ECG was performed, which consistently showed atrial fibrillation with a ventricular rate ranging from 53 to 156 beats per minute and an average rate of 110 beats per minute. No other rhythm disturbances were recorded. During the course of treatment, the patient switched from an vitamin K dependent oral anticoagulant (Acenokumarol) to a non-vitamin K antagonist oral anticoagulant (NOAC) (Rivaroxaban). The patient was also started on an angiotensin receptor-neprilysin inhibitor (ARNI) and a sodium-glucose co-transporter-2 (SGLT-2) inhibitor, and a hospital admission was scheduled for further cardiological evaluation. One month later, the patient was admitted to the hospital. The echocardiographic findings showed no significant changes, with an EF of 20%. Atrial fibrillation

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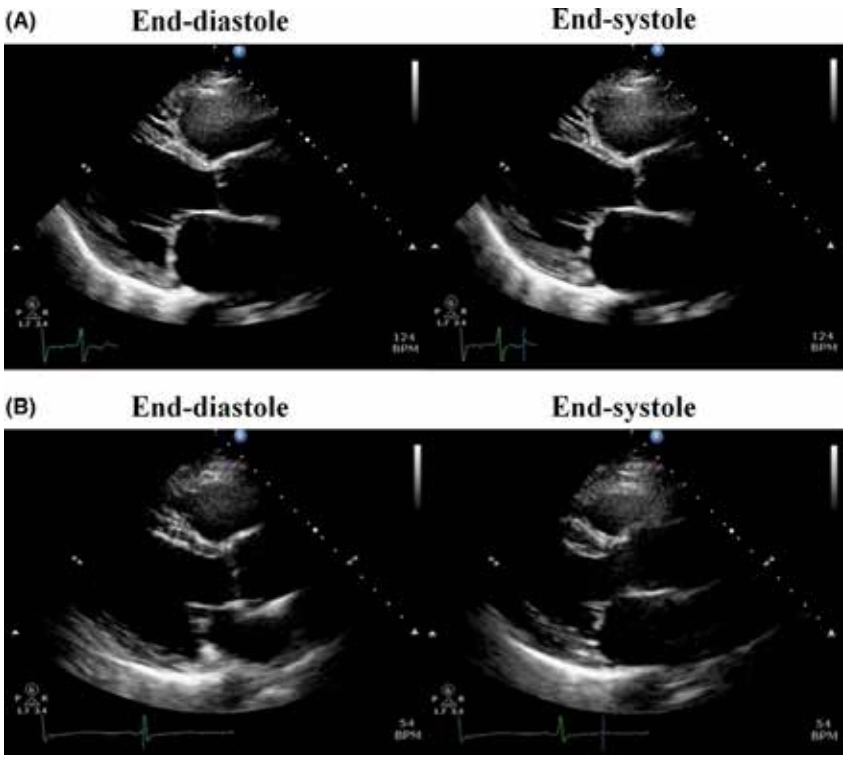

Figure A and B, A) Transthoracic echocardiography on admission showed a dilated left atrium and left ventricle. The left ventricular wall motion was severely and diffusely hypokinetic. The left ventricular ejection fraction calculated by the biplane Simpson's method was 20%. B) Transthoracic echocardiography after 6 months depicted systolic function improvement in both the left atrium and left ventricle. The left ventricular ejection fraction was 65%.

with a heart rate of 100 beats per minute was observed on the electrocardiogram. Coronary angiography was performed, revealing no angiographically significant stenosis. Due to the unsuccessful attempt to pharmacologically convert atrial fibrillation to sinus rhythm, it was decided to proceed with direct-current cardioversion. In an analgesic-sedated state, a synchronized DC shock of 200J was delivered, successfully converting atrial fibrillation to sinus rhythm. The patient was monitored in the intensive care unit and remained hemodynamically stable, maintaining sinus rhythm. The patient was discharged from the hospital on a NOAC (CHA_2DS_2-VASc-2), Amiodarone, and a comprehensive heart failure treatment regimen. Six months later, the patient returned for a follow-up visit. Subjectively he feels well and denies any sensation of palpitations or skipped heartbeats. Sinus rhythm was observed on the electrocardiogram. A repeat ECHO was performed, showing a significant improvement in left ventricular systolic function to 65%.

Tachycardia-induced cardiomyopathy (TIC) is a condition characterized by impaired cardiac function resulting from prolonged periods of elevated heart rate[1,2]. The sustained rapid heartbeat places excessive stress on the heart, leading to structural and functional abnormalities, including a decrease in systolic ejection fraction (EF). TIC may manifest months to years after the onset of the responsible tachycardia, but because TIC is a rate dependent cardiomyopathy, those patients with higher tachycardia rates develop TIC earlier[4]. However, with timely intervention and restoration of sinus rhythm, patients with TIC have the potential for significant recovery in their EF.

Tachycardia, defined as a heart rate greater than 100 beats per minute, can result from various causes, including atrial fibrillation, atrial flutter, ventricular tachycardia, or supraventricular tachycardia. Prolonged tachycardia episodes lead to a decrease in the heart's ability to pump blood efficiently, ultimately affecting cardiac function and structure.

TIC, the prolonged and rapid heart rate disrupts the coordination and efficiency of the heart's pumping action. The constant demand for increased cardiac output causes the ventricles to work harder and become less effective in contracting and emptying blood. As a result, the systolic ejection fraction decreases, indicating reduced cardiac performance[5]. The cornerstone of TIC management involves identifying and addressing the underlying cause of tachycardia. Various treatment options are available, including medication, catheter ablation, and electrical cardioversion. Although, due to the serious potential consequences of this syndrome, a definitive cure to the arrhythmia as can be obtained with a catheter ablation, should be pursued whenever possible[6]. The primary goal is to restore sinus rhythm, allowing the heart to regain its normal rhythm and optimize cardiac function.

Once sinus rhythm is successfully restored, patients with TIC often experience significant improvements in their systolic ejection fraction. As the heart rate stabilizes, the ventricles can contract more effectively and pump blood efficiently. The reduced workload on the heart allows for the recovery of myocardial function and structural remodeling. The recovery of systolic ejection fraction after sinus rhythm restoration in TIC patients can vary. In some cases, EF improvement may be ob-

served within weeks, while in others, it may take several months. The duration and severity of tachycardia, as well as individual patient factors such as age, overall health, and underlying cardiac conditions, can influence the rate and extent of EF recovery[7].

While sinus rhythm restoration plays a crucial role in EF recovery, it may not be the sole determinant. Additional factors, such as the presence of underlying structural heart disease, coexisting comorbidities, and the overall response to treatment, can impact the extent of EF improvement. Concurrent management of heart failure, including lifestyle modifications, medication therapy, and cardiac rehabilitation, may be necessary to optimize recovery[8].

In this case due to the failure of pharmacological conversion, the decision was made to proceed with electrical cardioversion. The patient underwent external synchronized direct-current (DC) shock, resulting in the successful restoration of sinus rhythm. Post-cardioversion, the patient's EF was closely monitored. Over time, there was a significant improvement in systolic ejection fraction, indicating enhanced cardiac function. The recovery of EF demonstrated the positive impact of electrical cardioversion on the patient's TIC.

Electrical cardioversion is a highly effective procedure for restoring sinus rhythm in patients with certain cardiac arrhythmias, particularly atrial fibrillation and atrial flutter. By delivering a synchronized electric shock to the heart, electrical cardioversion aims to reset the heart's electrical activity and promote coordinated contractions. While the procedure has a high success rate, careful patient selection, appropriate sedation, and close monitoring are essential to ensure safety and optimal outcomes[3].

After successful sinus rhythm restoration and improvement in systolic ejection fraction, ongoing monitoring and follow-up are essential. Regular echocardiography and clinical evaluations can help assess the recovery progress and guide further management decisions. Lifestyle modifications, adherence to medication, and continued surveillance for potential arrhythmias are critical for long-term maintenance of cardiac health.

Conclusion

Tachycardia-induced cardiomyopathy is a condition characterized by impaired cardiac function resulting from prolonged periods of elevated heart rate. However, with prompt identification and restoration of sinus rhythm, patients with TIC have the potential for significant recovery in their systolic ejection fraction. The normalization of heart rate allows for improved myocardial function.

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Sažetak

Kardiomiopatija izazvana tahikardijom: oporavak sistolne ejekcione frakcije nakon obnavljanja sinusnog ritma

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U našem prikazu slučaja radi se o bolesniku starom 63 godine koji se javio na pregled zbog osećaja lupanja i preskakanja srca, zamaranja i nedostatka vazduha. Ovi simptomi su bili prisutni tokom godinu dana, a intenzivirali su se nekoliko dana pre pregleda. Nakon urađene dijagnostike postavljena je dijagnoza tahikardijom indukovane kardiomiopatije(TIC) gde je atrijalna fibrilacija (AF) bila aritmija koja je izazvala kardiomiopatiju. Prvi pokušaji konverzije u sinusni ritam primenom Amiodarona nisu bili uspešni, zato je izvršena elektrokonverzija, što je rezultiralo uspešnim uspostavljanjem sinusnog ritma. Ejekciona frakcija (EF) je pažljivo praćena nakon elektrokonverzije i zapaženo je značajno poboljšanje sistolne funkcije. Tokom perioda praćenja u daljem toku se održava sinusni ritam, što ukazuje na značaj terminisanja tahikardije koja je dovela do kardiomiopatije u obnovi EF. Ovaj prikaz naglašava ključnu ulogu intervencija usmerenih ka lečenju tahikardijom indukovane kardiomiopatije, ističući značaj uspostavljanja sinusnog ritma u poboljšanju ejekcione frakcije. Rano prepoznavanje i preduzimanje odgovarajućih terapijskih mera za lečenje tahikardijom indukovane kardiomiopatije su od suštinskog značaja u sprečavanju trajnog oštećenja srčanog mišića i postizanju najboljih mogućih ishoda za bolesnika.

Ključne reči: *tahikardijom indukovana kardiomiopatija, atrijalna fibrilacija, elektrokonverzija, ejekciona frakcija*