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Biventricular Resynchronization : Case Report and Literature Review

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Abstract :
Cardiac resynchronization therapy (CRT) was introduced to restore left ventricular synchrony in patients with heart failure. Currently, more than 30% of patients do not respond to this therapy. CRT has proven its effectiveness in reducing morbidity and mortality in well-selected patients. A better understanding of the pathophysiological mechanisms, implantation techniques, and technological advances in devices has improved the response to this therapy. We present a case of a super-responder.

Keywords : Resynchronization Therapy, Cardiac Resynchronization Therapy (CRT), Heart Failure, Morbidity and Mortality, Implantation Techniques.

Introduction

Biventricular resynchronization is a major option in the therapeutic arsenal for heart failure due to systolic dysfunction (LVEF $\leq$ 35%) and left bundle branch block, leading to left ventricular dyssynchrony. The technique has been known since 1994, and its positive results have been well demonstrated regarding clinical benefits in terms of quality of life, improved left ventricular function through reverse remodeling, and enhanced patient survival. Recent technological advances should soon reduce the proportion of 'non-responders' to this stimulation method (1, 2). A longer RV-LV delay is associated with a 30% reduction in the risk of hospitalization for heart failure decompensation or death, or based on clinical criteria: NT-proBNP levels, LV ejection fraction, and clinical outcomes (3, 4, 5).

Observation

We report the case of a 52-year-old patient with no notable personal or family medical history, a former alcohol and tobacco user who quit over three years ago, followed for five years for dilated cardiomyopathy (DCM), diagnosed as primary after excluding ischemic origin and structural involvement through echocardiography, myocardial scintigraphy, and cardiac MRI. The patient is in New York Heart Association (NYHA) functional class III, despite optimal medical therapy (carvedilol, ramipril, spironolactone, furosemide, and valsartan). The ECG shows a sinus rhythm at 70 bpm with left ventricular hypertrophy and a complete left bundle branch block (LBBB) at 160 ms (Figure 1a). On echocardiogram, the left ventricle (LV) is dilated (LVEDD at 75 mm), ejection fraction (EF) is decreased to 27%, the left atrium is not dilated, there is no mitral regurgitation, the right ventricle (RV) is not dilated, and it has good function (Figure 2a). The biological tests showed no abnormalities (complete blood count, renal function, blood electrolyte panel, liver function, phosphocalcium levels, and TSH). Referring to the European Society of Cardiology (ESC) 2021 guidelines, the indication for resynchronization therapy is class I in this patient (NYHA class III under optimal medical therapy with

sinus rhythm, complete LBBB, duration ≥ 150 ms, EF < 35%, life expectancy >1 year). The patient underwent a cardiac resynchronization therapy pacemaker (CRTp). An echocardiogram, exercise test, and telemetric check performed two months after resynchronization showed satisfactory results with an EF of 55% (Figure 2b), a functional capacity of 11 METs, an atrioventricular (AV) delay reprogrammed to 30 ms with the SYNCAV option activated for a QRS duration of 86 ms (Figures 3a, 3b). The patient is considered a super-responder (with an EF gain > 15%), awaiting confirmation of results in six months.

Discussion

Heart failure is one of the most severe conditions with high morbidity and mortality rates. Resynchronization therapy, complementing optimal medical treatment, aims to restore left ventricular (LV) contraction synchrony (1, 2). It reduces mortality and hospitalizations due to heart failure decompensation, as well as improves the quality of life for patients (3), as demonstrated in large clinical studies. However, it is estimated that 20 to 30% of patients do not respond to this therapy (6). The choice between CRT-pacemaker (CRTp, pacing option) and CRT-defibrillator (CRTd, defibrillator option) depends on age, etiology, and comorbidities (Figure 4). The COMPANION study (7) compared CRT to medical treatment alone, showing a 36% reduction in all-cause mortality in the CRT group, especially among those who had CRTd. An extension of the CARE-HF study (7) demonstrated that CRTp reduced the risk of sudden cardiac death by 5.6% among responders, suggesting this effect might be due to reverse remodeling. Predictors for CRT response include QRS duration and morphology. In contrast, mitral regurgitation, the extent of myocardial fibrosis on cardiac MRI, and RV systolic dysfunction are predictors of non-response. Indeed, the non-responder rate is around 30%. Patient selection is based on the European Society of Cardiology (ESC) 2021 guidelines, considering only electrocardiographic criteria, LV ejection fraction, and life expectancy. Adjusting stimulation modes and AV and VV delays at 6 and 12 months can improve CRT response (6). This adjustment is necessary due to the reverse remodeling induced by CRT, which alters ventricular conduction patterns.

Conclusion

Heart failure is a common condition (affecting 1-2% of the general population) and a serious one, with significant morbidity and mortality despite therapeutic advancements. Resynchronization therapy has strengthened the therapeutic arsenal for heart failure with reduced ejection fraction. Patient selection for this therapy is currently guided by recommendations derived from studies that demonstrated the benefit of CRT in reducing mortality and hospitalizations due to heart failure decompensation. Ongoing studies are evaluating additional patient selection parameters to broaden the indication spectrum.

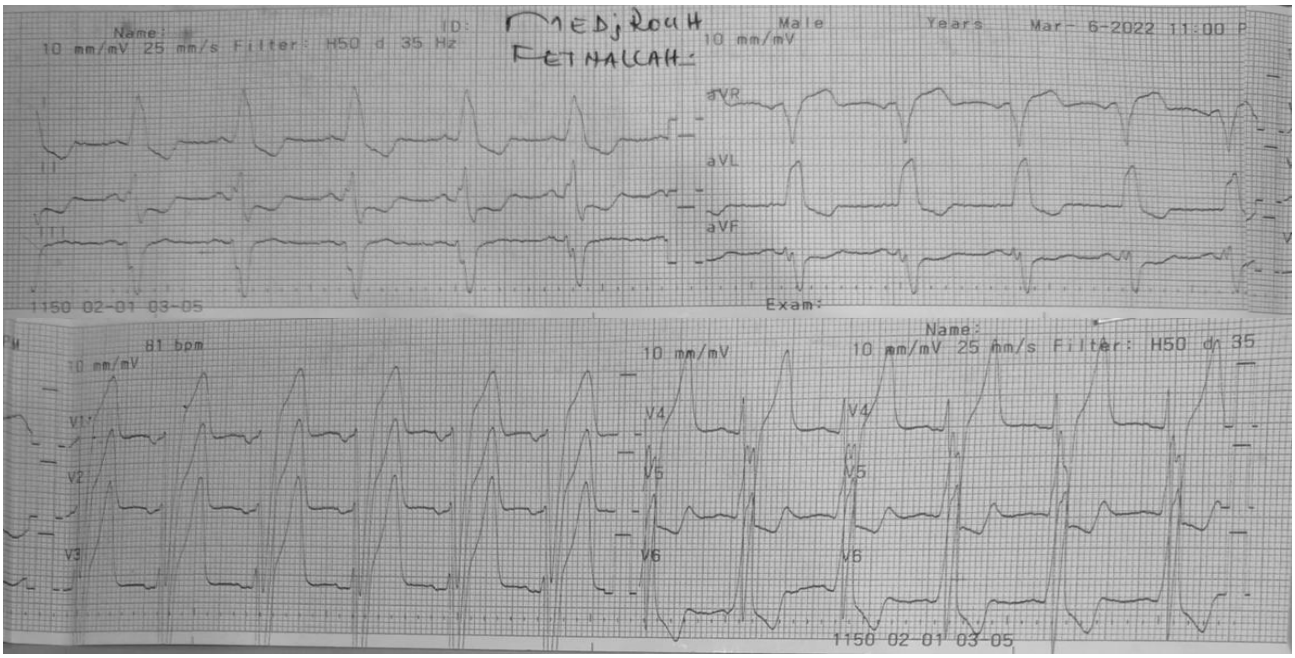

Figure 1a : Sinus rhythm, complete left bundle branch block, QRS duration at 160 ms (before CRT).

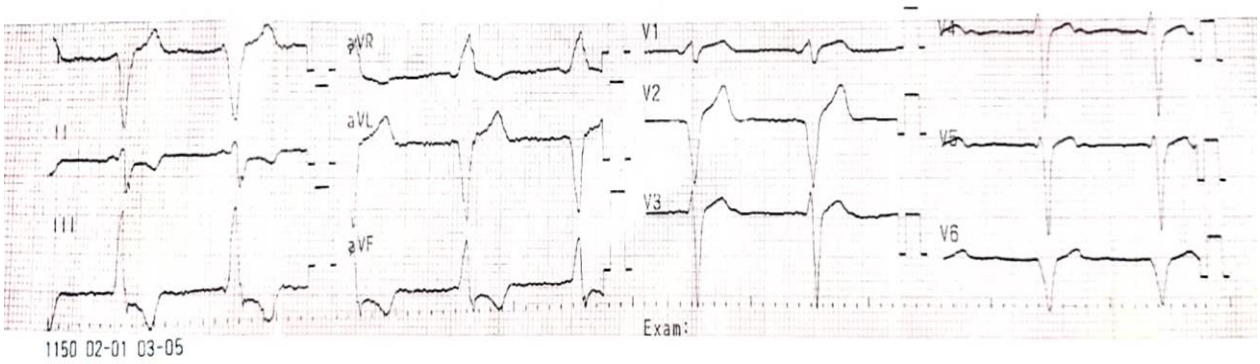

Figure 1b: QRS refinement with duration at 100 ms (after CRT).

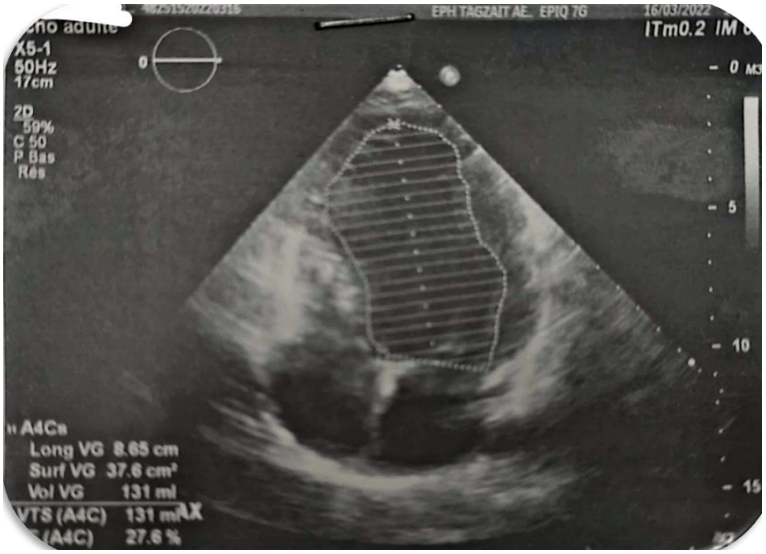

Figure 2a: Left ventricular dilation, EF at 27%, 4-chamber view. (avant CRT)

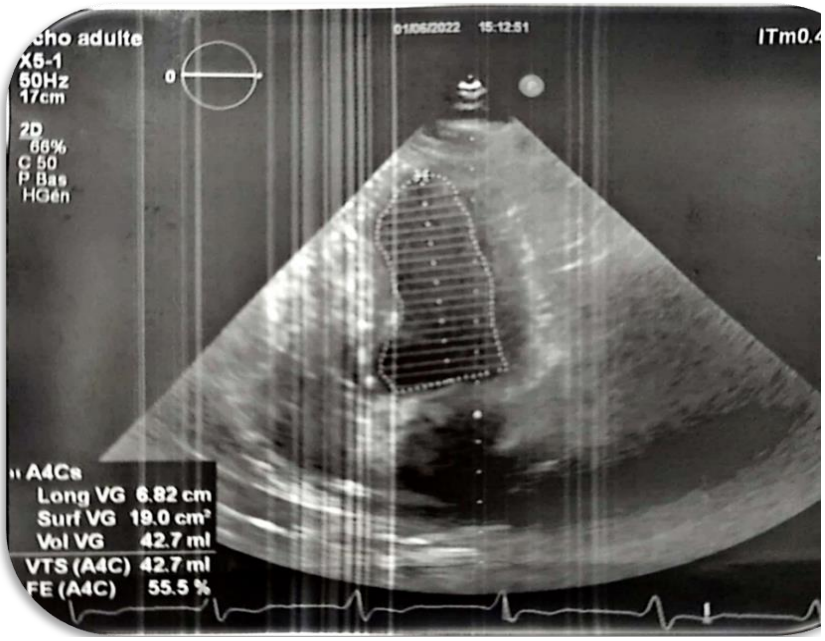

Figure 2b: Left ventricular EF at 55%, 4-chamber view (after CRT).

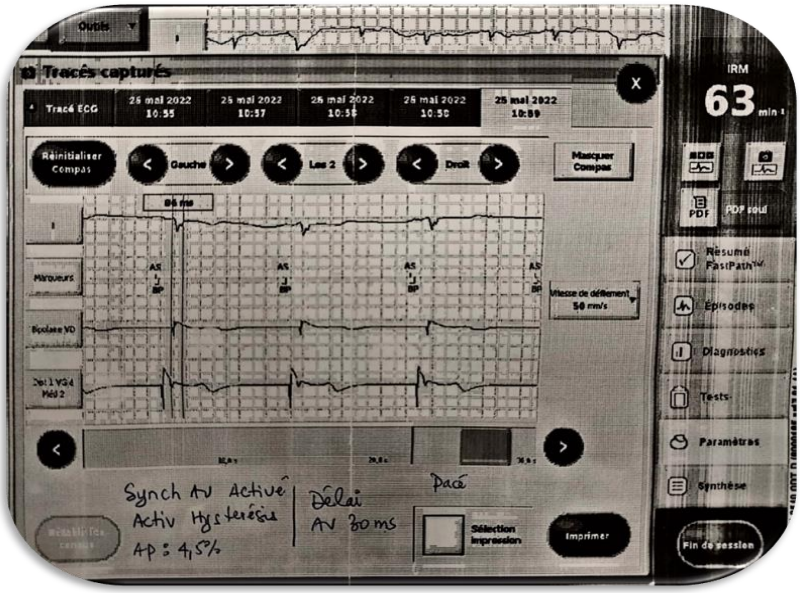

Figure 3b: Telemetric control 2 months after CRT/AV delay: 30 ms.

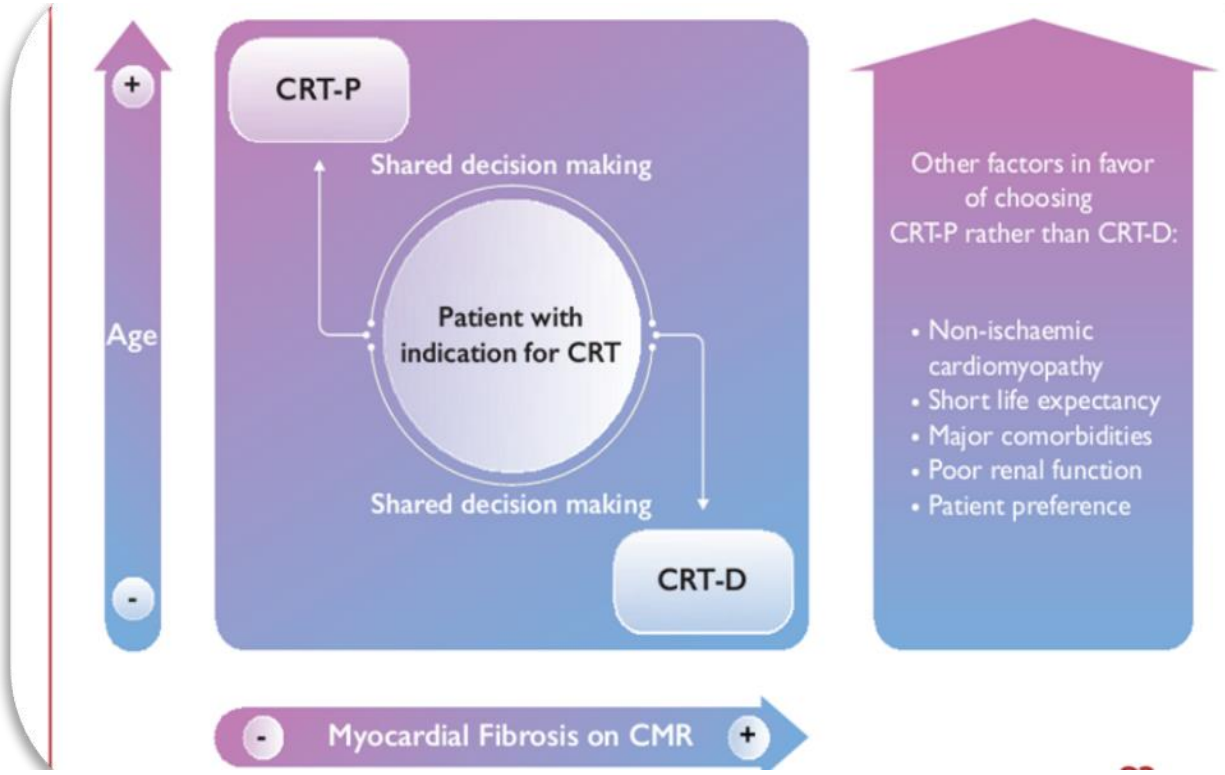

Figure 4: 2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy (6).

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