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Translating Heart Health Knowledge into Action: A Vascular and Risk Reduction Program for Women Aged 35 to 65 Years

April Manuel, RN, PhD, Sandra MacDonald, RN, PhD, Sue Ann Mandville-Anstey, RN, PhD, Heather Percy, BN, and Andrew Coffin

Abstract

Background: *Globally, about 8.6 million women die each year due to cardiovascular disease with cerebral vascular disease being the third leading cause of death in women. The province of Newfoundland and Labrador has one of the highest rates of vascular disease in comparison to the rest of Canada. Women in Newfoundland and Labrador have higher rates of vascular disease than their female cohorts across Canada. A vascular risk reduction program for women aged 35 to 65 years was developed and implemented in a rural and an urban setting.*

Purpose: *An evaluation of the program was conducted to assess the impact of the program on participants' satisfaction and to assess how women were able to apply acquired knowledge into their everyday lives to improve their vascular health.*

Procedure: *A thematic analysis of qualitative data collected during two focus groups (N=19) was completed.*

Findings: *Three core themes were identified that captured the experiences of the women who participated in the program including Solidifying One's Risk, Translating Knowledge into Action, and Making a Change.*

Implications: *Implementation of community-based vascular education programs must consider the context in which the program is delivered, the population's unique needs, and existing resources if they are to be successful in sustaining healthy lifestyle behaviours known to decrease one's risk for vascular disease.*

Key words: women's health, cardiology, adult education, community health

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Highlights

- Implementation of community-based vascular education programs must consider the context in which the program is delivered, the population's unique needs, and existing resources if they are to be successful in sustaining healthy lifestyle behaviours known to decrease one's risk for vascular disease.
- Laypersons and health care providers, who reside in the community, need to be included in the planning and delivery of community-based education programs to ensure their sustainability.

Since the late 1990s, the general public has been exposed to a myriad of vascular health information and health promotion strategies, yet vascular disease, in particular cardiovascular disease (CVD), and cerebral vascular disease or stroke, remain in the top 10 leading causes of death in the world (World Health Organization [WHO], 2014). In 2012 nearly 17.5 million people died from CVDs (WHO, 2015). Of those deaths, approximately 7.4 million were related to CVD while 6.7 million were due to stroke (WHO, 2015). Roughly 8.6 million women worldwide die from CVD annually, with stroke being the third leading cause of death in women globally (Bushnell et al., 2014; Simmons, 2012; WHO, 2010). It is projected that the number of deaths linked to CVD worldwide will peak in 2030 at 23.6 million (Shanthi, Puska, & Norrving, 2011).

In Canada, CVD ranked second with 21% of all deaths, followed by stroke with 6%. However, between 2000 and 2009, both heart disease and stroke showed a decline in the number of deaths (Statistics Canada, 2009), and in Newfoundland (-10.5% and -9.4% respectively) (Newfoundland and Labrador Centre for Health Information, 2014). Despite strides in research and prevention, CVD continues to be the second leading cause of death for men and women aged 45 to 84 years. In Newfoundland alone there were 987 deaths from heart disease and 305 from stroke in 2009 (Statistics Canada, 2009). Newfoundland and Labrador (NL) has one of the highest mortality rates for CVD in comparison to the rest of Canada with 202.3 deaths per 100,000 of the population (The Conference Board of Canada, 2015). NL also has the highest mortality rates from stroke (29.9%) in comparison to the national average of 17.9% (Heart and Stroke Foundation, 2014).

Women in NL are at higher risk for developing vascular conditions partly attributed to the fact they have high rates of obesity (24.2 %), hypertension (22.5%), diabetes (9.9%), smoking (16.5%), drinking alcohol (15.2%), engage in less physical activity, eat fewer servings of fruits and vegetables, and have a higher incidence of vascular disease than their female cohorts in other parts of Canada (Statistics Canada, 2013). Vascular disease is a significant global health problem and, women in NL are at higher risk for developing vascular conditions. Specially designed programs that support and help these NL women translate knowledge about vascular disease into healthy behaviours and lifestyle changes are needed (Tedesco, Giuseppe, Napolitano, & Angelillo, 2015) to reduce the high mortality rates from vascular conditions.

Purpose

The purpose of this project was to examine the impact of participation in a four-week Vascular Risk Reduction Program (VRRP) on participants' satisfaction with the program, knowledge, and perception of translating that knowledge into lifestyle changes in NL.

Background

Community-based programs can have a positive impact on women's vascular health by reducing risk factors for CVD (Folta et al., 2009; Sadeghi et al., 2014; Villablanca et al., 2009). Specially designed vascular risk reduction programs need to reach out to women within their communities and should provide a variety of innovative teaching learning strategies appropriate for this specific population (Sadeghi et al., 2014; Secker-Walker et al., 2000; Villablanca et al., 2009). Community-based vascular educational programs have been shown to be effective in helping women reduce the impact of risk factors that contribute to cardiovascular disease and stroke including hypertension, hyperglycemia, hypercholesterolemia, obesity (Folta et al., 2009; Sadeghi et al., 2014; Villablanca et al., 2009), smoking (Secker-Walker et al., 2000), and sedentary lifestyle (Perry, Rosenfeld, Bennett, & Potempa, 2007).

In one community program, Noble Walker et al. (2009) found that women who received health information on nutrition and physical activity via a newsletter increased their physical activity and adopted a healthier diet. Health education programs that use diverse and innovative teaching learning strategies such as group sessions, phone coaching, texting, web-based approaches, and program manuals, were also noted to be effective in changing health behaviours (Anderson-Bill, Winett, & Wojcik, 2011; Kozica, Lombard, IIic, Harrison, & Teede, 2015b). For example, a web-based health education program designed to modify weight, nutrition, and physical activity reported a healthier diet, increased exercise, and weight reduction in participants (Anderson-Bill et al., 2011). Similarity, a telehealth stroke education program was shown to have a positive impact on participants' satisfaction, knowledge, and lifestyle changes (Schweickert et al., 2011), yet few of these community programs exist for women aged 35 to 65 years, especially those who live in rural areas.

Researchers have shown that participation in health education programs (Kozica, Harrison, Teede, Moran, & Lombard, 2015a) and sustainability of new health behaviours (Broekhuizen, Kroeze, van Poppel, Oenema, & Brug, 2012; Crouch, Wilson, & Newbury, 2011) can vary depending on participants' readiness to change their lifestyle and perceived benefits of the program, program accessibility, and presence of peer support and persuasion (Kozica et al., 2015a). Barriers to positive health outcomes include disengagement, lack of anonymity, self-consciousness, and segregated networks (Kozica et al., 2015a). Furthermore, rather than target everyone at risk, risk reduction programs should concentrate on those at high risk for CVD such as those with a preexisting heart condition, diabetes (Crouch et al., 2011), or in the case of this vascular risk reduction program—women. Although most strokes are preventable, women are not always aware of the signs or their risk for having a stroke (Ennen & Beamon, 2012) or cardiac event, mainly because they may have a different clinical presentation, as compared to men (Davis et al., 2013).

The WHO (2009) stated that a population health approach that addresses the use of tobacco, diet and physical inactivity, alcohol consumption, and cardiovascular disease risk factors is needed to reduce the prevalence and incidence of cardiovascular disease. Building on the suggestions of the WHO action plan (WHO, 2009), the World Heart Federation (2010) has challenged health care providers to raise awareness among those at risk for cardiovascular disease and to embrace teachable moments. Rising to this challenge, an innovative vascular risk reduction program for women (VRRP) was designed for women aged 35–65 years and the impact of the program on participants' satisfaction with the program, knowledge, and perception of translating that knowledge into lifestyle changes was studied by these authors.

The Vascular Risk Reduction Program

The VRRP is a four-week program consisting of four one-hour weekly sessions that focused on personal risk for developing vascular disease, how to increase physical activity and heart healthy nutrition. The authors, members of the Heart and Stroke Foundation, St. John's, and a team of interdisciplinary health care providers with experience in vascular health, all helped to design the program. Elements of an existing Heart and Stroke Foundation program titled, "Heart to Heart" (Heart and Stroke Foundation, 2013) were incorporated into the program including lectures and visual aids. The content of the VRRP was verified with experts practising in the field of cardiovascular health. A cohort of volunteer health care providers (e.g., dietitian, physician, kinesiologist, physiotherapist, nurse, and pharmacist) living in the region where the sessions took place delivered the program.

Aim

The aim of this project included the following:

1. To assess the impact of the VVRP on participants' satisfaction.
2. To assess the impact of the program on the translation of knowledge into heart health behaviours.

Methods

Design

A descriptive qualitative approach was used to explore and describe the experiences of the women who participated in the VRRP (Polit & Beck, 2008). A content analysis of the data identified essential patterns and themes.

Sample

Inclusion criteria for participants in this study included women who (a) were between the ages of 35–65 years, (b) had a preexisting risk factor for vascular disease such as hypertension, hypercholesterolemia, angina, diabetes, (c) were able to communicate fluently in English, and who were (d) capable of understanding the purpose of the study.

Recruitment

The Heart and Stroke Foundation Health Promotion Division (HPD) conducted target recruitment for participants over a period of three months. Recruitment strategies included posting a poster advertising the VRRP in several locations including hospitals and physicians' offices, and placing an ad describing the program in local newspapers, and on the local television and radio channels. Participants could self-refer to the program by contacting the HPD directly and receive information regarding the program. The program was offered to all women who were between the ages of 35 to 65 years, who self-identified as having vascular disease.

The HPD coordinated resources such as the space and educational materials needed to implement the program. The VRRP was delivered in one urban and one rural setting in NL over a period of two months. Methods of program delivery included PowerPoint presentations, round table discussions, question and answer periods, written resources, and a series of interactive activities including fitness training and a grocery store tour.

Data Collection

At the end of the VRRP program two focus groups were conducted; one with each group of urban and rural participants to collect qualitative data on their satisfaction and perceived impact of the program. Open-ended questions guided the focus group interviews (see Table 1). Each interview was audio taped and lasted about one hour.

Data Analysis

Two members of the research team, with expertise in qualitative data analysis, completed a thematic analysis of the qualitative data to identify and confirm recurring themes and to ensure rigour of the findings. This article reports the findings of the two focus groups.

Ethical Considerations

Ethics approval for this project was not required, as the focus was program evaluation. Ethical guidelines for research with human subjects from the Tri-Council were followed, including informed consent. Participation in all activities was on a voluntary basis and participants were aware they could withdraw from the VRRP and the evaluation at any time. Prior to the focus group the purpose of the study was explained. Identifying information collected throughout the program was removed and each participant questionnaire and interview was assigned a code to ensure the data were anonymous. Focus group interviews were recorded and transcribed into a password-protected computer. All data were stored in a locked cupboard in a private office where only the primary investigator had access.

Results

A convenience sample of 32 women between the ages of 35 to 65 years participated in the VRRP. Nineteen participants chose to attend the focus group at the end of the program with eight participants from the urban setting and 11 from the rural setting. Each of the participants had one or more of the following risk factors: smoker, diabetes, dyslipidemia, hypertension, obesity, peripheral vascular disease, coronary artery disease, cerebral vascular disease, and angina. Fifty-two percent of the 32 participants were retired and 48% were currently employed. Eighteen (82%) of the participants had graduated high school with 10 of those continuing their education in university or college. The majority of participants (55%) were married. Ninety-four percent of participants reported an annual income over $20,000, with 44%

Table 1: Example Interview Questions

1. Can you tell me how you heard about this program?
2. Can you tell me about your experience with the VRRP? What did you like about the program?
3. Do you have an example of an activity that you found particularly helpful?
4. Were there parts of this program that you feel could be improved? Can you provide an example?
5. Overall, how satisfied are you with this program? What did you find most challenging about this program?
6. Has your understanding of health-promoting behaviours changed?
7. Did you learn new information? Can you provide me with an example?
8. Do you feel that the information was easy to understand?
9. What kinds of lifestyle changes have you made since attending this program?
10. Is there any additional information that you would have liked to see added to this program?

over $60,000.

A thematic analysis identified three central themes that were captured from the focus group discussions including *Solidifying One's Risk*, *Translating Knowledge into Action,* and *Making a Change*.

Solidifying One's Risk captures the theme that as women started to discuss their own personal family stories, in addition to content of the VRRP, they became more aware of their own personal risk. This awareness motivated them to continue with the VRRP and make lifestyle changes to reduce their vascular risk. *Translating Knowledge into Action* describes the key aspects of the course that engaged participants in the VRRP and fostered a translation of existing or new knowledge into lifestyle changes. *Making a Change* highlights specific lifestyle changes made by the participants such as diet, exercise, and self-advocacy. Threaded throughout each theme are elements of the VRRP that participants were satisfied with or areas that they felt could change to improve subsequent program offerings.

Solidifying One's Risk

There was a general consensus among the participants that after participation in the VRRP they were more "in-tune" with their own personal risk for developing vascular disease. Several women stated that this awareness motivated them to translate what they already knew into their everyday lives. *"I have the skills and the knowledge …we know what we need to do, but we are not practising it."* Participants also consistently spoke of how round table discussions throughout the VRRP brought to light their family histories of heart disease that sparked a mindfulness of their risk status, as summarized by one person, *"It [VRRP] refreshed a lot of things, and it was a wake-up call"*, and *"I have my father's physiology myself, so I expect it to happen [diabetes and heart disease]."* This heightened sense of being at risk led some participants to make lifestyle changes such as their diet, as evident in the story of this woman who recalls the untimely death of her brother at age 39 from a heart attack. *"He had high cholesterol… I have carotid blockages. I know what I have to do, but it's always nice to get new information and start applying it."* It was the sharing of stories such as these among the group that prompted another participant, who initially described herself as being healthy, to reflect on her own family history and come to the conclusion that she was at risk for vascular disease. *"All of us [siblings] are fairly healthy; I am on high blood pressure pills myself… I better get a handle on all of this before I get into [brothers'] situation [having a stroke]."*

Once participants had solidified the fact that they were at risk, the next logical step was to acquire the knowledge about how to decrease their risk for vascular disease and the means to translate this knowledge into action.

Translating Knowledge into Action

This theme captures participants' growth in knowledge with respect to diet, medications, available resources, benefits, and personal risk. It is this knowledge that motivated many of the women to engage in lifestyle changes in hopes of decreasing their risk for vascular disease.

Participants spoke of the information provided to them by the dietitian as helpful in making dietary changes. Knowledge about reading labels, food sugar content, and daily requirements of salt intake appeared to leave a lasting impression on the women. *"It's so important to look at your food… we just say I don't eat much sugar … but we need to look at the labels and what's in it."* The women welcomed new information such as the daily intake of sodium.

Many women were surprised because what they had thought was factual knowledge was not the case. "*Things have changed so much. I thought I could have 23 or 25 milligrams and now I am told that you should aim for 15 milligrams of sodium per day."* Having the correct information was seen as essential to engaging in a healthy diet. Facts about healthy eating were reinforced through an exercise in reading food labels while on a grocery tour. Reading labels for most participants was a new skill that they enjoyed and found informative in helping them select food items.

Others referred to knowledge gained about recommended portion sizes as being new. *"I was shocked when [dietitian] did the meat. I almost fell off the floor. Those little roasts. We are overeating too much."* For one person, information such as this was the incentive to get her to start to measure and weighing her food again. For others, the knowledge about healthy eating motivated them, as one person said, *"To take the diabetic course more seriously"* and to start monitoring their diet. *"I think it [VRRP] gave you the incentive to be more careful about what you are eating."*

Salient throughout the narratives was awareness that planning meals was an essential life skill they needed to work on to decrease their risk for vascular disease. Two participants shared stories of their children who make healthy meals a family priority. *"They [children] work full-time, but they have made healthy cooking a priority; they do not stop for fast food. …They plan their meals and then go grocery shopping… .I do it backwards."* For these individuals, being able to draw on past experiences in their families helped them solidify the relevance of the information. In this case, planning a family meal is not a novel idea, but one that they have been exposed to in their everyday lives; hence, a behavioural change that is realistic, attainable, and practical. Several members of the group remarked that the inclusion of formalized meal planning would be an asset to the program.

Many participants were not aware of resources in their community or how to access them. For this group, acquiring knowledge simply inferred information of existing community resources. *"I know more about the resources that are in my community."* Information regarding walking trails, recreation facilities, free or drop-in activities, and senior programs provided were received well by the group. One woman, however, noted that the cost associated with gym access was a deterrent to exercise; hence, *"if you know there are community resources available, then you are more likely to use them."* Similar sentiments were noted in another comment. *"It was great just knowing what was in my own community because, quite frankly, I did not know everything that was there."* Despite having this knowledge participants, by the end of this program, did not increase their physical activity, but several stated they were contemplating starting some sort of physical activity.

While participants agreed that knowledge was critical in helping them make healthy life choices, some participants recognized that it is sustaining these changes that is the most challenging. *"It is not the lack of knowledge, but actually getting people interested to do it."* Fostering a sense of engagement was critical in motivating participants to participate in the four-week program. Engagement in the program was nurtured through the delivery and content of the presentations. Participants found the grocery store tour, the session on vascular risk factors and medications the most informative and interesting. The sense from the participants was that they found the *"hands-on approach"* during the grocery store engaging, as it allowed them to translate or apply their knowledge in the real world. However, one concern noted was that there were too many people on the tour, which limited the interactions and left people in the back of the group having difficulty hearing the information. *"There were 21 of us and we were all trying to listen and I found that because I was in the back I had a hard time keeping up and trying to listen."* Participants thought the grocery store tour should be limited to 10 individuals. One participant indicated she wore a hearing aid and on one occasion had problems hearing the speakers. A microphone was offered as a solution to this problem.

Several people mentioned that knowledge of the anatomy of the body, overview of common medications, and impact of a poor lifestyle on increasing one's risk for vascular disease were motivating factors to make lifestyle changes, as one woman explained, *"All of the arteries, blockages, and everything… you could see for yourself. You saw the carotid and if a blockage goes any further down what could happen"* and *"I think people need to understand what medications they are taking and why."* The fact that presenters used layman's terms helped participants understand the content, kept them interested, and facilitated them to translate this new information into context of their everyday lives. For example, the statistics on risk factors predisposing one to vascular disease presented for some were considered a cue to action, as one participant summarized nicely, *"The stats was alarming… it was just what I needed to get myself back on track… I am just coasting along, not getting any worse, but not getting any better and I want to get better."* Another participant made an appointment with her family doctor after experiencing pain in her jaw, an atypical symptom for women. She attributed this action to the knowledge acquired in the VRRP, *"I actually had a bad neck for a while and a pain in my jaw and after listening to him talk [physician] I went to my doctor and told him about it… I had a stress test done because of that."*

All of the participants agreed that the learning environment was suitable and created a relaxed social atmosphere that was positive in nature. *"It's just the kind of [atmosphere] you need to speak whatever you want to say."* Adding to this was the supportive, encouraging, and respectful qualities of the presenters, which engaged them in the program. *"You felt supported, encouraged, and safe. Nobody was judging you. You were treated as an equal."* The only improvement offered was the timing of the program. That is, some felt that 1830 hours was a bit early for those working and with personal obligations at home.

One criticism of the program was that at times there seemed to be a lot of overlap of information. Although some found that this reinforced key concepts and was considered *"a refresher"* for others it made the sessions longer than needed. Despite this, the general consensus was that they would like to have more sessions with a variety of health care professionals. Evident in the narratives is the fact that the participants enjoyed the interactions with the health care providers, having face-to-face conversations with them, and being able to ask questions readily, as the following comment notes. *"Having access to health care professionals was wonderful."* In many respects, it was the high level of engagement expressed by the women in the VRRP that helped them translate knowledge into practice and fostered lifestyle changes.

Making a Change

The theme *Making a Change* captures participants' efforts to address those modifiable factors that impact their cardiovascular health (e.g., diet, exercise). With the exception of one person, participants' exercise patterns did not change after participation in the VRRP. However, many of them verbalized a plan to increase their physical activity. *"I have not started exercising yet, but I have been losing weight each week and the next phase is to get the exercise back in."* Participants spoke of walking, using exercise videos and resistance bands as a means to increase their physical activity. *"I done more [exercise] in the house because you cannot get out much in the way of walking. I've got a video that I dusted off with great intentions."* The one person who did make a change in physical activity started a community exercise program for seniors.

When asked what factors impeded their participation in physical activity, several participants stated that lack of exercise was attributed to the snow and poor sidewalk conditions. *"The number one reason for not exercising is the sidewalks; you cannot get out the door"*, and the *"cold Newfoundland winters"*, that do not lend themselves to outside activities. Other deterrents to physical activity identified were the cost of formalized physical activity programs, as captured in these comments. *"There are lots of reason why people do not exercise. I can't afford it,"* and *"These gyms are so darn expensive."* A subsidized exercise program by the government was offered as a potential solution, particularly for those on a fixed income, such as the case with older adults. Other suggestions offered were more emphasis on healthy lifestyle in schools and the addition of more physical fitness strategies in the VRRP, as stated in this comment. *"There is not emphasis on just being healthy in the early education system, and maybe there should be."* Many commented that knowledge of community resources, such as those provided in the program, was helpful in that now they were aware of what services were available, where, when, and the cost.

Participants reported that the biggest lifestyle change they had made throughout the program was with respect to their diet. Many changed their diet by reducing their portion sizes, using a smaller plate, planning healthy meals, and eating more vegetables. *"I have been trying to eat the right foods and the right amount."* Making a plan and sticking to it seemed to be a challenge they faced time and time again. Several participants, who identified themselves as visual learners, wanted more printed materials such as food recipes, a *"hands-on"* cooking class, or an exercise in label reading prior to the grocery store tour, as additional methods to foster changes in eating habits. *"I'm such a visual learner… So, like a visual aid or something, a little pamphlet"* and *"Maybe we all could look at a product each and think is this good or is this bad or what makes this good or bad , before we did the grocery tour."*

For one participant imperative to understanding her risk was being comfortable enough to question treatments and ask questions of her health care provider. "It [VRRP] gave me a wake-up call to start questioning my doctor and to get a second opinion of that kind of thing." This sense of self-advocacy was saliently threaded throughout many narratives. Being able to converse with health care providers during the VRRP helped one participant overcome a sense of what she described as intimidation. *"We are often intimidated by our physicians, but you know that [access to health care provider] helped me in that way… to ask him questions about my health."*

A common thread throughout participants' narratives was the lack of psychological support to help them make healthy lifestyle changes. For some, despite the fact that they had the knowledge, they could not translate it into practice. This was frustrating at times, as this woman said. *"The exercises are there, the nutrition is there, and the statistics are all there [to support a change], but how do you do it? Who can you talk to? I don't know if I need a psychiatrist? "* Another woman stated, *"I am addicted to food, why am I addicted? I have the skills and knowledge like most of us, we know the risk, and we know all that stuff [information about proper foods]."* They felt that a session with a psychologist, or referral to a life coach would help them understand and manage their behaviours.

Discussion

Our findings are similar to other programs reported in the literature (Folta et al., 2009; Kozica et al., 2015a) in that women expressed an increased willingness to participate in behavioural changes to improve their CV health. It was clear that this motivation was fostered by a sense of being at risk, as evident in the sharing of personal stories. This is in alignment with the genetic literature that suggests that risk perception is a concept that is socially constructed. That is, laypersons construct their ideas about risks in reference to factors outside the realm of numerical labels, drawing on the subjective nature of risk and personal beliefs about inheritance (Cameron, Sherman, Marteau, & Brown, 2009; McAllister, 2002; Norris, Spelic, Synder, & Tinley, 2009; Shiloh & Saxe, 1989; Smith, Michie, Stephenson, & Quarrell, 2002). In realizing this, community-based educational programs should consider engaging participants in discussions about their perception of being at risk for vascular disease as a means to help them solidify their risk and motivate them to make lifestyle changes to decrease their risk. A closer examination of the genetic literature may provide further insights into how to engage individuals at risk for vascular disease in education programs.

Participants reported that the VRRP helped them to translate their existing knowledge into health behaviours for their everyday lives (e.g., reading food labels and reducing the size of meal portions). Acquiring the knowledge to make lifestyle changes that are not only beneficial, but also sustainable was what posed the greatest challenge. These findings have implications for future offerings of vascular health promotion strategies for this population by considering more interactive education sessions to further translate knowledge into action (e.g., cooking classes, grocery tours, stress reduction techniques, and physical activity classes). Such programs should also provide more 'take home tools' and support materials to be used at home (e.g., list of community resources, exercise plans, meal plans, and recipes). Fundamental to the success of such a program is access to counselling services that can help people contextualize their sense of being at risk, factors that impede their success in sustaining healthy behaviours, and to craft realistic goals. In rural communities where access is limited, we must consider alternative modes of delivery of health care programs such as web-based counselling services or the use of telehealth if the goal is program sustainability.

Keeping in alignment with Kozica et al. (2015b), we found that participants were engaged, wanted to learn about how to decrease their vascular risk, and attended weekly meetings. As noted in the literature, contributing to the success of the VRRP was the presence of strong community networks and health care providers willing to deliver, coordinate, and advertise the program (Kozica et al., 2015a; Kozica et al., 2015b; Villablanca et al., 2009). The fact that health care providers were approachable, knowledgeable, and were able to answer participants' questions in terms that were easily understandable helped sustain a sense of community collaboration.

On a broader level, it is important that community councils take a proactive role in promoting health behaviours within the community. This includes ensuring that consumers are aware of existing resources and programs in the region. Councils need to ensure that sidewalks and walking trails are accessible and safe year round. Community-based programs can provide support for at-risk populations, increasing access to health care providers with expertise in counselling services. It is only through joint efforts that create a sense of community engagement that community-based programs can be sustained and successful.

Implications for Practice

Community engagement at the grass roots level is critical to any program's success. When crafting rural health education programs, educators need to take the time to understand the context in which the program is being delivered, the needs of the population, and existing resources in the community to ensure sustainability of the program. Attention must focus on engaging laypersons and health care providers in the implementation of such programs and crafting goals that are realistic in the community. ♥

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A Multidisciplinary Approach to the Development and Implementation of Best Practices Using an Innovative Clinical Pathway for the Management of Cardiac Arrest Patients with Cognitive Dysfunction: A Case Study

Bonnie Quinlan, RN, MScN, Carolyn Cooper, RN, MScN, and Nicole O'Meara, BSc

Abstract

Out-of-hospital cardiac arrest (OOHCA) affects 20 to 140 people per 100,000 globally with survival ranging from 2% to 11% (Meaney et al., 2013). Patients who have survived, but have been left with cognitive impairments due to anoxic brain injury should be offered early identification and initiation of rehabilitation needs during their admission to mitigate the impact of these deficits (Moulaert et al., 2011). Unfortunately, most cardiac survivors do not receive specialized rehabilitation during their acute hospitalization and there are no clinical pathways that currently exist to guide acute care practitioners regarding the appropriate timing of cognitive screens and early rehabilitation interventions. This tertiary care institution designed and implemented a clinical pathway and patient and family education tools, which have systematically improved the identification and treatment of patients requiring cognitive rehabilitation. In this paper, the authors discuss the pathway/tool development and use a case study to highlight these interventions.

Key words: out-of-hospital cardiac arrest, cognitive impairment, early interventions, best practices

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Highlights

- Cognitive injury occurs in approximately half of all out of hospital cardiac arrest patients
- Clinical pathway used to identify patients requiring cognitive rehabilitation
- Application of pathway highlighted through case study

The purpose of this paper is to provide an overview of the impact and approach to treating out-of-hospital cardiac arrest patients within a tertiary cardiac care centre, identifying challenges that affect long-term patient outcomes and quality of life. To provide context to the discussions, the authors will review the increasing prevalence of out-of-hospital cardiac arrest in Canada and the current treatment and rationale. In the article, the authors outline the development of an innovative clinical pathway by a multidisciplinary team. This project has resulted in this specialized population receiving the comprehensive cognitive support they need during their cardiac admission to address these challenges and provide them with the best possible chances of recovery and return to the patient's definition of a normal life.

Prevalence of Out-of-Hospital Cardiac Arrest: Identifying the Scope of the Problem

Out-of-hospital cardiac arrest affects 40,000 Canadians every year (Heart & Stroke Foundation, 2013). With improvements to access of emergency care technology, such as the increased availability of automated external defibrillators (AED) and education of the general population using them, the number of survivors has been increasing (Meaney et al., 2013). The term used when emergency personnel successfully resuscitate a patient is return of spontaneous circulation (ROSC). The most common cause of cardiac arrest is coronary artery disease (Deo & Albert, 2012). However, for the patient and family the most significant long-term effects related to the event are often the cognitive complications, not the heart disease (Kragholm et al., 2013). Systematic reviews reveal only a few high-quality studies related to long-term cognitive impairments after an out-of-hospital cardiac arrest (Moulaert, Verbunt, van Heugten, & Wade, 2009). All of these indicate cognitive impairments are common, affecting all cognitive domains with memory, attention and executive functioning being the most severely affected domains (Moulaert et al., 2009). In order to reduce the impact of cognitive dysfunction, induced therapeutic hypothermia is now considered to be the standard of care for out-of-hospital cardiac arrest survivors, as it has been shown to be a predictor of good neurological outcomes (Kragholm et al., 2013).

Cardiac Arrest and Therapeutic Hypothermia

In 2010, our tertiary care cardiac institution, in partnership with Regional Emergency Response Personnel, developed a protocol to identify and treat patients who met the eligibility requirements for induced hypothermia. In order for a cardiac arrest patient to be considered for therapeutic hypothermia within our institution they must be older than 18 years of age, cardiac arrest must be less than 30 minutes to Advanced Cardiac Life Support and have return of spontaneous circulation without full neurological recovery not attributed to sedation (Moudgil et al., 2014). The introduction of therapeutic mild hypothermia for survivors of cardiac arrest has improved survival and cerebral outcomes (Meaney et al., 2013). The processes that cause brain injury are temperature dependent; fever increases toxic neurotransmitter release, inflammatory cytokine production and cerebral metabolic demand which, ultimately, leads to permanent neuronal damage (Geocadin, Koenig, Jia, Stevens, & Peberdy, 2008). Mild hypothermia can block or mitigate these processes (Kragholm et al., 2013). A meta-analysis has demonstrated that patients treated with hypothermia were more likely to reach a good cerebral performance category (CPC) at discharge: a score of 1, which reflects good cerebral performance or 2, which illustrates moderate cerebral disability (Kragholm et al., 2013). Since September 2010, our institution has treated 268 ROSC patients with 67% of them surviving to discharge. Of those who survived, 80% had a CPC score of 1 or 2.

The process of therapeutic hypothermia involves the insertion of a cooling catheter into the femoral artery on arrival to hospital. A core temperature of between 32-34 degrees Celsius is targeted and maintained for 24 hours (Moudgil et al., 2014). Thereafter, the patient's temperature is slowly increased to normal, a process termed the 'rewarming phase.' This phase may last an additional 48 hours. Once this process is complete (if successful) sedation is lightened, extubation is initiated and assessment of neurological recovery begins.

Early Interventions

Recovery from cognitive impairment does not occur simply with the passage of time (Moulaert et al, 2011). Experts all agree that early intervention is key in order to provide patients with the maximum opportunity to achieve the greatest level of cognitive and emotional wellness. Studies point to four components of successful early intervention programs (Moulaert et al., 2011):

1. Early cognitive screening (optimal timing of this decided by an Occupational Therapist)
2. Supply of information and support for family and caregivers (how they can participate in recovery, how to manage behaviours)
3. Promotion of self-management behaviours (use of memory aids, environmental cues)
4. Referral, as needed, to specialized care when necessary (brain injury rehabilitation units, support groups).

Early identification of cognitive dysfunction and treatment are essential to providing patients with the best possible chances of recovery. Studies suggest that most of the improvements in cognitive recovery may be limited to the first three months (Moulaert et al., 2009) making it essential that acute care providers intervene to ensure the best possible outcomes.

Prior to our new clinical pathway, no systematic process existed to assess the cognitive function of patients who survived therapeutic hypothermia and extubation. Consults to our colleagues in occupational therapy and neuropsychology were based on obvious signs of cognitive dysfunction and not any objective testing done by health professionals who are trained and experienced in this type of sensitive screening. The Cerebral Performance Score test, although widely used, is considered by neuropsychologists a crude test, not designed to detect subtle psychological or social disabilities that may be very significant to a patient and his/her family (Moulaert et al., 2009). As a result, significant cognitive dysfunction and emotional impairments can be missed and, consequently, go untreated. A further significant caveat is safety issues such as returning to work and driving; how can health care providers ensure patients have been objectively assessed to resume these activities without using appropriately validated instruments? Researchers cite over half of all survivors of cardiac arrest experience significant cognitive dysfunction and other consequences such as problems with emotional functioning, limitations in daily life activities, reduced participation in society and a decreased quality of life (Moulaert et al., 2011). The partners and families of these patients may also experience high caregiver strain and symptoms of depression or post-traumatic stress (Moulaert et al., 2011). This burden to our patients and families was the foundation or the catalyst for the development of our new pathway and educational tools.

Development of Pathway and Tools

Clinical pathways are structured, multidisciplinary care plans that detail the essential steps in the care of patients with the goal of linking evidence to practice optimizing clinical outcomes (Rotter et al., 2010). It was recognized that our institution needed a systematic approach or pathway to care for this patient population grounded in best practices and evidence-based research. In order to guide our knowledge translation process, the authors used the Ottawa Model for Research Use (OMRU) (Graham & Logan, 2004) to address the development of the tools and the translation of the existing research knowledge into clinical practice. The model relies on assessing, monitoring and evaluating each element before, during and after implementation (Graham & Logan, 2004). The authors had previous experience working with this model to implement other best practices within the institution and found it to be particularly useful for this type of project. The element of assessing the practice environment first for possible barriers and supports and, thus, tailoring interventions, facilitates a more successful adoption of the innovation (Graham & Logan, 2004).

The primary development team consisted of the cardiology advanced practice nurse, the clinical manager of the unit that received most of the patients from the CCU after the initial hypothermia process was complete and an occupational therapist. This core group would also be primarily responsible for the integration of the Ottawa Model for Research Use throughout the project, including continuing assessment of outcomes related to the pathway and educational tools. At the time, we were fortunate to have an occupational therapy master's student who conducted a comprehensive literature review and analysis of the best practices surrounding the care of patients with anoxic brain injury, part of the student's master's thesis project. This primary team began by meeting with key leaders (neuropsychologists, physiatrists, and therapists) from the acquired brain injury (ABI) program for our region to gain a better understanding of the interventions and treatments required by this group of patients and to better enable us to integrate cardiac and neurological recovery. For many of our patients the ABI Program would be the bridge between the cardiac institution and home. This inpatient program focuses on improving and helping patients manage difficulties in thinking skills, including memory, attention, learning, planning and problem solving, with the goal of returning to their community (The Ottawa Hospital, 2016). After this initial groundwork was complete, we added the following multi-disciplinary members to begin work on the clinical pathway and educational tools: physiotherapists, social workers, neuropsychologists, cardiologists, clinical managers, students, dietitian, nurse educators, and administrative staff.

The multidisciplinary group started with a presentation from the occupational therapy student to ensure that all members had a comprehensive understanding of the literature and best practices that should be the foundation of all developed pathways and tools. Regular meetings were held to outline the overall objectives and smaller working groups were formed to develop the pathway, booklets and resources. All sub-groups reported back to the larger team for review and feedback making changes as needed, reflecting the dynamic interactive process of using the OMRU. End users trialed and evaluated each tool developed to ensure usability and perceived effectiveness of the information.

Tools Developed

Clinical Pathway

The new clinical pathway followed patients from admission day to discharge or transfer from the institution. It was divided into three phases based on the patient experience (hypothermia process/post extubation/recovery on the ward), not the chronological admission day. It served as a guide or checklist for nursing, medicine and allied health members to follow indicating the necessary consults timing of appropriate tests, interventions and education classes, as well as the expected outcomes. For example, all patients have cognitive screening conducted by an occupational therapist. Based on the result and the recommendation by the occupational therapist, selected patients would then be assessed by a neuropsychologist. Staff was provided with cognitive stimulation exercises that they could practise with patients and encourage family members to provide, as well. The pathway also indicated when to provide educational booklets and support resources to family and caregivers.

Cardiac Arrest and Hypothermia Pamphlet

On admission to hospital, family members are provided with an educational handout that describes the rationale for the hypothermia and how it is done. As this is always a shocking time for families, the pamphlet is something they can review frequently, reinforcing the significance of the process and outlining each phase. It also helps family 'make sense' of the multiple tubes they see when they first enter the Coronary Care Unit. It is emphasized to family that often it is difficult to have any concrete information regarding cognitive outcomes for at least 72 hours after admission.

A Guide for Patients and Families: The Next Steps of Therapeutic Hypothermia

This resource is provided to family when the patient has been successfully extubated and has a CPC score of 1 or 2 and sometimes 3. Scores that are higher indicate a poor prognosis (Safar, 1981) and resources provided in the booklet would not be appropriate. This detailed guide provides patients and families with information on the diverse health care professionals who could be potentially involved with care and describes their roles. A key chapter also describes common behaviours that patients may exhibit and how family can help manage them. The booklet includes resources that family can bring from home to improve cognitive development such as cards, family photos, calendars and games. At this point, the occupational therapist would also meet with the patient and the primary care giver to provide additional, more patient-specific materials to improve cognitive function. The resources at the end of the guide include a variety of programs/supports to which patients or families can self-refer after discharge, if necessary.

Case Study

The chosen case study highlights the implementation of the clinical pathway using all educational tools developed. The case study involves a 53-year-old female patient who experienced a witnessed cardiac arrest. The patient was exercising in a gym at the time and a bystander performed cardiopulmonary resuscitation (CPR) and delivered three shocks with an AED. When the paramedics arrived, they delivered an additional two shocks, as well as one ampoule of epinephrine. The patient was then transported to our tertiary cardiac care institution where she underwent emergency percutaneous coronary intervention (PCI). Medical staff determined that the patient had an estimated time from collapse to return of spontaneous circulation of 10 minutes. Therefore, after the PCI the ROSC cooling protocol was initiated.

While in the coronary care unit (CCU), the patient's cardiac status remained stable. However, there were several related complications. The patient incurred facial trauma resulting from a fall during her arrest requiring nasal packing. The patient developed ventilator-acquired pneumonia and required a tracheotomy as a result of a failure to wean from the ventilator. Because of these conditions, she also required a feeding peg for nutrition.

On rewarming, she was significantly neurologically impaired. A computerized tomography scan of her head showed diffuse cerebral edema and multiple infarctions in her parietal lobe, an area of the brain responsible for spatial awareness. Damage to this area impairs self-care skills such as dressing and bathing. There is also an inability to recall numbers, verbal and memory deficits, as well as changes in personality (Riddoch & Humphreys, 2001).

Due to the complexity of the condition of this patient, a multidisciplinary team approach was required to obtain the best possible outcome in recovery. The professionals from the following areas were involved in this case: medicine, nursing, physiotherapy, dietitian, speech language pathology, neuro-psychology/behavioural management, occupational therapy and a physiatrist. The clinical pathway guided staff as to when the appropriate health care professional should be consulted with each speciality building on the assessments and recommendations that had been completed, facilitating strong communication and a best practice plan of care.

Recovery

The recovery of the patient involves the domains of cognitive stimulation and motor stimulation. From week one to week 10 the patient progressed from being able to only say one word to fully formed sentences. Nursing and physiotherapy explained the planned therapy to the patient in short sentences and required only one action of feedback from the patient. Using this approach she was encouraged to perform hand and face washing, as well as other self-care tasks.

Cognitive Recovery

Music therapy was used for retraining the patient's brain. This therapeutic approach is gaining recognition as an effective tool in the restoration of communication, motor control, balance, strength, perception and cognition (Gilbertson & Aldridge, 2008). A calendar for temporal and location orientation was set up in her room and personal effects from home such as a blanket and family pictures were used to assist with self-recognition.

As the patient progressed she was encouraged to use brain stimulation games such as word search puzzles. As well, she played simple card games with her family. From weeks four to nine, the patient experienced emotional labiality. This took the form of crying, screaming, rocking and biting. Behavioural modelling was used to control these tendencies and the approach varied from suggestion and guidance to setting boundaries to indicate non-acceptable behaviour.

It should be noted that the family was an important part of this patient's recovery; they were educated in all aspects of this therapy. This was primarily based on cognitive recovery information in the patient booklet, described above. Furthermore, additional emotional and coping support for the family was provided through a community-based rehabilitation centre, specializing in treating patients with brain injuries, a resource that was discovered during the development phase of our project. As shown in Figure 1, the patient showed cognitive improvements after 10 weeks of a number of therapies. Figure 1 is a map of care documenting the patient's cognitive improvement and recovery after 10 weeks of a number of therapies.

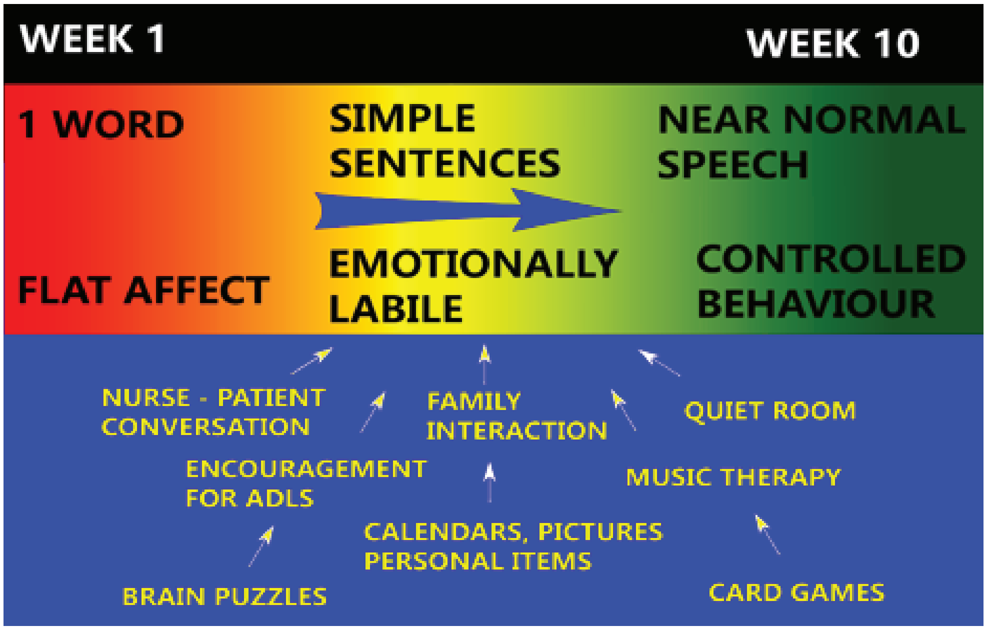

Figure 1: Factors of Treatment and Recovery with Cognitive Stimulation

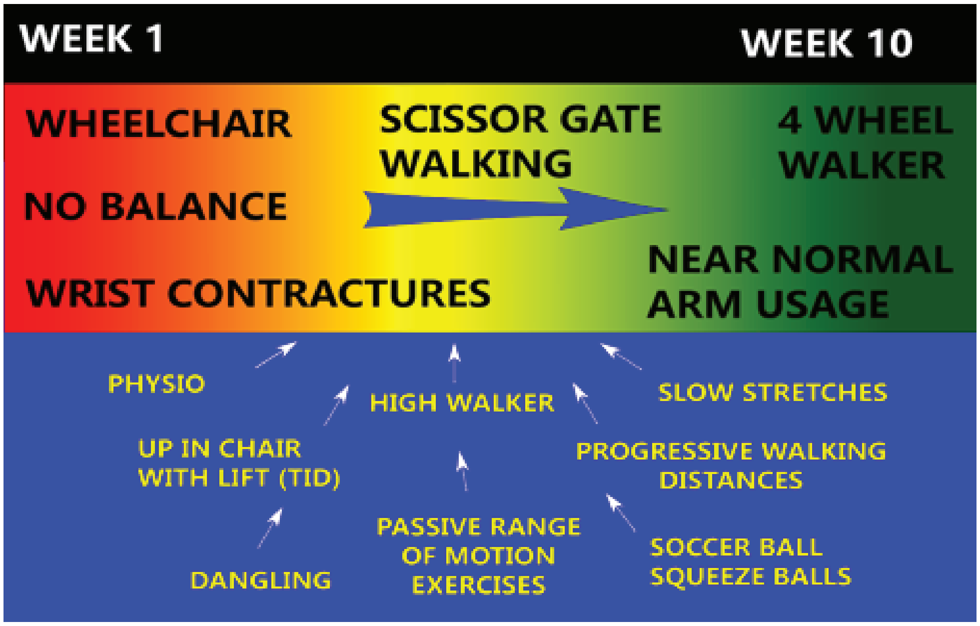

Figure 2: Factors of Treatment and Recovery with Motor Stimulation

Motor Recovery

From week one to week 10, the patient made significant motor improvement. In addition to nursing therapy, the patient had two sessions with a physiotherapist each day. The family was encouraged to do passive range of motion and stretching exercises with her when they visited. Initially the patient required a lift for transfer from bed to wheel chair. On discharge, she was walking independently with the use of a four wheel walker. The patient had developed a left wrist contracture. During this time, she progressed from no control of her arm and wrist to 90 percent range of motion and use.

The patient initially had no sense of balance. She progressed from sitting up with aid, to staff-assisted walking by week five. At the end of week 10, she could walk unassisted using a four wheeled walker. Significant cuing and encouragement were required to obtain these results.

To aid in gross motor skills, while the patient was still wheel chair bound, the nurses devised an ad-hoc soccer training task. The patient enjoyed kicking a soccer ball. The fact that it was enjoyable was an important factor in maintaining the treatment and was beneficial in aiding her development in communication. This therapy also helped to enhance her mood, as well as increase her confidence in using her gross motor skills. As shown in Figure 2, the patient underwent a number of treatments that contributed to improved mobility and motor skills. The map of care for motor recovery, in Figure 2, documents the patient's treatments that contributed to improved mobility and motor skills. It was interesting to note there was a correlation between the improvements of the patient's cognitive abilities with that of her motor skills. The patient was discharged at the end of week 10 to the Regional Acute Brain Injury In-Patient Program.

Conclusion

At least half of all survivors of out-of-hospital cardiac arrest have cognitive deficits leading to a decreased quality of life and lost productivity, and negatively impacting significant others (Lim, Verfaellie, Schnyer, Lafleche, & Alexander, 2014). All current research indicates this is under-diagnosed and under-treated in current care (Moulaert et al., 2011). Early intervention programs are designed to detect and manage these problems with the capacity to improve patient outcomes; the overarching goal of not only returning patients to their baseline level of functioning, but also capturing the essence of who they actually are, as individuals and family units. ♥

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Risk Factors and Best Practices for the Prevention of Post-Cardiac Surgery Surgical Site Infections in a Tertiary Care Centre

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Abstract

Background: *Post-cardiac surgery surgical site infections (SSIs) pose devastating consequences in terms of morbidity and mortality to patients.*

Objective: *To examine current risk factors and best practice perioperative care for prevention of SSI following cardiac surgery through the lens of the demographic/clinical characteristics of patients who developed post-cardiac surgery SSIs at a major tertiary care institution, and to identify where documentation is lacking and could be improved to better serve clinical practice.*

Methods: *A literature review on post-cardiac surgery SSI prevention and risk factors was performed. These risk factors were examined through a retrospective chart review of the population of patients who developed SSIs during the study period.*

Results*: The study population was characterized by a high prevalence of risk factors including age, diabetes, obesity, operative time, blood glucose control, surgical re-exploration, blood transfusions, and emergency context, as well as differences from best practice guidelines such as preoperative showering. Compared to other populations in the literature, several of these risk factors were more prevalent at the study site than in the other comparable populations.*

Conclusion: *The patient population had a relatively high prevalence of risk factors, and the care received by these patients varied in some ways from best practices. Using best practice guidelines, known risk factors, and the data specific to the institution can provide insights for analysis and practice improvement efforts in the form of identifying at-risk patients, improving adherence to best practice guidelines, targeting areas to focus care efforts, and improving clinical documentation.*

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Highlights

- An in-depth look at the major contributing factors to developing post-cardiac surgery surgical site infections at a major Canadian cardiac surgery centre.
- The study population was characterized by a high prevalence of risk factors including age, diabetes, obesity, operative time, blood glucose control, surgical re-exploration, blood transfusions, and emergency context, as well as differences from best practice guidelines such as preoperative showering.
- Using best practice guidelines, known risk factors and the data specific to the institution can provide insights for analysis and practice improvement efforts in the form of identifying at-risk patients, improving adherence to best practice guidelines, targeting areas to focus care efforts, and improving clinical documentation.

Background

Patients undergoing cardiac surgery are at risk for developing surgical site infections (SSIs), which can have devastating consequences in terms of morbidity (Tang, Maganti, Weisel, & Borger, 2004), pain, and psychological distress (Swenne, Skytt, Lindholm, & Carlsson, 2007), and death in between 5% and 20% of severe cases (Graf et al., 2010; Lepelletier et al., 2005). A post-cardiac SSI also has economic implications such as an increase of length of hospital stay (Graf et al., 2010). This additional time spent on the unit and the additional amount of intensive care required for these patients puts a significant financial strain on the health care system, the family and society (Syndor & Perl, 2011). These potential outcomes indicate there is a fundamental responsibility to eliminate this cardiac surgery complication.

There are many risk factors previously identified in the literature that have resulted in best practice guidelines. Nonetheless, the incidence of post-cardiac surgery SSI persists and ranges from 1–6% (Edwards et al., 2009; Lepelletier et al., 2005; Lucet, 2006). At the institution that was examined for this study, a major Canadian university-affiliated tertiary care centre, the complete elimination of post-cardiac surgery SSI remains elusive despite efforts for continued improvement and excellence in care. Health care institutions, as a whole, are operating in a time with an unprecedented rate of technological advances, but are also treating a population of patients who are older and live with more comorbidities than ever before. These circumstances may not be reflected in previous research. These factors indicate the need for further investigation into the population of post-cardiac surgery patients who developed SSIs in order to illuminate risk factors, areas of best practice, and documentation practices that could be of particular focus for care improvement efforts.

This is a complex problem that involves all members of an interdisciplinary health care team. Nurses have many responsibilities at the bedside, which put them at the forefront of infection prevention such as preoperative preparation, postoperative assessment, patient education, and pain assessment. In addition, nurses have an indirect role in patient care, as they are responsible for developing policies and procedures, conducting audits, quality control, determining workload, and allocating resources, among other responsibilities. Therefore, nurses have a professional responsibility to contribute to efforts that reduce the risk and incidence of post-cardiac SSI.

Aim and Methods

To address this responsibility, a retrospective chart review was conducted with the following questions in mind:

> *What are the characteristics of a single tertiary care centre's population of patients who developed a surgical site infection following cardiac surgery between January 1, 2009, and June 30, 2012, in terms of demographics/clinical characteristics and perioperative care received?*
>
> and
>
> *What clinical characteristics and best practices related to SSI prevention are not appropriately documented during the patient's stay?*

Results were analyzed to reveal exceptional characteristics of this population, as well as care practices this population received including adherence to best practice care guidelines and documentation practices. The purpose of this study was to pinpoint aspects unique to this population while making recommendations for future research and targeted care improvement efforts in a tertiary care centre setting within the modern health care climate. The discussion will be broken down by demographic and clinical risk factors, clinical management variables, nursing care initiatives, and documentation procedures.

The retrospective chart review was conducted using the charts of the entire population of 127 patients who developed an SSI following cardiac surgery between January 1, 2009, and June 30, 2012. This time period was the most recent set of data available, best reflecting the current perioperative care practices used at the study site. An electronic chart review tool was developed for the purpose of this study. The variables selected for this tool were based on the most recently published best practice guidelines and a comprehensive literature search. Permission to access the charts of all patients in the study population was requested and granted from the research ethics board at the study site, as well as from the Director of Professional Services prior to data collection.

As per the ethical requirements set out by the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* (CIHR, NSERC, & SSHRC, 2010) measures were taken to ensure the privacy of the individuals whose charts were under review was maintained and to protect any identifiable information (CIHR, NSERC, & SSHRC, 2010). No identifying information was recorded into the database and confidentiality was maintained in regards to all patient information in the charts.

Findings

The chart review data describes the patient demographics, clinical characteristics and care received in terms of proportions of patients with certain risk factors and best practices. Table 1 presents the key findings classified as preoperative, intraoperative, postoperative variables, and outcomes including infection type breakdown of the population.

The age of the population ranged from 37 to 87 years, with a mean age of 70.5 years (STD 10.3 years). Parsonnet scores (predictive scores for mortality following adult cardiac surgery) ranged from 0 to 44, with a mean of 21.65, putting the average patient into the "high risk" category. Forty-eight patients (40.3%) had an American Surgical Association rating (ASA) of 3, meaning they had severe systemic disease. Seventy-one (59.7%) patients had an ASA rating of 4, indicating that more than half the patients were at risk of death from extensive cardiovascular disease/circulatory compromise.

The mean length of procedure was 261.25 minutes (STD 95.85 minutes), ranging from 113–640 minutes. The mean length of cardio-pulmonary bypass (CPB) was 117.94 minutes, (STD 69.37 minutes) ranging from 40–484 minutes.

Greater than half the patient population had diabetes. Intra-operative blood glucose levels and number of measurements were abstracted and cross-tabulated by diabetic status. Diabetics had a mean high of 10.36 mmol/L (STD 1.87 mmol/L) while non-diabetics had a mean high of 8.68 mmol/L (STD 1.95 mmol/L). Diabetics had a mean low of 7.38 mmol/L (STD 1.81 mmol/L) while non-diabetics had a mean low of 5.77 mmol/L (STD 0.84 mmol/L). Patients had their blood glucose measured a mean of 6.35 times (STD 2.49) during the surgery. Diabetics had a mean proportion of 0.28 of their measurements being > 10 mmol/L, which was 7 times more frequent than non-diabetics (mean proportion of 0.04). The average highest blood glucose scores for the population, as whole, were above 10.0 mmol/L for postop day 0, post op days 4 and 5. Diabetic and non-diabetic patients had similar mean daily low blood glucose scores.

Table 1: Patient characteristics (N=127)

Variable	Frequency	%
Preoperative:		
Age over 70 years old	78	61.4
Gender		
Female	63	49.6
Male	64	50.4
Current smoker	23	18.1
Infection at time of surgery	9	7.1
Comorbidities		
Diabetes	72	56.7
Peripheral vascular disease	20	15.8
Congestive heart failure	48	37.8
Diagnosed renal failure	25	19.7
Chronic obstructive pulmonary disease	21	16.5
Obesity		
BMI 30.0–39.9(kg/m^2)[a]	41	34.2
BMI >40.0(kg/m^2)[a]	14	11.7
Surgery Context		
Preoperative IABP	7	5.5
Admitted from home	67	52.8
Admitted from other hospital	60	47.2
Elective surgery	60	47.2
Urgent surgery	46	36.2
Emergency surgery	21	16.5
Preoperative Care		
Received two chlorhexidine showers	92	72.4
Hair clipped more than once	4	3.1
Received preoperative teaching session	93	73.2
Intraoperative:		
CABG	117	92.1
Bilateral IMA harvest	7	6.1
IMA harvest in diabetics[b]	61	84.7
Open saphenous vein harvest	14	12.8
Valve procedure	44	34.7
Multiple procedure operation	41	35.0
Intraoperative blood transfusion	88	69.3
Postoperative:		
Postoperative blood transfusion	77	60.6
Surgical re-exploration	34	26.8
Received CPR	4	3.2
Altered mental status	31	24.4
Outcomes		
Infection Type		
Saphenous vein infection	46	36.2
Superficial sternal infection	57	57.6
Deep sternal wound infection	35	35.3
Organ space sternal wound infection	7	7.1
Culture performed on infection site	110	86.6
Culture performed prior to discharge[c]	70	63.6
Patients discharged home after initial admission	82	64.6
Patients readmitted	52	40.9
Deaths due to infection	6	4.8

Notes: [a] based on n=120 because of missing data. IABP = Intra-Aortic Balloon Pump. CABG = coronary artery bypass graft. [b] based on n=72 diabetic patients who received CABG surgery. Altered mental status is defined as any recorded incident of delirium, confusion or agitation post-operatively, as recorded in the discharge summary of the patient's chart. [c] based on n=110 patients who had cultures performed

Patients were admitted for a mean of 37.3 days (STD 41.0 days). The mean time from surgery to initial discharge was 32.9 days (STD 41.1 days). Patients were readmitted for a mean of 26.6 days (STD 28.3 days).

The most commonly identified organism in cultures of the patients who developed infections was coagulase negative staphylococcus (CNS), regardless of location and severity of the infection. Following CNS, the next most common infectious agent was enterococcus species at 11.03%. In total, 32 different infectious agents were identified. Despite all being diagnosed with an SSI, 110 patients had cultures performed for their infections and 17 did not.

Not all of the 127 patient charts had data for every single variable. For example, height and weight were documented for 120 patients. Thirty of a total 121 patients who underwent a sternotomy had the number of wires used in sternal closure recorded. Several of the variables targeted for collection in the study had limitations in the documentation that reduced their usefulness and clarity for analysis. In terms of preoperative hair clipping, the location of the clipping was not recorded (i.e. sternal site, saphenous site). Antibiotic prophylaxis dose was recorded for 123 patients, but only 119 had a start time. The end time for antibiotic administration was never explicitly recorded, so the duration of infusion was impossible to determine. The number of patients who received Vancomycin that were MRSA positive at the time of surgery was small, and it is not known if the remaining patients were given Vancomycin due to a cefazolin allergy. Accurate pain scores were also not universally collected for all 127 patients. The method of documenting pain at the study site changed during the time period for which data were collected. A tool for more accurately measuring pain in sedated patients was introduced. Furthermore, often only one pain rating was written for an entire shift, overlooking fluctuations in pain ratings throughout the day or effect of analgesic interventions.

Discussion

Based on the findings it was possible to identify current risk factors and aspects of perioperative care surgery that may have contributed to the incidence of post-cardiac surgery SSI in this population. While many risk factors have been described in the literature, this institutional setting revealed a profile containing risk factors that require particular vigilance, as seen in the following section. Though we believe the findings of this study could inform potential changes to practice, a future case control comparison to a similar population that did not develop infection is required to confirm if these characteristics and practices contributed to infection development.

Demographic and Clinical Risk Factors

Advanced age, gender (although whether males or females are at higher risk is debated in the literature) (Association of

Professionals in Infection Control and Epidemiology, 2008; Buja et al., 2012; Risnes, Abdelnoor, Almdahl, & Svennevig, 2010), smoking, diabetes, peripheral vascular disease (Russo, Epi, & Spelman, 2002; Tang et al., 2004), heart failure, COPD, impaired immune response, and obesity have all been identified as clinical characteristics that are associated with increased risk of SSI post-cardiac surgery (Buja et al., 2012). Many of these risk factors impede wound healing, suppress immune function, and impair blood flow or tissue oxygenation, ultimately promoting infection development (Buja et al., 2012). Interestingly, the patient population who developed post cardiac -SSI at this tertiary care centre had a demographic and clinical profile that differed significantly from comparable populations in the literature in a number of respects.

Age

The average patient age was 70.5 years, with 61.4% of patients over 70 years of age. Risnes et al. (2010) found that patients over the age of 70 have a 75% greater chance of developing mediastinitis. DSWI incidence also increases with age (Buja et al., 2012). Other studies looked at age as a risk factor for SSI following cardiac surgery. A sampling of comparable populations of patients who developed SSIs following cardiac surgery shows mean ages of 65 (Chen et al., 2012), 66.1 (Lu, Grayson, Jha, Srinivasan, & Fabri, 2003), and 65 years (Tang et al., 2004). These populations, with DSWI rates of 1.17%, 2.6% and 0.77% respectively, each showed age to be significantly associated with developing an SSI. The markedly higher age is consistent with the hypothesis that the recipients of cardiac surgeries today are different from the patients studied even in the recent past. The susceptibility of the older patient population requires more vigilant monitoring and adherence to best practice guidelines.

Diabetes

Diabetes was also very common in the study population. Patients with a history of insulin-dependent diabetes are at an increased risk of developing DSWI (Lu et al., 2003; Risnes et al., 2010; Tang et al., 2004; Wang & Chang, 2000). The microvascular changes and platelet dysfunction associated with diabetes can result in poor leukocyte infiltration, inadequate oxygenation, and clotting dysfunction, as well as decreased delivery of growth factors, fibroblasts and collagen required for healing (Buja et al., 2012). In addition, the damage to lymphatic vessels, nerves and blood vessels makes tissues a more favourable environment for microorganisms (Buja et al., 2012). This is exacerbated by depressed neutrophil function and associated weakened bactericidal immunity, as well as depressed cell-mediated immunity in diabetics (Buja et al., 2012). Finally, hyperglycemia and acidemia further create a more hospitable environment for microorganisms (Buja et al., 2012). In our population of patients with post-cardiac SSIs, 56.7% had a diagnosis of diabetes. In comparison, 8.3% of patients (Lu et al., 2003), and 24.3% (Risnes et al., 2010) had diabetes in other samples in the literature. No other comparable population in the literature had a greater than 50% rate of diabetics in the group that developed an infection. As this is such a prevalent risk factor in this population, patient education about the importance of maintaining euglycemia could prevent SSIs after discharge (Buja et al., 2012). Vigilant intra- and postoperative glucose control is especially important for this population (Buja et al., 2012) due to the established association between hyperglycemia and increased rates of SSI (Jeon, Furuya, Berman, & Larson, 2012).

Obesity

Finally, we found that 44.9% of the study site's patients who developed an SSI had a body mass index (BMI) greater than 30 kg/m^2. This is a similar level to what is reported in the literature (41.3% in Lu et al., 2003), but represents a large proportion of our population. Patients with a BMI greater than 30 kg/m^2 are at increased risk for SSI (Colombier, Kessler, Ferrari, von Segesser, & Berdajs, 2013; Lu et al., 2003; Risnes et al., 2010). It is notable that 11.7% of the patients who developed an SSI in our population had a BMI > 40 kg/m^2, which put them at even further increased risk (Buja et al., 2012).

There are a variety of reasons as to why obesity increased the risk of post-cardiac SSI. First, obesity is associated with diabetes and prolonged operating times because of technical surgical challenges. In addition, the abundant adipose cells release pro-inflammatory and anti-inflammatory factors, which disregulate the inflammatory response (Buja, et al., 2012). The difference in body composition can result in differences in serum and tissue concentrations of antibiotics. Obese patients are susceptible to being under-dosed or over-dosed when the pharmacokinetic alterations required in obesity are not acknowledged. Lastly, obesity can cause more straining of the subcutaneous sutures, increasing the risk for dehiscence (Buja et al., 2012). Because of the high prevalence of obesity, interventions that minimize the risk in these patients are of the utmost importance. For example, using supportive bras, nutritional education, and vigilance towards proper antibiotic titration could be helpful reducing post-cardiac SSI incidence.

Clinical Management Variables of Interest

Emergency Surgery

Emergency surgery involves rapid transfer to the operating room. In order to save the patient's life, sacrifices in preoperative preparation may be made. The patient may not be able to receive a proper chlorhexidine shower, pre-operative teaching, or have had the opportunity to make pertinent lifestyle changes (i.e., altering smoking behaviour) or may not be homeostatically optimized (i.e., optimization of blood sugar) prior to surgery. Sixteen-and-a-half per cent of the study patients had emergency procedures, which is known to put patients at higher risk for surgical site infection following cardiac surgery (Lepelletier et al., 2005). When compared to other populations of patients who underwent cardiac surgery, this is quite high. The population described by Lu et al. (2003) showed rates for emergency procedures in patients with SSI at 2.8% compared to patients without SSI at a rate of 2.2%. Similarly, Chen and colleagues (2012) looked at major infections following cardiac surgery, and found an adjusted odds ratio for developing infection if the patient underwent an emergency surgery to be 1.99, indicating a patient is twice as likely to develop a major infection following CABG compared to someone who underwent an elective procedure. However, in Chen and colleagues' study, only 4.4% of the patients who developed infections underwent an emergency procedure (compared to 2.2% of the patients without major infection). Our population has a much higher level of emergency procedures. This suggests that many of these patients were in situations where care could not be optimized to meet best practice standards.

Length of Procedures

Longer operative times, for instance, are associated with heightened SSI rates (Buja et al., 2012; Risnes et al., 2010; Tang et al., 2004) because it results in poor tissue oxygenation, higher likelihood of exposure to contaminants or tissue desiccation, and is more likely to be associated with blood loss (Buja et al., 2012). The population in this study had a mean surgical time of 261.25 min (SD 95.85 min). This is longer than other comparable populations in the literature (203 min in Tang et al., 2004). Similarly, Tang and colleagues (2004) found that performing both valve and CABG concomitantly increases the risk of developing SSI. This represents more than one quarter of the population of this study. The length of procedure may necessitate a longer CPB time, which has been suggested to be to be an independent risk factor for SSI development (Risnes et al., 2010; Salis et al., 2008; Tang et al., 2004). It has been suggested that CPB increases rates of endotoxemia. The period of relative hypotension and hypoperfusion during CPB appears to allow the endotoxin from gut commensal microbes in the intestinal mucosal barrier to enter systemic circulation. Klein and others (2011) hypothesized that the endotoxins stimulate an inflammatory response, which, in turn, causes a down regulation of the immune system. Consequently, this could put the body at increased risk of postoperative infection. The results demonstrate that this population, on average, underwent a long period of CPB (117.94 minutes) in comparison to other populations that developed cardiac SSI (73.1 min in Risnes et al., 2010; 98.3 min in Tang et al., 2004). A possible cause was that 35.0% of the patients in the study population underwent multiple procedures during the same operation. This illustrates the advances in technology that have allowed surgeons to perform multiple complex procedures concurrently, and also the prevalence of unwell patients who require multiple procedures.

Furthermore, surgical re-exploration increases the likelihood of infection (Buja et al., 2012; Lu et al., 2003). Re-exploration is typically performed because the patient is showing hemodynamic instability, such as bleeding, and/or inadequate cardiac function. This could mean that the tissue is not being perfused adequately, decreasing wound healing and inflammatory function, which is a predisposition for infection. In addition, this increases procedure length and CPB time and, consequently, increases the associated risks for infection. Furthermore, surgical re-exploration often occurs in the context of an emergency and, for the reasons stated above, may result in the prioritization of immediate life-saving interventions over perioperative infection prevention procedures. A large proportion (26.8%) of the patients studied underwent surgical re-exploration. This is much higher than the 6.4% of patients with post-cardiac surgery in Lu et al.'s (2003) study who had undergone surgical re-exploration.

Blood Transfusions

The large percentage of patients who received intraoperative and postoperative blood transfusions is another factor that might have predisposed this population to developing SSIs. Despite it being a known risk factor for the development of infection (Buja et al., 2012), blood products are administered in the context of prioritizing hemodynamic stability over the potential infection risk.

Intraoperative Blood Glucose Control

The best practice standards for intraoperative blood glucose control recommend that blood glucose levels remain below 10 mmol/L (Lazar et al., 2009). For the population as a whole, 18% of measurements were above 10 mmol/L. When broken down by patients with and without diabetes, 28% and 4% of intraoperative blood glucose measurements were above 10 mmol/L respectively. While overall, the high levels of blood glucose suggest that there could be more rigorous control of blood glucose, the high proportion of diabetics in this population of patients who developed SSI following cardiac surgery demands perhaps higher than usual vigilance towards blood glucose control.

Nursing Care

A number of treatment details related to nursing care directly impact patients' predisposition for developing SSIs. The chart review found a few nursing-specific care practices that may have contributed to the development of SSIs.

Skin Disinfection

According to the documentation reviewed, more than one quarter of the population did not receive skin disinfection, as per best practice guidelines, prior to their surgery. Current best practice suggests a chlorhexidine-gluconate shower the night before procedure and the morning of the procedure close to the surgery time (within four hours) and following any hair removal. This has been shown to reduce surface bacteria and help to prevent surgical site infection (Stewart, Eyers, & Earnshaw, 2006). Only 15.8% received one shower, and 11.8% did not receive a shower, or did not have anything documented. Furthermore, the charts did not contain a space to record the time of the shower, so it was impossible to determine whether the second shower was within four hours of surgery. Emergent cases may necessitate non-adherence to showering best practice guideline, as there may be less time.

The most common infectious agent was CNS at 66.21% of all infections. CNS is a common cause of nosocomial infections, though other populations of patients developing SSI following cardiac surgery had lower rates of CNS (32%) infection compared to the study site (Mauerman, Sampathkumar, & Thompson, 2008). CNS is usually found in hospitals on non-sterile skin surfaces, with certain strains being known to cause tissue infection and others being thought apathogenic (Tan, Ng, & Ng, 2006). This may indicate that practices surrounding skin disinfection and hygiene may require review in order to prevent the spread of this particular pathogen.

Despite the diagnosis of SSI, 11.72% of patients had no cultures performed on the infection site. This does not compare favourably to the literature, where rates of 1.9% of patients with infections not having cultures are seen (Risnes et al., 2010). Additionally, 6.21% of patients who were diagnosed as being infected had no growth occurring in their culture.

Only 63.6% of patients had their culture performed during their initial stay. The remaining patients (36.4%) were cultured on their readmission for their infection. This represents most of the patients (40.9%) who were readmitted. Half of all patients who were readmitted were readmitted within two weeks of their discharge. It is possible that something in their discharge environment contributed to the development of the infection. Teaching proper hygiene and self-care habits to patients may help to minimize the risk of developing infection after discharge, thereby reducing the overall incidence of SSI. Additionally, nurses must practice rigorous monitoring of the signs and symptoms of surgical site infection, especially prior to discharge.

Postoperative Blood Glucose Monitoring

Postoperative blood glucose control is also an important factor to consider when discussing infection risk. Postoperatively, nurses play a large part in ensuring blood glucose levels stay below the recommended best practice guidelines of 10.0 mmol/L for the ICU stay and below 7.8 after the ICU stay, or starting postop day 3 (Lazar et al., 2009; Safer Healthcare Now, 2011). The average highest blood glucose scores for the population as whole were above 10.0mmol/L for post op day 0, post op days 4 and 5. An analysis was also performed considering the presence or absence of diabetes. The average highest blood glucose scores were above best practice guidelines for diabetics, throughout post op day 0 to post op day 5. For patients without diabetes, the average highest blood glucose level was above best practice guidelines for post op day 0, post op day 4 and day 5. This suggests a more frequent approach to glucose monitoring postoperatively could be put into place, particularly for diabetics. However, clinicians should act on these findings cautiously, as tight blood glucose control has been associated with a higher incidence of inadvertent hypoglycemia without overall improvement in outcomes (Buchleitner, Martinez-Alonso, Hernández, Solà, & Mauricio, 2012). A comparison in a case-control analysis is required to confirm whether postoperative glucose control has contributed to infection development.

Documentation

As part of our exploratory analysis, documentation was examined for two reasons. First, it was relevant in order to establish the quality of the data available for abstraction from a chart review. This can provide insight into how to document for more efficient use in future chart reviews. Additionally, appropriate documentation can serve to facilitate adherence to best practice guidelines. The practice of documenting certain aspects of best practice guidelines may act as a reminder for health care professionals, as well as ensuring health care professionals are accountable for ensuring implementation of best practices.

Preoperative Hair Clipping

As was stated earlier in regards to preoperative showering, inadequate documentation limited our ability to analyze adherence to best practice guidelines for various procedures. Preoperative clipping was one of these procedures. The pre-operative checklist indicates whether or not a patient was "clipped," but not which part of the body, so we were unable to link the clipping site, to the site of infection. Time of clipping is not listed as well, so we were unable to determine whether it occurred before or after showering, and how long before surgery it occurred. Best practice guidelines recommend against hair removal unless absolutely necessary, meaning that it will interfere with the surgical procedure, in which case clippers will be used prior to the last shower before surgery (Adams, 2008; Adisa, Lawal, & Adejuyigbe, 2011; Gaston & Kuremsky, 2012; Karegoudar et al., 2012; Tanner, Norrie, & Melen, 2011). Despite these guidelines recommending against hair removal, 54.3% of patients received hair clipping. More thorough documentation would make it possible to assess if this clipping was truly necessary, and provide a visual cue to encourage nurses to analyze the need while increasing accountability.

Teaching

It has already been suggested that involving patients in their care through teaching may help reduce the incidence of post-cardiac SSI by encouraging self-care habits. Prior to cardiac surgery, patients are supposed to receive a teaching session that outlines the details of the procedure, and what to expect throughout their perioperative experience. Teaching has been associated with reduced stress and depression, better physiological outcomes, and a decreased length of stay (Shuldham, Fleming, & Goodman, 2002). More than a quarter (26.8%) of patients did not receive a documented pre-operative teaching session. This could be explained by a number of reasons. Patients arriving emergently do not have the opportunity to receive pre-operative teaching, putting them at a potentially higher risk for SSI. Another reason some patients did not receive adequate teaching could be due to language barriers. Regardless if the patient received a teaching session, it was not possible to abstract the details of the teaching session, or if repeat teaching sessions occurred throughout the patients' stays. It was also not possible to determine if the teaching was altered for patient cognitive status, or if a verification of understanding took place. A case control comparison is required to determine if education contributed to SSI development. Nonetheless, the documentation requires alteration to determine the quality of these teaching sessions, and to ensure some form of standardization to the teaching sessions.

Pain Assessment

Pain, through its association with stress, anxiety and its consequent activation of the sympathetic nervous system has been linked to delayed wound healing (Bechert & Abraham, 2009; Walburn, Vedhara, Hankins, Rixon, & Weinman, 2009). More specifically, the release of cortisol and cathecholamines is linked to impaired immune function and vasoconstriction leading to decreased peripheral blood supply, oxygen and nutrients and, thereby, resistance to infection (Bechert & Abraham, 2009). This suggests that good pain control can indirectly promote wound healing. Pain from the chart demonstrates that pain overall seems to be well managed, never really surpassing the mild pain cut point. One of the limitations, however, is that after cardiac surgery, patients are not able to articulate their pain because they are intubated and possibly sedated. There is a tool that measures pain in ICU patients who are intubated and/or sedated called the Critical-care Pain Observation Tool (CPOT). However, this was only implemented for half of the charts we reviewed. Also, the CPOT does not consider the severity of pain. Therefore, we were unable to describe the pain of our entire population. Even when just considering the patient self-report scale out of 10, often only one pain rating was recorded for the entire day, which did not consider the the rise and fall of the therapeutic effect of medication, or incidental pain, and indicates that some pain data or incidents went undocumented. In order for pain to be properly researched in a chart review, and possible effects of nursing practice, documentation needs to be more thorough and systematic.

Strengths and Limitations

A strength of this study is that it identifies characteristics unique to this Canadian tertiary care setting, which is operating within the modern health care climate of increased technological advances, and an older population with more comorbidities. Although results cannot be generalized to all facilities performing cardiac surgery, it can be prudently interpreted by other Canadian tertiary care settings which patients may be at particular risk for developing infection. Similarly, this study identifies areas of care that could be amended or require more vigilant attention in order to adhere to best practice guidelines to minimize risk of developing SSI following cardiac surgery. This is one of the first studies, to our knowledge, which identifies areas of documentation that could help to promote adherence to best practice guidelines by serving as a reminder and promote accountability of health care providers.

However, caution should be taken when interpreting these results. As this study was a chart review, there is a risk that there was a discrepancy between what was documented and what actually occurred in practice. Furthermore, there were aspects of care that could contribute to the development of SSI, such as hand hygiene, which we were unable to analyze via a chart review. Finally, because this was a descriptive study, we cannot confirm our results as true risk factors for infection without a case control comparison.

Implications for Practice and Directions for Future Research

This study has identified several areas that could be the focus for efforts to prevent SSI in this population. These recommendations include changes to practice and documentation, as well as targeting patients who have a particular susceptibility. As has already been alluded, future research on risk factors should be conducted with the use of a comparison group. This would allow us to confirm or reject and possibly identify new risk factors for SSI after cardiac surgery. This would also allow us to more appropriately amend nursing care and pinpoint the unique challenges facing the cardiac surgery population in this major tertiary care setting. ♥

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