Multi-Disciplinary Approach to Long-Standing Left Bundle Branch Block with Dyssynchrony and Aortic Stenosis – Case Report

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Abstract (210/250 words)

Background: Cardiac resynchronization therapy (CRT) is recommended for patients with symptomatic heart failure in sinus rhythm with left ventricular ejection fraction ≤35%, QRS duration ≥150ms and left bundle branch block (LBBB) morphology. However, when severe left ventricular dysfunction and cardiogenic shock are present, treatment paradigms are often limited to palliative medical therapy or advanced therapies with durable left ventricular assist device or heart transplant as the functional and survival benefit of CRT in these patients remains uncertain.

Case Summary: A 77-year-old white man with long-standing LBBB with dyssynchrony, severely reduced left ventricular ejection fraction (LVEF) of 4%, and severe bicuspid aortic stenosis presented with worsening heart failure symptoms. After multidisciplinary heart team evaluation and preoperative optimization, the patient underwent a surgical aortic valve replacement with simultaneous intraoperative initiation of CRT with pacemaker (CRT-P) and temporary mechanical circulatory support. Echocardiography at 44 days and 201 days post-discharge showed an LVEF of 29% and 40%, respectively.

Discussion: This case demonstrates that reverse remodeling and native heart recovery was successfully achieved in a patient with advanced structural heart disease, presenting with cardiogenic shock, through an early and aggressive approach involving multidisciplinary heart team evaluation, treatment of severe AS with SAVR, prophylactic intraoperative initiation of temporary mechanical circulatory support and early initiation of CRT-P.
Learning Points:

1. Recognize the potential value of conventional therapies, and opportunity for reverse remodeling, in patients with severe left ventricular dysfunction and cardiogenic shock.

2. Appreciate the potential value of perioperative temporary mechanical circulatory support in high-risk patients undergoing cardiac surgery shock and the role of early initiation of postoperative cardiac resynchronization therapy in appropriately selected patients.

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AS – aortic stenosis; CI – cardiac index; CRT-P – cardiac resynchronization therapy with pacemaker; CT – computed tomography; ECG – electrocardiogram; LBBB – left bundle branch block; LVET – left-ventricular ejection fraction; PA – pulmonary artery; PCWP – pulmonary capillary wedge pressure.
Introduction

Long-standing left bundle branch block (LBBB) can lead to left ventricular (LV) dyssynchrony and cardiac remodeling that contribute to reduced left ventricular ejection fraction (LVEF) and heart failure (HF).(1) Initiation of cardiac resynchronization therapy (CRT) in these patients can normalize LV dyssynchrony, improve LVEF and promote reverse cardiac remodeling.(2) Thus, CRT is recommended for symptomatic HF patients in sinus rhythm with LVEF ≤35%, QRS duration ≥150 ms, and LBBB morphology.(3) However, there is no clear evidence supporting the initiation of CRT specifically in patients with advanced HF and cardiogenic shock.(4) 

Case Summary

A 77-year-old white man with longstanding left bundle branch block (LBBB), dyssynchrony and severe bicuspid aortic stenosis (AS) presented with worsening dyspnea and orthopnea (New York Heart Association class IV). Physical exam demonstrated jugular venous distention to the jaw at 90° and a grade III/IV systolic crescendo murmur. His comorbidities included hypertension, pre-diabetes, stage 3 chronic kidney disease, and cold agglutinin disease. Home medications included sacubitril-valsartan (24 mg-26 mg twice daily) and furosemide (40mg twice daily). He had been evaluated at another hospital three months prior and was declined for both surgical (SAVR) and transcatheter aortic valve replacement (TAVR) and instead underwent palliative balloon aortic valvuloplasty. He continued to symptomatically worsen and thus sought a second opinion regarding high-risk intervention at our center.

Initial electrocardiogram showed sinus rhythm with a complete LBBB and QRS duration of 180ms (Figure 1). Transthoracic echocardiogram revealed severe biventricular dilation and dysfunction with an LV ejection fraction (LVEF) of 4% and a bicuspid aortic valve with severe AS (area: 0.86 cm²) (Video 1). A computed tomography scan of the chest revealed a 5.2cm ascending aortic aneurysm with low-lying coronary ostia (Figure 2). Review of a prior left heart catheterization revealed no significant
coronary artery disease. Initial laboratory assessments demonstrated a creatinine of 1.81 mg/dL, a total
bilirubin of 1.2 mg/dL, and an N-terminal pro b-type natriuretic peptide of 21,918 pg/mL.

The patient was admitted to the cardiovascular intensive care unit (CVICU) and a pulmonary
artery (PA) catheter was placed, which initially demonstrated PA pressures of 73/34 mmHg (mean 51
mmHg), a pulmonary capillary wedge pressure of 31 mmHg and a cardiac index of 1.6 L/min/m². A
nitroprusside drip was initiated at 20 mcg/min and up-titrated for afterload reduction along with
intravenous diuretics (furosemide 80 mg twice daily) for volume status optimization. Additionally,
bedside stress echocardiography with 15 mcg of dobutamine demonstrated a peak aortic gradient of 63
mmHg (compared to 43 mmHg before dobutamine), consistent with contractile reserve.

Multidisciplinary heart team assessment was initiated, and the patient was evaluated for both
TAVR and SAVR with consideration of perioperative mechanical circulatory support. The structural
heart team deemed the patient to not be a candidate for TAVR given his low coronary ostia and risk for
occlusion, along with the presence of his ascending aortic aneurysm. Due to the presence of LBBB,
visible dyssynchrony, severe AS and aortic aneurysm, the patient was offered open heart surgery with
intraoperative placement of an Impella 5.5 (Abiomed, Danvers, MA) temporary left ventricular assist
device (LVAD) as bridge to recovery. Electrophysiology consult recommended intraoperative placement
of epicardial leads and a pacemaker generator for postoperative pacing. Given the intention for immediate
postoperative CRT initiation and potential for cardiac recovery, CRT with pacemaker (CRT-P) was
selected over CRT with defibrillator. Due to concerns for hemodynamic instability during anesthetic
induction, an intra-aortic balloon pump was placed the day prior to surgery.

On hospital day 14, the patient underwent SAVR (27mm Inspiris) and ascending aorta
replacement (30mm Gelweave) with right axillary Impella 5.5 insertion. Additionally, epicardial
permanent pacing leads were sutured in standard fashion to the right atrium, anterior surface of right
ventricle, and posteroinferior surface of the LV for dual chamber CRT-P to facilitate improvement in
cardiac function and earlier Impella weaning. Postoperatively, the patient was transported to the
CVICU in stable condition on Impella 5.5 and moderate dose inotropic support with pacemaker resynchronization therapy initiated (programmed AV and VV delays; 100% biventricular pacing).

Following serial hemodynamic monitoring and transthoracic echocardiograms demonstrating improvement in cardiac function, the Impella was weaned and removed on postoperative day (POD) 9 and inotropic support was weaned on POD 10. The patient experienced a prolonged hospital course due to acute kidney injury requiring temporary dialysis, reintubation and tracheostomy, bacteremia, and hematuria all from which he fully recovered.

Transthoracic echocardiography on POD 31 demonstrated an improved LVEF of 28%. The patient was transferred to the regular nursing floor from the CVICU on POD 45 and discharged to a skilled nursing facility on POD 61. Echocardiography at 44 days and 201 days (Video 2) post-discharge showed an LVEF of 29% and 40%, respectively. Additionally, the patient walked back into the outpatient clinic for his 1-year postoperative follow-up and reported significant functional and quality of life improvements. Electrocardiogram at this visit revealed a QRS duration of 178ms (Figure 3).

Discussion

We present a patient with advanced LBBB and dyssynchrony along with severe AS and an ascending aortic aneurysm who underwent successful surgical repair of his complex cardiac conditions and achieved native heart recovery with improved LV function. This outcome was facilitated by a multimodal therapeutic approach involving treatment of severe AS with SAVR alongside planned, intraoperative initiation of both biventricular resynchronization therapy with CRT-P and temporary mechanical circulatory support (MCS) with an Impella 5.5. Although the patient presented with significant AS despite prior balloon aortic valvuloplasty, this palliative intervention likely allowed the patient time to seek a second opinion at our center.

Current guidelines recommend CRT initiation for symptomatic HF patients in sinus rhythm with LVEF ≤35%, QRS duration ≥150 ms, and LBBB morphology.(3) However, patients with advanced HF
and cardiogenic shock may have minimal improvements in cardiac function or survival with initiation of CRT.(4) Therefore, in these patients, treatment options are often limited to palliative medical therapy or advanced therapies with durable LVAD or heart transplant. The absence of coronary artery disease and prior myocardial infarction, LBBB, and severe AS with demonstration of contractile reserve, suggested that SAVR with CRT-P was a viable strategy for this patient. Additionally, this patient fulfilled the Strauss criteria for LBBB, defined as a QRS duration $\geq$140ms and mid-QRS slurring/notching in two contiguous leads, which has been associated with high rates of response to CRT.(8,9)

Given that this patient’s degree of LV dysfunction imparted high risk for perioperative hemodynamic instability and postcardiotomy cardiogenic shock, planned intraoperative initiation of Impella 5.5 support was utilized. Additionally, CRT-P was proactively initiated early in the postoperative course to facilitate Impella weaning and reduced need for inotropes. Collectively, the combination of perioperative Impella support, SAVR, and biventricular pacing likely contributed to both short- and long-term native heart recovery and earlier reverse remodeling as seen through this patient’s echocardiographic and functional status improvements over the first six months postoperatively. However, appropriate patient selection for this approach must be cautiously undertaken as prediction of favorable outcomes remains elusive due to limited experience. Therefore, evaluation by a multidisciplinary heart team with input from structural heart, electrophysiology, heart failure and cardiac surgery is critical. Thus, referral of these complex cases to experienced high-volume centers is recommended to ensure the most optimal outcomes.

Our patient demonstrates that reverse remodeling and native heart recovery may be facilitated in select patients with advanced structural heart disease, presenting with cardiogenic shock, through an early and aggressive multimodal therapeutic approach. Meticulous preoperative evaluation by a multidisciplinary heart team led to a treatment plan including prophylactic intraoperative initiation of Impella 5.5 support and early initiation of CRT-P. Achieving reverse remodeling and avoiding LVAD or
heart transplantation should always be the goal, however, optimal patient selection and execution remain the practical challenges.

**Data availability:** The data underlying this article cannot be shared publicly due to patient privacy. The data will be shared on reasonable request to the corresponding author.

**Statement of Consent:** The authors confirm that written consent for submission and publication of this case report including the images and associated text have been obtained from the patient in line with COPE guidance.

**References**


Figure Legends

Figure 1. Electrocardiogram on admission. Sinus rhythm with a complete left bundle branch block.

Figure 2. Non-contrast computed tomography scan of the chest. Demonstrates ascending aortic aneurysm.

Figure 3. Electrocardiogram 6-months post-discharge. Biventricular pacing.
Figure 1
165x94 mm (DPI)

Figure 2
130x90 mm (DPI)