

CLINICAL COLUMN

Cardiac Resynchronization Therapy in Congestive Heart Failure Patients

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Congestive heart failure (CHF) is a complex, progressive health issue estimated to affect 500,000 people in Canada with 50,000 new patients being diagnosed each year (Heart and Stroke Foundation, 2014). It continues to be associated with significant morbidity and mortality, with an average annual mortality rate of 5% to 50% depending on severity of symptoms, heart dysfunction, age and other associated factors (Arnold et al., 2006). Canada's annual in-hospital mortality rate is 9.5 deaths/100 hospitalizations in patients over 65 years, with mortality rising to 12.5 deaths/100 hospitalizations in patients over 75 years (Lee et al., 2004). Prognosis for heart failure patients is poor, with an average one-year mortality rate of 33% (Lee et al., 2004). Management of CHF requires a unique plan of care for each individual, based on his or her symptoms, clinical presentation and disease severity (Arnold et al., 2006). The Canadian Cardiovascular Society (CCS) consensus conference outlines the recommendations for management of heart failure. These guidelines begin with accurate diagnosis of heart failure and include patient education, lifestyle modifications and consideration of co-morbidities, combination pharmacological therapy, mechanical device therapy and surgical measures (Arnold et al., 2006). A collaborative effort among health care teams, patients, and their caregivers is required in order to achieve optimum results that have a measurable impact on CHF patients (Arnold et al., 2006).

Congestive Heart Failure

CHF is defined as a complex clinical syndrome in which abnormal heart function results in or increases the risk of clinical signs and symptoms of low cardiac output and/or pulmonary or systemic congestion (Arnold et al., 2006). Heart failure (HF) can be divided into systolic or diastolic heart failure. In systolic heart failure, there is reduced cardiac contractility, whereas in diastolic heart failure there is impaired cardiac relaxation and abnormal ventricular filling (Hobbs & Boye, 2014).

Medical management of CHF requires a combination of therapies. Lifestyle modifications include weight reduction, appropriate management of co-morbidities and regular physical activity individualized to the patient's symptoms and functional capacity (Arnold et al., 2006). Restricting dietary sodium

intake to less than 2g/day helps minimize fluid retention. Further sodium and fluid restriction may be suggested for those with ongoing fluid retention and congestion despite diuretic therapy (Arnold et al., 2006). Current recommendations for pharmacological therapy include a patient specific combination of angiotensin converting enzyme inhibitor (ACEI), and/or angiotensin receptor blocker (ARB), beta blocker and aldosterone antagonist. Careful consideration must be given to renal function while titrating CHF therapy. Persistent CHF symptoms may also be treated with digoxin and vasodilators. Diuretic therapy is recommended for most patients with congestive symptoms. Once acute symptoms are relieved, the lowest dose should be used to maintain stable symptoms (Arnold et al., 2006). Where available, referral is recommended to multidisciplinary outpatient clinics with expertise in heart failure for patients with recurrent symptoms to provide education, specialized evidence-based medical therapy, and referral for appropriate interventions (Arnold et al., 2006).

Although there have been many advances in the management of heart failure, there continues to be a significant number of patients with persistent symptoms despite maximum tolerable therapy (Kumar & Saxon, 2003). A great deal of research has been conducted to find therapies to treat this population of patients.

Classification of Congestive Heart Failure

Heart failure is classified by the severity of functional limitations and correlates fairly well with prognosis (Hobbs & Boye, 2014). Health care providers require documentation of functional capacity in order to manage heart failure effectively and evaluate outcomes. One validated tool that is currently used to measure functional capacity is the New York Heart Association (NYHA) classification system. Careful consideration must be given to the classification of patient symptoms when making decisions about patient management.

The Effects of Ventricular Dyssynchrony

One quarter to one third of patients with CHF have some form of intraventricular conduction abnormality (Jarcho, 2005). This electrical conduction delay often results in dyssynchronous ventricular contraction, which is mechanically inefficient (Jarcho, 2005). This can lead to abnormal interventricular septal wall motion, reduced stroke volume, reduced

rise in LV pressure, reduced diastolic filling times and worsening mitral regurgitation (Kumar & Saxon, 2003). Ventricular dyssynchrony is shown to have a negative impact on the progression of heart failure and has been associated with severe symptoms and poor prognosis (Arnold et al., 2006). Traditional right ventricular pacing devices create an artificial conduction delay, which has been shown to impair ventricular function (Jarcho, 2005). Studies have shown that patients with left ventricular (LV) dysfunction and delayed ventricular conduction may benefit from more synchronous contraction. Since the mid-1990s synchronized biventricular pacing has been used in CHF patients to resynchronize ventricular contraction and thus improve the pumping function of the heart.

Cardiac Resynchronization Therapy

Cardiac resynchronization therapy (CRT) involves simultaneous pacing of both ventricles to reestablish coordinated contraction in patients with systolic dysfunction and ventricular dyssynchrony due to left bundle branch block (Neubauer & Redwood, 2014). Resynchronization with CRT has been shown to improve LV function, reduce mitral regurgitation, enhance cardiac output and reduce heart failure symptoms without increasing myocardial energy consumption (Exner et al., 2013). Placement of the CRT device involves implanting a pacemaker the size of a half-deck of cards, usually just below the collarbone. Three wires (leads) are implanted: one in the right atrium, one in the right ventricle and a third through the coronary sinus of the right atrium. It is advanced posteriorly toward the left ventricle, then through a venous branch running along the free wall of the left ventricle (Jarcho, 2005). These leads are connected to the device monitor that emits tiny pulses of electricity to pace both ventricles simultaneously (American Heart Association, 2014). Figure 1 depicts a biventricular pacing device and lead placement for CRT.

Who Qualifies for CRT?

QRS duration, functional class, and left ventricular ejection fraction (LVEF) are used to determine who qualifies for CRT (Exner et al., 2013). The updated CCS guidelines recommend CRT for patients in sinus rhythm with NYHA class II, III or ambulatory class IV symptoms despite optimal medical therapy with QRS duration >130ms and LVEF of <35% (Exner et al., 2013). Recent randomized trials (EchoCRT) have shown that use of CRT in patients with systolic heart failure and narrow QRS complex less than 130ms, does not reduce death rate or hospitalization and, in fact, increases mortality (Ruschitzka et al., 2013). Consideration should also be given to heart failure patients in permanent atrial fibrillation (AF) who are otherwise suitable for therapy (Exner et al., 2013). CRT may be considered for patients in sinus rhythm with NYHA class II, III or ambulatory class IV heart failure with LVEF <35% and a QRS >150ms not due to LBBB (Exner et al., 2013). Patients with chronic right ventricular (RV) pacing with ongoing symptoms of heart failure

and LVEF <35% should also be considered for CRT (Exner et al., 2013). It is recommended that heart failure patients who need device revision be considered for upgrade to CRT if eligible (Parkash et al., 2013).

Subjective as well as objective evaluation of the pre-CRT implantation functional capacity and symptoms are important, particularly in patients in whom there is disparity between the reported symptoms and the clinical assessment, or to distinguish the non-HF related causes of functional limitation (Parkash et al., 2013). Implantable cardioverter-defibrillator (ICD) should also be considered for CRT patients who meet the requirements for ICD therapy (Howlett et al., 2009).

Benefits and Risks of CRT

Clinical trials such as the Comparison of Medical Therapy Pacing, and Defibrillation in Heart Failure (COMPANION) study and the Cardiac Resynchronization in Heart Failure (CARE_HF) study have shown the potential benefits of CRT for patients with symptomatic heart failure and a wide QRS complex. It has been shown that patients with a QRS duration greater than 150 ms respond more favourably than those with lesser degrees of QRS prolongation (Howlett et al., 2009). CRT has been found to decrease the combined risk of death from any cause or first hospitalization, and when combined with an ICD, significantly reduces mortality (Bristow et al., 2004). Also of importance, patients have noted an increased sense of security following CRT device insertion.

As with any invasive procedure, there are risks associated with CRT insertion. These may include infection, reaction to medications used during the procedure, blood loss or damage to a blood vessel or the heart wall (St. Jude Medical, 2014). Unfortunately, for reasons that are not always clear, CRT therapy does not benefit all patients. In some cases unsuccessful lead placement may be the cause or the severity of dyssynchrony may have been overestimated prior to insertion (Jarcho, 2005).

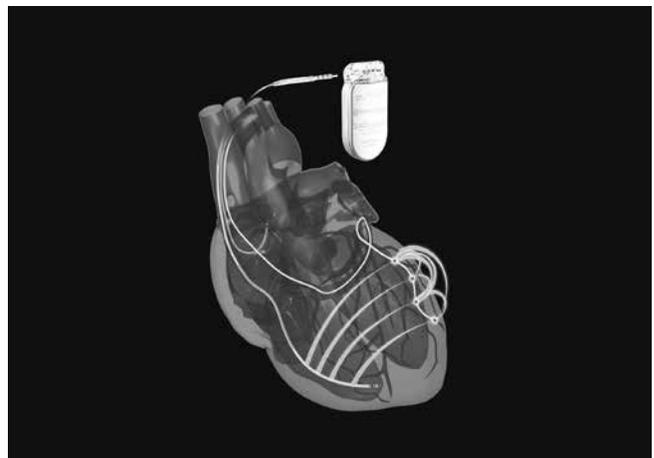


Figure 1: Lead Placement for CRT
(Used with permission from St. Jude Medical)

Studies and the Evidence

As noted, there have been numerous studies conducted on the use and benefit of CRT in heart failure patients. In 2004 the COMPANION study concluded that compared to medical therapy alone, CRT significantly reduced the rate of death or hospitalization by 34% in the pacemaker group and by 40% in the pacemaker-defibrillator group (Bristow et al., 2004). Another large-scale study, CARE_HF followed in 2005 and CRT patients were compared with patients who had medical therapy only. The CRT group had significantly fewer deaths from any cause and fewer hospitalizations for a major cardiovascular event. The CRT group also had better improvement in ejection fraction, overall symptoms and quality of life scores than the group with medical therapy only (Cleland et al., 2005). In 2008, the REsynchronization reVERses Remodeling in Systolic left vEntricular dysfunction (REVERSE) trial demonstrated that CRT, in combination with optimal medical therapy, reduced the risk for heart failure hospitalization and improved ventricular structure and function in NYHA functional class I-II patients with previous HF symptoms (Linde et al., 2008).

Bradley et al. (2003) did a meta-analysis looking at the efficacy of CRT. They showed that CRT reduced heart failure hospitalizations, but its benefits were seen mainly in patients with NYHA class III-IV symptoms. A second meta-analysis showed

that CRT reduced the number of deaths from progressive CHF by 51% and hospitalizations by 29%, although no significant reduction in all-cause mortality was found (McAlister et al., 2004). It is evident that in addition to standard pharmacological therapy, CRT improves symptoms and quality of life and reduces complications and the risk of death (Cleland et al., 2005).

Conclusion

Over the past 20 years, researchers and health care teams have gained a better understanding and developed many new therapies for heart failure that have improved the prognosis for those affected (Arnold et al., 2006). As new data are collected, the management and treatment of heart failure continues to evolve. Researchers strive to develop best practices in order to improve both the quantity and quality of life for CHF patients. CRT is not exempt from this scrutiny. Investigators continue to look for improved and alternate therapies in order to optimize patient care, as well as clarify the role and benefit of CRT in heart failure patients who fall outside the current recommended guidelines. ♥

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REFERENCES

- American Heart Association. (2014). *Cardiac resynchronization therapy*. Retrieved from www.heart.org/HEARTORG/Conditions/HeartFailure/Cardiac.
- Arnold, J.M., Liu, P., Demers, C., Dorian, P., Giannetti, N., Haddad, H., ... White, M. (2006). CCS consensus conference recommendations on heart failure: Diagnosis and management. *Canadian Journal of Cardiology*, 22, 23–45.
- Bradley, D.J., Bradley, E.A., Baughman, K.L., Berger, R.D., Calkins, H., Goodman, S.N., ... Powe, N.R. (2003). Cardiac resynchronization and death from progressive heart failure: A meta-analysis of randomized controlled trials. *Journal of the American Medical Association*, 289, 730–740.
- Bristow, M.R., Saxon, L.A., Boehmer, J., Krueger, S., Kass, D.A., De Marco, T., ... Feldman, A.M. for the Comparison of Medical Therapy, Pacing, and Defibrillation in Heart Failure (COMPANION) Investigators. (2004). Cardiac-resynchronization therapy with or without an implantable defibrillator in advanced chronic heart failure. *New England Journal of Medicine*, 350, 2140–2150.
- Cleland, J.G., Daubert, J.C., Erdmann, E., Freemantle, N., Gras, D., Kappenberger, L., & Tavazzi, L. (2005). The effect of cardiac resynchronization on morbidity and mortality in heart failure. *New England Journal of Medicine*, 352, 1539–1549.
- Exner, D.V., Birnie, D.H., Moe, G., Thibault, B., Philippon, F., Healey, J.S., ... Parkash, R. (2013). CCS guidelines on the use of cardiac resynchronization therapy: Evidence and patient selection. *Canadian Journal of Cardiology*, 29, 182–195.
- Heart and Stroke Foundation. (2014). *Statistics on heart failure*. Retrieved from <http://www.heartandstroke.com/site>
- Hobbs, R., & Boye, A. (2014). *Heart failure*. Retrieved from www.clevelandclinicmeded.com/.../cardiology/heart-failure
- Howlett, J.G., McKelvie, R.S., Arnold, J.M., Costigan, J., Dorian, P., Ducharme, A., ... White, M. (2009). Diagnosis and management of right-sided heart failure, myocarditis, device therapy and recent important clinical trials. *Canadian Journal of Cardiology*, 25, 85–105.
- Jarcho, J.A. (2005). Resynchronizing ventricular contraction in heart failure. *The New England Journal of Medicine*, 352, 1594–1597.
- Kumar, U.N., & Saxon, L.A. (2003). Ventricular resynchronization: A promising therapy for heart failure. *American Journal of Geriatric Cardiology*, 12(1), 41–48.
- Lee, D.S., Johansen, H., Gong, Y., Hall, R.E., Tu, J.V., & Cox, J.L. (2004). Regional outcomes of heart failure. *The Canadian Journal of Cardiology*, 20, 599–607.
- Linde, C., Abraham, W.T., Gold, M.R., St. John Sutton, M., Ghio, S., & Daubert, C. (2008). Randomized trial of cardiac resynchronization in mildly symptomatic heart failure patients and in asymptomatic patients with left ventricular dysfunction and previous heart failure symptoms. *Journal of the American College of Cardiology*, 52, 1834–1843.
- McAlister, F.A., Ezekowitz, J.A., Wiebe, N., Rowe, B., Spooner, C., Crumley, E., ... Abraham, W. (2004). Systematic review: Cardiac resynchronization in patients with symptomatic failure. *Annals of Internal Medicine*, 141, 381–390.
- Neubauer, S., & Redwood, C. (2014). New mechanisms and concepts for cardiac-resynchronization therapy. *The New England Journal of Medicine*, 370, 1164–1166.
- Parkash, R., Philippon, F., Shanks, M., Thibault, B., Cox, J., Low, A., ... Exner, D.V. (2013). CCS guidelines on the use of cardiac resynchronization therapy: Implementation. *Canadian Journal of Cardiology*, 29, 1346–1360.
- Ruschitzka, M.D., Abraham, W.T., Singh, J.P., Bax, J.J., Borer, J.S., Brugada, J., ... Holzmeister, J. (2013). Cardiac-resynchronization therapy in heart failure with narrow QRS complex. *New England Journal of Medicine*, 369, 1395–1405.
- St. Jude Medical. (2014). *CRT pacemakers*. Retrieved from <http://health.sjm.com/heart-failure-answers/treatment-options/cardiac-resynchronization-therapy/crt-p>