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Cardiac rehabilitation in BC: An approach based on Dr Hellerstein's model

Risk factor modification, diet, and exercise are still key to improving heart health.

ABSTRACT: Dr Herman Hellerstein was one of the first physicians to recognize there was more to cardiac disease than just the heart. In the 1950s his research led him to develop a multidisciplinary approach to cardiac rehabilitation that targeted the many facets of heart health. He went on to demonstrate that optimal treatment of heart disease requires both lifestyle modifications and medical treatment. Today lifestyle modifications are the foundation for cardiac rehabilitation programs in British Columbia. Patients who take part in cardiac rehabilitation have an improved quality of life and a substantially lower risk of dying. In fact, cardiac rehabilitation has been shown to reduce mortality by as much as 26%. In spite of the known benefits, cardiac rehabilitation programs in BC are currently underutilized. We hope to change this by increasing awareness of the benefits and the availability of programs based on Dr Hellerstein's approach to heart health.

Dr Herman Hellerstein grew up in the mining town of Dillonvale, Ohio, where he witnessed firsthand the effects of poverty and poor working conditions on people. He attended medical school at Western Reserve University and soon found himself drawn to cardiology. A dedicated researcher, he examined hearts in 2000 consecutive autopsies to determine the incidence of cardiac disease.[1] He studied methods to correlate ECG findings with infarct territory, and worked to make ECG machines more usable in the office and hospital settings. He was a strong proponent of cardiopulmonary resuscitation at a time when it was felt that nothing could be done for a fibrillating heart. But he found the true passion of his life when he was approached by the Cardiac in Industry Committee in 1949 to determine if patients who had experienced a myocardial infarction (MI) could safely return to work.[1]

Pioneering post-infarction care

At the time Dr Hellerstein first became involved in cardiac rehabilitation (CR), complete bed rest for 6 weeks was the treatment of choice for an infarct.[1] The practice of allowing patients to sit up in bed or walk around the room was

only slowly being adopted. Patients who had an MI were often considered invalids and advised never to return to work. In the 1950s, knowledge of cardiovascular risk factors was in its infancy. The American Heart Association and American College of Cardiology (AHA/ACC) would not formally recognize hypercholesterolemia as a risk factor for atherosclerosis until 1961.[1] ECG machines were bulky and considered of little use in the acute care setting. Coronary angiography and cardiac surgery were still largely experimental. Balloon angioplasty, coronary stents, thrombolysis, and coronary artery bypass grafting were not available. Medical therapy generally consisted of nitrates alone.

It was in this context that Dr Hellerstein pioneered a post-infarc-

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tion care model intended to rehabilitate patients and return them to their work and previous levels of activity.[1]

Using groundbreaking ideas for the time, Dr Hellerstein forged one of the first multidisciplinary approaches to disease with a clinic staffed by physiotherapists, dietitians, vocational counselors, and psychotherapists.[1] When he found a dearth of information on how much energy was actually expended while people performed various tasks, he began going to workplaces himself with research teams to measure blood pressure and heart rate response to activity.[1]

Initially considered radical, Dr Hellerstein's approach to CR, exercise, diet, and return to work faced resistance. Today his approach is widely accepted as being beneficial to patients with coronary artery disease (CAD). He eventually founded the Work Classification Clinic, was appointed chairman of the International Society of Cardiology's Council on Preventative Medicine and Cardiac Rehabilitation, and authored many papers and several books about heart health.[1] His most recognized book, *Healing Your Heart*, shows patients how modest changes in lifestyle can lead to large reductions in cardiovascular risk.[2] Dr Hellerstein spent much of his life promoting a healthy lifestyle for his patients and teaching his students to do the same. He died in 1993 at age 77 from cancer.

Managing CAD

Coronary artery disease is a narrowing of the blood vessels surrounding the heart. This narrowing results from an inflammatory process that is driven by multiple associated risk factors.[3] The beginnings of atherosclerotic plaque formation are seen even in childhood,[4] with as many as 1 in 6 teenagers exhibiting early evidence of CAD.[5] While the disease is common, the progression of atherosclerosis and the age when patients present to the medical system are variable. Until 2007, CAD was the largest killer of Canadians. In the Canadian 2008 mortality statistics, CAD placed a close second to cancer in all-cause death, and remained the number one killer of women.[6] This is despite advances in cardiology that have dramatically decreased MI mortality for patients younger than 65 years old from close to 30% within the first month[7] to less than 5%.[8]

CAD is a chronic illness rather than an acute one that we treat aggressively once and then forget about. While the flashy TV show management of an MI is often what comes to mind for both physician and patient, the much less glamorous lifestyle changes of diet, exercise, and risk factor management are what provide lasting benefits.

By participating in CR, patients can decrease their risk of death from an MI by up to 26%, to a risk as low as 1%.[9] The multidisciplinary approach pioneered by Dr Hellerstein targets physical, psychological, social, and vocational areas of a patient's life. Ideally, it should include all of these elements, as illustrated in **Table 1**.[10]

Evidence for risk reduction

The implementation of CR within communities has often been variable in scope and practice, which has led to difficulties in evaluating its effica-

Table 1. Key elements of cardiac rehabilitation programs.

Patient referral process

Patient assessment:
- Risk stratification
- Exercise stress testing
- Risk factor assessment

Health behavior interventions and cardiovascular disease risk factor modification

Nutritional counseling

Risk factor counseling and management:
- Lipids
- Hypertension
- Smoking cessation
- Diabetes
- Psychosocial issues
- Weight management, particularly abdominal obesity
- Psychosocial management
- Physical activity counseling
- Exercise training

Patient education programs:
- Health behavior adherence strategies
- Medication adherence strategies

Outcomes assessment programs:
- Health outcomes
- Educational outcomes
- Behavioral outcomes
- Service outcomes

Continuous quality improvement programs

Continuous professional development programs

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cy. However, a recent meta-analysis by Heran and colleagues evaluated 10 794 patients with CAD who may or may not have been revascularized and who were randomly assigned to either exercise-based CR or usual care.[11] Most of these patients were low-risk, middle-aged Caucasian males. Within less than a year of follow-up, CR was found to reduce hospital admissions by 31%. In the longer term, CR was found to significantly reduce overall mortality by 13% and cardiovascular mortality by 26%. This was consistent with previous meta-analyses. Taylor and colleagues showed a decrease of 20% in all-cause mortality and a decrease of 26% in cardiovascular mortality with CR,[12] while Clark and colleagues demonstrated a 15% decrease in all-cause mortality.[13] In addition, while the meta-analyses by Heran and Taylor were unable to demonstrate a reduced incidence of MI or need for revascularization, Clark's 2004 meta-analysis showed a 17% overall reduction in recurrent MI over a median 12-month follow-up period.

Beneficial for all

One of the most powerful aspects of CR is that the benefits transcend age and sex. In fact, women and the elderly, who have been traditionally underserved by CR programs in the past, stand to gain significantly from participating.

The prevalence of CAD increases with age, and as the Canadian population ages we will need to focus on prevention of coronary events to reduce the burden on our health care system. A normally aging person develops a blunted response to physical exercise, decreased oxygen uptake, and decreased cardiac output at maximal exercise.[14] When compared with their younger counterparts, however, elderly patients have comparable relative increases in exercise tolerance with exercise train-

Table 2. Targets for the management of modifiable cardiac risk factors.

Risk factor	Target
Hypertension	• < 140/90 in all patients* • < 130/80 in patients with diabetes mellitus*

Lipids	• High-risk chronic kidney disease patients with known CAD, peripheral artery disease, atherosclerosis, and most patients with diabetes; Framingham risk score ≥ 20%†
	  • LDL-C ≤ 2 mmol/L or ≥ 50% decrease in LDL-C
	  • apoB ≤ 0.80 g/L or non-HDL-C ≤2.6 mmol/L
	• Moderate-risk patients with Framingham risk score 10%–19% and LDL-C > 3.5 mmol/L, or apoB ≥ 1.2 g/L or non-HDL-C ≥ 4.3 mmol/L
	  • LDL-C ≤ 2 mmol/L or ≥ 50% decrease in LDL-C
	  • apoB ≤ 0.80 g/L or non-HDL-C ≤ 2.6 mmol/L
	• Low-risk patients with Framingham risk score < 10% and LDL-C ≥ 5.0 mmol/L† or history of familial hypercholesterolemia
	  • ≥ 50% decrease in LDL-C

Blood glucose	• HbA1c ≤ 7.0‡
Smoking	Smoking cessation

*As in CHEP 2012 guidelines[19]
†As in the Canadian Cardiovascular Society 2012 guidelines[20]
‡As per Canadian Diabetes Association 2008 guidelines[21]

ing.[14-16] In the past, women may have been less likely to attend a CR program because many were older than men when they first presented with an MI.[17] While women still tend to be older at first presentation, those attending CR programs have been shown to achieve significant reductions in inflammatory markers, as well as reductions in other cardiac risk factors.[18] In a study of 778 patients stratified by age and gender, the improvement in exercise capacity as measured by peak metabolic equivalent of task (MET) values achievable was 36% in men younger than 65 and 36% in men older than 75.[16] Similar results were seen for women, with an improvement in exercise capacity of 41% in women younger than 65 and 32% in women older than 75. The biggest changes in exercise tolerance were seen in patients who had poor initial exercise capacity (MET value less than 5) but were compliant with the program.

Elements of CR

Cardiac rehabilitation improves heart health by supporting patients as they address their modifiable risk factors and improve their diet and exercise habits.

Risk factor modification

Determining how patients should be treated begins with identifying their risk both for an initial MI and for potential future events using the Framingham risk score or the Reynolds risk score. Cardiac risk factors may be either modifiable (e.g., hypertension, dyslipidemia, diabetes) or nonmodifiable (age, sex, family history). Current recommendations for control of modifiable risk factors are shown in **Table 2**.[19-21] In BC, patients attempting to quit smoking can access a smoking cessation program that provides financial coverage for over-the-counter smoking cessation aids, including the nicotine patch, gum, and inhaler. Bupropion and varenicline, as well as multiple types of nicotine replacement, have all been shown to help patients in their efforts to quit smoking.[22]

Diet

Diet is a major lifestyle element of CR. Patients are seen by a dietician to

assess their current diet and to make heart healthy changes that are both easy to incorporate and to maintain. Because of the wide range of patient dietary habits, risk factors, and cultural backgrounds, dietary advice must be tailored to the individual. Previous efforts have focused on foods to eliminate (fat, salt, simple sugars), but more recently guidelines have begun to advise on foods to include in a heart healthy diet. Health Canada 2007 has nutritional guidelines for inclusionary, neutral, and exclusionary foods, as shown in **Table 3**. Incorporating healthy dietary changes rather than simply excluding unhealthy foods appears to make a difference in preventing nonfatal MI and cardiovascular mortality. In the Lyon Diet Heart Study patients were randomly assigned to either a prudent diet (unhealthy foods excluded) or a Mediterranean-type diet (healthy foods included). The results showed a 68% decrease in both non-fatal MI and cardiovascular mortality with the inclusionary Mediterranean-type diet.[23] Similar results have been found in other studies, including studies of the AHA Step 2 diet.[24-26] Interestingly, this effect appears to be independent of the change seen in traditional cardiovascular risk factors. In the Lyon study, there were no changes in serum lipid levels between groups, suggesting patients should be advised to continue a healthy diet even if they see little change in their risk profile. The optimal heart healthy diet should include a low intake of saturated fats and cholesterol, a low intake of salt, and a high intake of vegetables and fibre.

Exercise

A regular exercise program is another major element of CR. Exercise training is extremely important to drive adaptive changes in the vascular endothelium. Exercise increases endothelium-derived nitric oxide and maintains vasodilatory capacity. Exercise also stimulates the development of collateral circulation, which may help decrease angina symptoms.[27-29] Additionally, exercise capacity has been shown to be a strong predictor of mortality. In a study of 12 169 males with documented CAD, the ability to expend more than 8 METs on exercise stress testing correlated with a cardiac mortality of less than 1%/year, 5 to 8 METs with a mortality of less than 2%, and fewer than 5 METs correlated with a mortality of more than 3%.[30] To provide a comparison, 8 METs is the equivalent of vigorous activity such as jogging and 5 METs is equivalent to moderate activity such as walking at 4.8 km per hour (3 miles per hour) or cycling on flat ground. By engaging in regular exercise, patients with CAD can reduce their all-cause mortality by up to 30%.[31]

Currently patients enrolled in CR

Table 3. Nutritional recommendations for the prevention and management of cardiovascular disease.		
Inclusionary foods	**Neutral foods**	**Exclusionary foods**
Antioxidant rich food: Fruits, vegetables, and grains	Total fat: < 30% of total calories	Saturated fatty acids: ≤ 7% total calories
Dietary fibre: > 25 g/day	Polyunsaturated fatty acids: 10% of total calories	Trans fat: ≤ 1% of total calories
Soluble fibre: 5–10 g/day	Alcohol: Women 0–1 drinks/day, men 0–2 drinks/day	Cholesterol: General population < 300 mg/day, people with CVD or 3 + risk factors for CVD < 200 mg/day
Soy protein (to replace animal protein): ≥ 25 g/day		Salt: Sodium chloride < 6 g/day, sodium < 2.4 g/day
Stanols/sterols: 2–3 g/day		
n-3 fatty acids: From fish (≥ 2 servings fish/week) or vegetable oils ~ 900 mg/day		
Monounsaturated fatty acids: Up to 20% of total caolries		
Nuts: Consumption of 21–28 g unsalted nuts/day isocalorically substituting for other foods		
Postassium: 4700 mg/day		
Calcium: Males 1200 mg/day, females 1300 mg/day		
Folate: 400–1000 μg/day		

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undergo initial exercise testing to obtain an exercise prescription. Monitoring cardiac patients as they begin an exercise program both increases patient confidence and allows a safe level of intensity to be determined.[32] An exercise prescription is given according to FITT principles (frequency, intensity, time, and type), as seen in **Table 4**.

Conclusions

For patients with heart disease, cardiac rehabilitation can have a significant positive impact on both the physical and mental aspects of their disease. CR programs have been shown not only to prevent premature death, but to make patients' lives more meaningful by allowing them to return to work and to participate in the activities they enjoy. As well, CR has been shown to be a low-risk and cost-effective way to manage CAD.[33]

Yet despite these benefits, CR is currently underutilized in BC, particularly among women and the elderly. Many barriers affect patient attendance, including referral bias and difficulties with transportation.

We hope to improve uptake of CR in British Columbia by increasing awareness of the benefits associated with cardiac rehabilitation. We also hope physicians will play a part by helping their patients access the programs listed at www.bcmj.org, since physician referral has been shown to improve patient enrollment in CR.[34]

Competing interests
None declared.

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Table 4. FITT (frequency, intensity, time, and type) recommendations for exercise training in cardiac rehabilitation.

Warm-up	A minimum of 5–10 minutes of cardiovascular and/or muscular endurance type activities at a target heart rate of approximately 20%–35% of HRR*	
Conditioning	Frequency	3–5 times/week
	Intensity	40%–85% of HRR*
	Time	20–40 minutes
	Type	Aerobic and resistance training
Cool-down	A minimum of 5–10 minutes of cardiovascular and/or muscular endurance type activities at a target heart rate of < 60% of maximum heart rate	

*HRR = heart rate reserve
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CR programs have been shown not only to prevent premature death, but to make patients' lives more meaningful by allowing them to return to work and to participate in the activities they enjoy.

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