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Sternal Precautions: Is it Necessary to Restrict Our Patients?

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Introduction

According to the Centers for Disease Control and Prevention, heart disease is the leading cause of death in the United States, affecting people of all ages and backgrounds. About 610,000 people from the U.S. die each year of heart disease, nearly 1 in every 4 deaths (CDC, 2013). Heart disease can manifest in a variety of conditions, with the most common being coronary artery disease which may lead to myocardial infarction, angina, heart failure, and arrhythmias.

Coronary artery disease (CAD) is a disease caused by "hardening" (termed atherosclerosis) of the coronary arteries on the surface of the heart (Michaels, 2002). Fatty deposits and plaques build up inside the arterial wall, leading to narrowing of these arteries. Due to the morbidity and mortality of coronary artery disease, the primary intervention is prevention. Those who are at risk or within early stages of the disease may require medications or lifestyle changes such as a healthier diet, exercise, and smoking cessation. However, many people with this diagnosis whose arteries have become severely narrowed may need surgical procedures to restore blood flow to the heart. The most common procedures are angioplasty, stenting, and coronary artery bypass grafts.

In a coronary artery bypass graft (CABG), "the surgeon uses a portion of a healthy vessel (either an artery or vein) from the leg, chest, or arm to create a detour or bypass around the blocked portion of the coronary artery" (Michaels, 2002). During a CABG, the heart is removed from the chest and the patient's circulation is maintained with a heart-lung machine. In order to remove the heart, the surgeon must perform a median sternotomy. Defined by Mosby's Medical Dictionary, median sternotomy involves making an incision from the top of the chest, at the

suprasternal notch, to the bottom of the chest, below the xiphoid process. The sternum is then separated, or broken, from top to bottom. At the conclusion of the procedure, the sternal halves are fused together with wires, and the soft tissue is approximated with sutures and staples (Irion, 2013). Following a CABG and median sternotomy, the patient typically requires 5-7 days within the hospital, and up to 3 months to fully recover from the surgery (Michaels, 2002). More than 300,000 CABG's are performed within the United States annually (Tuyl, 2012).

Complications Post-Sternotomy

Although sternal complications following a sternotomy are infrequent, they still occur in about 3-5% of all cases (Irion, 2013). Sternal complications include hematoma, infection, instability, incisional pain, infection, and/or wound dehiscence (Brocki, 2009). Wound infection may lead to osteomyelitis of the sternum, dehiscence, and mediastinitis (Irion, 2013). These complications can be very extreme and have a significant impact on the patient's recovery. They often lead to increased morbidity and mortality, lesser quality of life, prolonged hospital stay, and an increase of healthcare costs (Brocki, 2009). However, these complications are considered preventable. In 2013, the Centers for Medicare and Medicaid Services instituted policies that would no longer cover the costs related to any preventable complication. This may help contain the costs by motivating health care providers and organizations to work hard at preventing these detrimental events (Irion, 2013).

Sternal Precautions

In an attempt to decrease the risk for sternal complications, sternal precautions have been employed with hope that they will minimize the incidence of dehiscence, instability, pain and infection of the sternum. A typical list of precautions that are used by many institutions include

avoiding: lifting more than 10 pounds, bilateral shoulder flexion and abduction greater than 90 degrees, reaching behind oneself, and pushing oneself up from a bed or chair with extended arms (Irion, 2013).

However, the use of sternal precautions is controversial because the origin of these precautions is difficult to find. Also, the type of precautions and the duration of the precautions varies among institutions, with no clinical evidence supporting a consistent protocol. Limited research exists to demonstrate that certain movement patterns (such as reaching behind oneself or reaching up above one's head) are likely to cause stress of the sternal skin and potentially lead to complications (Irion, 2013). The theoretical rationale for this clinical practice is based on orthopedic principles of fracture healing in long bones, expert opinion, institutional protocols and studies in cadavers and models (Balachandran, 2014).

Following median sternotomy, many patients feel dependent on others and may feel like a burden. Also, they express being afraid of causing damage to their heart and surgical site, which may result in decreased activity (Brocki, 2010). When being educated on following sternal precautions, many of their activities of daily living as well as desired exercise becomes limited for as long as 10 weeks after surgery. However, in other types of surgeries, patients are encouraged to be as independent as possible. Early activity following surgery leads to improved overall outcomes; and physical exercise, including arm movements, increases blood flow to and from the heart and accelerates tissue repair (Brocki, 2010).

Resuming normal activities in the postoperative period, as well as being as physically active as possible, has proven to lead to improved outcomes and better quality of life. According to the American Heart Foundation, physical activity plays an important role in the recovery period after a heart attack or heart surgery, by maintaining weight, lowering blood pressure,

improving cholesterol levels, and increasing confidence, happiness, and relaxation. They recommend that patient's participate in light to moderate exercise and maintain their independence with light gardening, housework, etc. However, sternal precautions that are employed often conflict with these recommendations and a patient's daily activities. For example, Beth Israel Deaconess Medical Center in Boston, Massachusetts recommends that patient's do not lift more than 10 pounds for 10 weeks. This precaution conflicts with many daily activities such as doing laundry, grocery shopping, lawn mowing etc., and requires the patient to be quite conservative for an extensive amount of time. Patient's may become even more fearful of complications with the current sternal precautions, and avoid the necessary activity and exercise needed during recovery.

The purpose of this literature search is to investigate the usefulness and effectiveness of current sternal precautions, and determine whether or not they are too restrictive of patient's upper extremity movements and physical activity. These precautions can lead to decreased quality of life and impair activities of daily living, but may also decrease the risk for sternal complications that lead to morbidity and mortality. Controversy exists due to the lack of evidence based protocols, unknown effect on patient outcomes, and discrepancies in pattern of use among institutions (Tuyl, 2012). A PICO question has been designed to guide the research conducted: Among patients who undergo sternotomies, does following sternal precautions prevent sternal complications and lead to improved recovery outcomes?

This literature search and patient situation relates to the IOM/QSEN competency of Evidence-based Practice. Evidence-based Practice integrates clinical expertise, patient values, and the best, most current research evidence when making decisions and caring for a patient (Duke University, 2015). Evidence-based practice enhances clinical outcomes and improves

quality of life. The practice of EBP is usually triggered by patient encounters which generate questions about the effects of therapy, the utility of diagnostic tests, the prognosis of diseases, or the etiology of disorders (Duke University, 2015). When incorporating EBP into one's decision making and professional practice, you must be able to perform efficient literature searching as well as evaluation of the literature. This paper is based on the inquiry about the effects of sternal precautions as part of a patient's recovery following a sternotomy. It is important to explore this because nurses should always be asking themselves "why am I doing what I am doing with my patients?" "Which of my practices are evidence based and which do not have any evidence to support them?" (MeInyk, 2009). If sternal precautions are indeed overly restrictive and preventing patients from achieving the best possible recovery outcomes, it is the job of the nurse and other healthcare providers to make changes to the current practice.

Review of the Literature: The Patient Problem

One of the reasons that sternal precautions are controversial is that there is no consistency in the way they are implemented throughout medical institutions. Different clinical experiences in the Boston area as a nursing student working with post-CABG patients was the spark of inquiry for this research, upon noticing the different precautions prescribed to the patients at these different institutions. It is important to acknowledge these different protocols, and consider why there is not a standard, consistent plan of care in place when attempting to reduce the risk of serious sternal complications.

Cahalin and LaPier (2011) presented an example of conflicting sternal precaution protocols, "an absence of agreement", within the state of Ohio. OhioHealth limits shoulder movement to 90 degrees, meaning no movement above the shoulder and extending arms above the head, whereas the Cleveland Clinic approves this movement. The Ohio State Medical Center

restricts patients from lifting more than 10 pounds, whereas the Cleveland Clinic restricts patients from lifting more than 20 pounds. Also, OhioHealth and the Ohio State Medical Center restrict patients from reaching their arms backwards, whereas the Cleveland Clinic does not include this restriction in their protocol at all. This article also acknowledges a Midwestern hospital that seemingly recommends the opposite of what most institutions have in place. In this hospital, they stress an importance of arm movements and shoulder flexion, abduction, and adduction exercises that are free of pain and performed slowly to increase the patient's activity after surgery. The lack of agreement among these healthcare institutions can lead to controversial interactions, because each hospital has a different idea of what is best for the patient and may view the other as not meeting these important standards. This controversy needs further assessment as to why this is the case for such a significant event in a patient's life.

In a web based survey conducted in 2014 in Australia, Balachandran and colleagues investigated the current practice regarding prescription of upper limb exercises within cardiac rehabilitation. The participants were physiotherapists from cardiac rehabilitations throughout Australia, with 69 valid responses for analysis. The survey interpreted the upper limb exercise guidelines that were implemented among these various rehabs. The results showed that the majority, 95%, followed a form of restriction when prescribing upper limb exercises to patients. However, the results also showed little agreement on the type and timing of these restrictions over the patient's course of cardiac rehab, as well as guidelines for when to progress the patient's exercise (Balachandran, 2014). When investigating the rationale for their exercise/restrictions prescription and progression, the majority of physiotherapists responded they based it on clinical experience (64%), then standard workplace protocol (35%), and then just 23% responded that it is based on best practice evidence (Balachandran, 2014).

The web survey results showed that in general, there are greater restrictions placed on unilateral exercise of the upper limb versus bilateral exercise of the upper limb, and more restriction on loaded (weight bearing) exercises versus unloaded exercises. However, there is no clear end point for these restrictions, and no empirical data supporting their rationale (Balachandran, 2014). According to the authors of this survey, cadaver and replica model studies only focus on bilateral, symmetrical forces on the sternum, therefore the current practice reported in the survey is not supported by these tests. Also, knowing that upper limb exercise may promote circulation for sternal healing and independent physical activity, current sternal precautions may be overly restrictive. These findings reflect the need for further research in order to set guidelines for a more appropriate approach. It is necessary to evaluate if it is more important to prevent sternal complications or restore patient functionality and independence post-operatively.

Swanson and La Pier (2014) suggest that current sternal precautions may be too restrictive. The authors propose that depressed physical activity, fear of activity, pain increased with movement, and various disuse syndromes may be related to sternal precautions (Swanson, 2014). Overly restrictive sternal precautions may cause decreased muscle strength and connective tissue mobility, which leads to pain and difficulty performing activities of daily living (ADLs) (Swanson, 2014). In turn, this can lead to a reduction in baseline physical activity, patient depression, and poor outcomes. The purpose of this research study was to determine the amount of peak force generated during common ADLs involving the upper limbs, and if instructing patient's to perform these tasks slowly will reduce the forces generated (Swanson, 2014). The goal is to determine if the sternal precautions being taught to patients does not allow patients to perform and function normally in their daily lives.

The participants of this study were recruited around a university community, and needed to be able to lift, push and pull 30 pounds with both upper limbs. 15 participants between 22 and 59 years old performed 19 lifting, pushing, and pulling tasks; 3 trials at their preferred speed and 3 trials at a slow speed. These tasks included lifting 10 pounds from the floor to a standing position, lifting groceries weighing 6.6 kg (about 15 pounds), pushing and pulling a vacuum, pushing and pulling open a commercial building door, and transitioning from a side-lying position to a sitting position (Swanson, 2014). The peak forces generated by the upper limbs during each task were measured, and mean peak forces were calculated to determine differences in force between the two speeds participants used (Swanson, 2014).

The results showed that only 6 out of the 19 tasks performed during the preferred speed trial generated less than 10 pounds of force: pulling a chair across a smooth floor, pushing closed a cabinet drawer as well as a refrigerator door, and pushing and pulling a vacuum over a carpet (Swanson, 2014). Pushing and pulling open a commercial building door and transitioning from a side-lying to sitting position generated peak forces greater than 20 pounds. All tasks performed at a slower speed generated less peak force, ranging from 8% to 61% (Swanson, 2014). This study is clinically significant because it found that many of the daily activities most people perform likely exceed the 5-10 pound weight restrictions implemented with sternal precautions. Patients who open and close a car door and the door to their physician's office will exceed the weight limit they were instructed to follow (Swanson, 2014). However, the study revealed that when patients closed a car door at a slower speed than normal, the force reduced from 14.1 pounds to 10.2 pounds.

Instructing patients not to lift more than 10 pounds, like many institutions currently do, does not consider the forces generated by many of the activities people will do following their

open heart surgery. Because there is no direct evidence supporting that when patients perform their ADLs they are at increased risk for sternal complications, the current precautions may be too restrictive, "arbitrary and unnecessary" (Swanson, 2014). This study had some limitations, because it did not directly measure sternal force, patients recovering from sternotomy, and most of the participants were under the age of 40 although most sternotomy patients are over 40. However, this study reflects that sternal precautions should allow for patients to perform their normal ADLs at a slower speed which may decrease the force applied to their upper limbs and sternotomy.

A potentially more transferable study to this PICO topic was conducted in 2013 by different authors for the same journal, the Journal of Acute Care Physical Therapy. This study focused on whether certain movements such as lifting and transfers applied different amounts of stress to the sternal skin, and if it supports any clear cut offs for movements that are safe and ones that are unsafe (Irion, 2013). Participants were ages 40 to 70, and they confirmed their ability to complete each task. The study was able to assess sternal skin stress through the placement of a Doppler blood flow probe that measured sternal skin movement and distortion (Irion, 2013). The 22 healthy subjects performed 3 trials each of 4 lifting tasks (arm only, 12-ounce can, 1-liter bottle, and a gallon of water from countertop to shelf), as well as transitions from lying to sitting and sitting to standing, with and without the use of their arms (Irion, 2013).

The results of this study showed that the heavier the object being lifted is, the more stress being applied to the sternal skin. Also, the study showed that when the participants made transitions in their positions following the techniques taught during sternal precautions (such as log rolling on to one side, and pushing up through the elbow), caused less sternal skin stress than common techniques involving pushing and pulling with the arms. However, it is unknown how

much sternal skin stress can be used to determine the stress being placed on the actual sternum, but it can reflect the varying amount of force during activities. Also, this study is limited by the convenience sample, which may not represent people who undergo sternotomy (Irion, 2013). Although the results showed less sternal skin stress during sternal precaution based transitioning, the results varied greatly among subjects. This variation suggests that no clear cut off can be made between safe and unsafe movements (Irion, 2013). Also, the results of these transitions in body position generated a force greater than lifting the heaviest object in the study. Because the transfers caused sternal skin stress greater than 8 pounds, it reflects that the current limitation of 10 pounds may be too restrictive (Irion, 2013).

Adams and colleagues (2008) attempt to challenge the current activity limits after a CABG. The authors investigate the safety of certain activities that are commonly discouraged as part of sternal precautions after cardiac surgery, such as mowing the lawn and golfing. Many healthcare professionals discourage these kinds of activities for 12 weeks after a CABG because of the involvement of the pectoralis major muscle connecting to the sternum (Adams, 2008). Based on expert opinion, there is fear that the exercise of this muscle will affect the sternal bone healing, and ultimately lead to complications during recovery. However, other activities such as upper body cycling contracts these muscle groups, and are typically not considered unsafe after cardiac surgery (Adams, 2008). The problem with restricting these activities is that patients become apprehensive and fearful of doing them, so they avoid doing the activities that they enjoy and may even become inactive entirely.

With this in mind, the authors of this article conducted a study of the effects of a simulated lawn mowing activity in patients 3 to 7 weeks after a CABG (Adams, 2008). Their goal was to challenge the potentially over restrictive current guidelines knowing that

"accelerating patients' return to their daily activities may improve their quality of life, help them avoid fear and inactivity, and be beneficial for future health" (Adams, 2008). 13 men participated and provided their consent as well as their physicians', and they performed 6 trials each of simulated lawn mowing. The lawn mower engine was removed, but altered to simulate the push and pull forces that occur when mowing the lawn (Adams, 2008). Chest radiographs were assessed before and after the trials. During each trial their sternums were palpated for instability, and their heart rates, rhythms, and blood pressures were monitored. The results showed that none of the 13 subjects experienced arrhythmias, detrimental heart rates and blood pressures, or sternal palpation findings that would warrant ending the study (Adams, 2008). The chest radiographs also did not show any signs of sternal separation and the wires remained stable.

This simulated lawn mowing activity reflects that "early upper body resistance exercise is not associated with overt evidence of sternal wound disruption" (Adams, 2008). The authors believe that their findings could be used in new sternal precaution guidelines that incorporate upper limb exercises, if they had a larger data sample. However, because physicians firmly believe in the current practice and fear the activity will harm their patients, receiving their consent limited their study and therefore resulted in a small sample size and the results can only be used as a hypothesis. Overall, this small study further reflects that sternal precautions may be too restrictive of patients, and this study could be replicated with a larger sample to provide more evidence based guidelines.

Review of the Literature: Nursing Interventions for the Future

The studies discussed above have all concluded that further research should be conducted, and is needed to evaluate the current sternal precaution guidelines as well as develop optimal guidelines for our patients. Also, the variations found in the studies suggest that the

effects of certain movements and ADLs on sternal skin and the bone vary from person to person. Therefore, the best practice would incorporate the individual in the plan of care. The sternal precautions would not be universal, rather they would be tailored to the individual's risk factors and comorbidities. Optimal sternal precautions would also allow patients to perform their ADLs, as long as they are encouraged to do them at a slower speed. Brocki and Cahalin (2010) present recommendations for the best practice regarding sternal precautions, which they believe would lead to overall better safety and quality outcomes.

Brocki and colleagues (2010) conducted a literature review regarding mechanical stress factors leading to sternal complications. The point of this literature review is similar to this paper: the authors questioned how restrictive sternal complications should be, knowing they often lead to a decrease in quality of life (Brocki, 2010). Brocki's literature review was guided by an aspect of the salutogenetic theory called "sense of coherence" (SOC) by Antonovsky, which focuses on "how and why people stay healthy during times of stressful conditions such as cardiac surgery" (Brocki, 2010). Sense of coherence (SOC) is defined as

> The person's feeling of confidence that situations consist on comprehensibility, manageability and meaningfulness, meaning the person's feeling of having the ability to comprehend, manage and find sense despite a stressful event. A person with strong SOC has greater coping capacity (Brocki, 2010).

Brocki argues that if sternal precautions were logical, meaningful and practicable, then patients would do them because they make sense, not because they are afraid they will hurt themselves if they do not. The best practice would be that sternal precautions make sense, are manageable, and comprehensible for all patients (Brocki, 2010).

Brocki's literature review included articles from CINAHL, PubMed, COCHRANE, and PEDRO. After analyzing the literature, recommendations were provided for future nursing interventions incorporating the best practice based on the level of evidence from each article (Brocki, 2010). The level of evidence was measured using the Oxford Centre for Evidence-Based Medicine Levels of Evidence shown in table 1.

Table 1: (Brocki, 2010)

Grade of recommendation	Level of evidence	Type of study
A	1a	Systematic review of (homogeneous) randomized controlled trials
	1b	Individual randomized controlled trials (with narrow confidence intervals)
B	2a	Systematic review of (homogeneous) cohort studies of " exposed" and "unexposed" subjects
	2b	Individual cohort study / Low-quality randomized controlled trials
	3a	Systematic review of (homogeneous) case-control studies
	3b	Individual case-control studies
C	4	Case series, low-quality cohort or case-control studies
D	5	Expert opinions based on non systematic reviews of results or mechanistic studies

The results of this literature review showed that the development of sternal complications is multifactorial, including the patient's characteristics, comorbidities, preoperative conditions, operative situation, and postoperative conditions (Brocki, 2010). These factors must be understood and considered when implementing sternal precautions to prevent sternal complications. Risk factors that are associated with sternal skin stress and forces acting on the sternotomy site include: "chronic obstructive lung disease, macromastia, obesity, suboptimal sternal closure, early surgical chest reoperation, prolonged postoperative ventilation, and premature overexertion" (Brocki, 2010.) The author considers these predisposing factors when providing what the guidelines should be for the best patient outcomes.

The first recommendation for best practice presented by Brocki is based on the evidence that coughing poses significant stress on the sternal incision, a force up to 40 pounds (Brocki, 2010). Patients should be taught to hug their chests when coughing and sneezing for the first 6-8 weeks following sternotomy, or if the coughing is frequent they should wear a sternal vest or binder to provide support. Based on the Level of Evidence chart in table 1, this recommendation is a grade D based on level 4 studies (Brocki, 2010). The next recommendation Brocki presents is based on the risk factor of obesity: "Patients with BMI > 35 should wear a supportive vest for sternal protection during the initial 6-8 weeks following sternotomy", a grade D recommendation based on expert opinion (Brocki, 2010).

Brocki's literature review also acknowledged the force placed on the sternum during weight bearing, loaded movements. The results revealed that a sternotomy can bear much weight without breaking the wires or separating the bone (Brocki, 2010). Therefore, the sternum will tolerate more than 10 pounds, discrediting the current practice. Brocki's next recommendation is that "loaded movements of the arms should only be done at a pain-free level, keeping the upper arms to the body during the initial 6-8 weeks following sternotomy", a grade D recommendation based on expert opinion (Brocki, 2010). Also, sternal skin normally takes 10 days to heal following sternotomy, and therefore precautions avoiding skin stress should last about 10 days, reconsidering a "generic" 10 week restriction. Brocki recommends "bilateral movements of the arms in the horizontal level, backwards or over the shoulder level, should only be performed within pain-free limits during the initial 10 days following sternotomy or until the wound is healed", a grade D recommendation based on level 4 studies (Brocki, 2010).

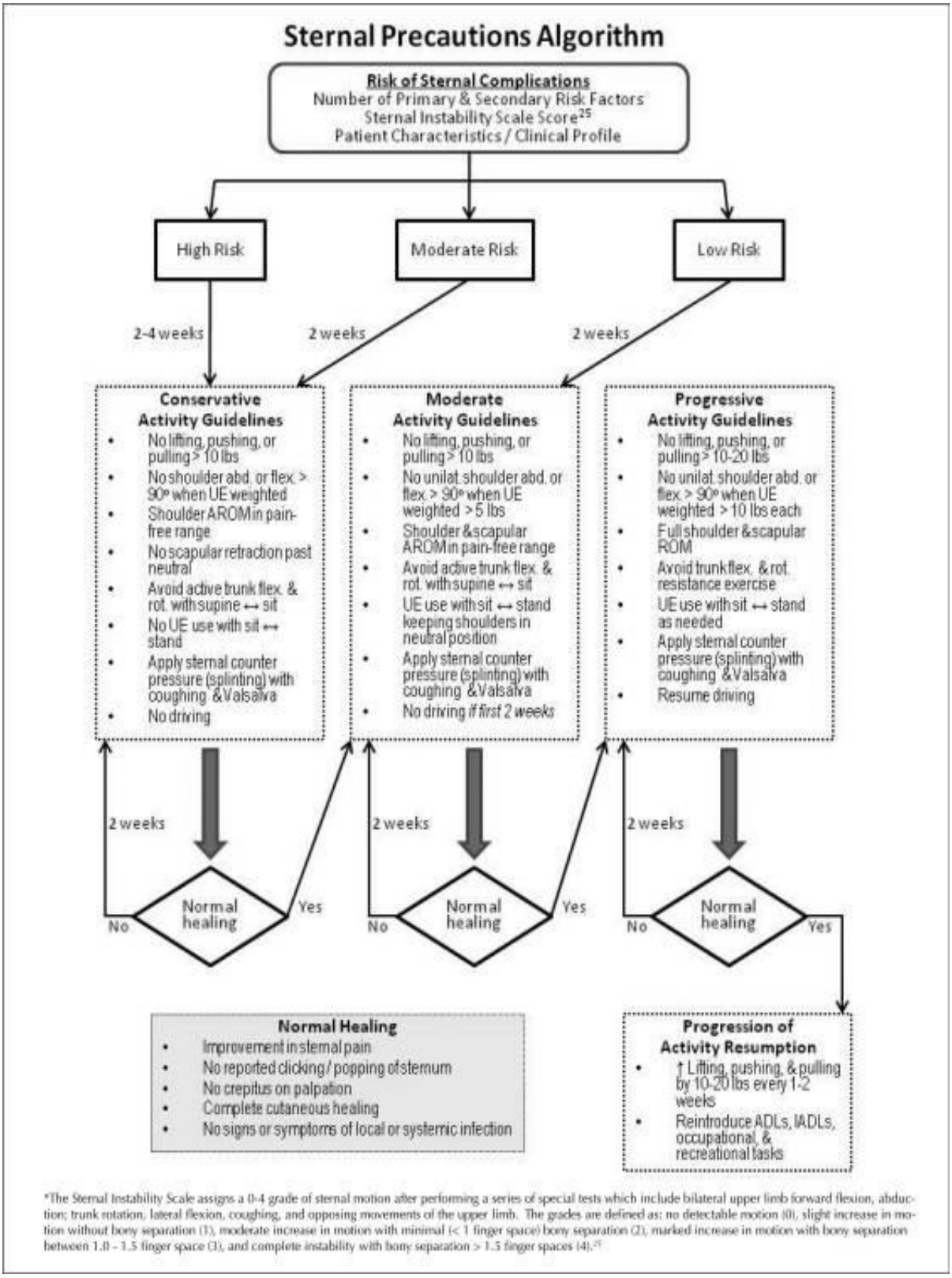
The next recommendation for the best practice acknowledges skin stress created by large breasts, and that women have a slower wound healing than men (Brocki, 2010). A supportive bra

with claps on the front for quick access to the chest should be worn at all times for women with a cup size greater than D (Brocki, 2010). The recommendation presented is “women with bra size > D should always use a supportive brassiere shaped to provide entire chest circumference support during the initial 6-8 weeks following sternotomy”, a grade B recommendation based on level 3b studies (Brocki, 2010). Finally, Brocki acknowledges the best practice to be used when transferring from a lying to sitting position: “Patients should use the “elbow method” during transfers from supine to a sitting position in order to minimize pain from the lower sternum during the initial 6-8 weeks following sternotomy”, a grade D recommendation based on expert opinion.

Brocki concludes that there is no scientific evidence to support weight restrictions, as long as the upper arms are close to the body and activity is pain free. Also, cough that is unsupported is the most important consideration for sternal stress that may cause sternal instability (Brocki, 2010). The recommendations Brocki presents are more patient centered based on their individual characteristics and clinical profile, and places more focus on their abilities rather than their restrictions. However, clinical research is still needed to support the best practice possible when recovering from a sternotomy (Brocki, 2010).

Cahalin and colleagues (2010) discuss that the current practice of sternal precautions needs to change based on the lack of agreement, evidence, and how they are more restrictive than precautionary. They recommend that guidelines should be changed to focus on patient characteristics, risk factors, and function when deciding what sternal precautions should be implemented. A sternal precautions algorithm, figure 2, is recommended to facilitate safer, better patient outcomes (Cahalin, 2011)

Figure 2 (Cahalin, 2010)



This algorithm provides guidelines for sternal precautions based on the individual patient's risk for sternal complications. This risk is based on their characteristics and clinical profile, as well as their sternal instability scale score 1-4 based on the absence or presence of bone separation. For example, if a patient is at a low risk for complications, they should follow the moderate activity guidelines presented in the algorithm for 2 weeks, and if normal healing is present, they should follow the progressive activity guidelines for 2 more weeks. Following this algorithm could avoid overly restricting a patient who is at minimal risk for sternal complications, while ensuring those who are at a high risk are safe and free of these adverse events.

Case Example

Undergoing cardiac surgery and sternotomy is a significant and serious event in a patient's life. The recovery process requires patient's to accept their new role as a person who's activity tolerance and health has decreased compared to before they underwent this surgery. Nurses help patients adapt to their new role; and assist them with their needs as they transition into the recovery phase and are discharged home. This process is known as the Transition Theory created by Afaf Ibrahim Meleis. Meleis studied people who did not make healthy transitions based on their insufficient role adaptation, and how nursing interventions can help facilitate these healthy transitions (Im, 2013).

A 71-year-old male admitted to Boston Medical Center in February underwent a CABG, an emergent surgery he had not expected. His past medical history included hypertension, diabetes mellitus type 2, hyperlipidemia and a history of stable angina. However, he was living independently at home, and seemingly controlling his diagnoses well. This patient was shoveling snow when he experienced severe chest and neck pain that was exacerbated with increased

physical activity. Upon hospitalization, it was determined he needed the bypass quickly to restore blood flow to his heart. This man was now taking on a new role as a patient undergoing a major surgery. He was beginning his transition from health to illness, an aspect of the Transition Theory. This patient transitioned from health to acute illness, as well as from independence to becoming a patient (Institute of Medicine, 2011).

Another important aspect of the Transition Theory is facilitators and inhibitors that affect a person's ability to have a healthy transition. In this case example, the patient seemed well prepared to make this transition from health to acute illness. He was being prepared for discharge, and was relatively independent. A facilitator of his healthy transition was his socioeconomic status; the patient had good health insurance, his own home, and available resources necessary to get him back on his feet. Also, the patient's knowledge level about his discharge instructions needed reinforcement, but overall he was eager to learn and able to restate understanding of the vital information that would help him through his recovery. Another facilitator was his family support, with the presence of his wife and two children who would be by his side during his transition back home. However, an inhibitor of this patient's transition is his diabetes mellitus, which predisposes him to sternal complications such as infection. Also, the increased stress on his body makes blood glucose management more difficult. Based on this patient's clinical profile, he may be considered at a moderate risk for sternal complications following figure 2's algorithm, and ideally would follow the conservative activity guidelines for 2 weeks, and then progress to the moderate activity guidelines with appropriate healing.

However, this patient will have to adjust to the sternal precautions taught to him at Boston Medical Center, including weight restrictions of 10 pounds for 8 weeks, avoiding pushing and pulling with upper limbs when sitting or standing, and splinting one's chest while

coughing. However, upon observation this patient was adapting to his new role and not having difficulty with moving. This patient was deconditioned from his 8 day stay within the hospital, another inhibitor to his recovery, but was able to get himself in and out of bed following sternal precautions, and walked a flight of stairs with physical therapy. The anticipated outcomes for this patient based on the Transition Theory is that he will take on his new role as a patient recovering from a CABG, and will be able to cope with his illness. Consideration of his diabetes mellitus and increased risk for infection requires close monitoring of his blood glucose levels, higher doses of his insulin to compensate for his new illness, and follow up care.

Conclusion

Many people must transition from health to an acute illness each year in the same way the patient in the above case example had to. Taking on this new role post-operatively requires patients to acknowledge certain sternal precautions, and understand their risk for sternal complications. The best practice for preventing sternal complications is following certain precautionary guidelines, rather than restricting their normal daily activities. This literature review suggests that the best practice is patient centered, and ensuring the best quality outcomes focuses on the patient's specific characteristics, risk factors and their ability to exercise within a pain free range (Brocki, 2010). Individualizing the plan of care for each patient will allow them to understand their capabilities and limitations, and will facilitate their recovery towards independence. Following a sternal precautions algorithm based on a client's risk for complications is a reliable revision to the current guidelines.

This literature review concludes that the current guidelines used to educate clients and families regarding the prevention of sternal complications following sternotomy is too conservative and restrictive. The weight restrictions of no more than 10 pounds commonly used

among healthcare institutions does not apply to the many daily activities that patients will perform each day following discharge, and therefore reflects that this restriction is unnecessary and may evoke excessive fear and inactivity among patients. Furthermore, restricting the patient's upper limb movement excessively, by discouraging participation in household chores or sports such as golf for 10 weeks may lead to decreased quality of life and poorer outcomes regarding sternal healing. Without physical activity and ability to participate in activities of daily living, the patient is restricted from the health benefits known to occur with exercise. It is a difficult balance to find following a sternotomy, and therefore further research is needed to create a consistent set of guidelines that are meaningful and based on the best evidence. However, patients should be encouraged to take caution during their transition after sternotomy to prevent complications, while they lead active, healthy lives.

References

About Heart Disease. (2009, November 16). Retrieved April 6, 2015, from http://www.cdc.gov/heartdisease/about.htm

Adams, J., Pullum, G., Stafford, P., Hanners, N., Hartman, J., Strauss, D., . . . Mccullough, T. (2008). Challenging Traditional Activity Limits After Coronary Artery Bypass Graft Surgery. *Journal of Cardiopulmonary Rehabilitation and Prevention, 20*(23), 118-121.

Balachandran, S., Lee, A., Royse, A., Denehy, L., & El-Ansary, D. (2014). Upper Limb Exercise Prescription Following Cardiac Surgery via Median Sternotomy. *Journal of Cardiopulmonary Rehabilitation and Prevention, 34*(1), 390-395.

Brocki, B., Thorup, C., & Andreasen, J. (2010). Precautions related to midline sternotomy in cardiac surgery - A review of mechanical stress factors leading to sternal complications. *European Journal of Cardiovascular Nursing,* 77-84.

Cahalin, L., & LaPier, T. (2011). Sternal Precautions: Is It Time for Change? Precautions versus Restrictions - A Review of Literature and Recommendations for Revision. *Cardiopulmonary Physical Therapy Journal, 22*(1), 5-11.

Im, E. (2013). Transitions Theory. 417-430.

Institute of Medicine.(2011). *The future of nursing: Leading change, advancing health. Washington* , D.C.:National Academies Press.

Introduction to Evidence-Based Practice. (n.d.). Retrieved April 7, 2015, from http://guides.mclibrary.duke.edu/c.php?g=158201&p=1036021

Irion, G., Julie, G., Cassie, H., Jones, E., & Vaccarella, A. (2013). Effects of Upper Extremity Movements of Sternal Skin Stress. *Journal of Acute Care Physical Therapy, 4*(1), 34-39.

median sternotomy. (n.d.) *Mosby's Medical Dictionary, 8th edition*. (2009). Retrieved April 8 2015 from http://medical-dictionary.thefreedictionary.com/median+sternotomy

Melnyk, B., Fineout-Overholt, E., Stillwell, S., & Williamson, K. (2009). Evidence-Based Practice: Step by Step: Igniting a Spirit of Inquiry. *AJN, American Journal of Nursing, 109*(11), 49-52.

Michaels, A. (2002). Angioplasty Versus Bypass Surgery for Coronary Artery Disease. *Circulation, 106*(1), 187e-190.

Physical Activity After Heart Attack and Heart Surgery. (2013, January 1). Retrieved April 6, 2015, from http://www.heartfoundation.org.au/SiteCollectionDocuments/CON-015.v3-PAafterHA-LR-secure.pdf

Swanson, L., & LaPier, T. (2014). Upper Extremity Forces Generated During Activities of Daily Living: Implications for Patients Following Sternotomy. *Journal of Acute Care Physical Therapy, 5*(2), 70-76.

Tuyl, L., Mackney, J., & Johnston, C. (2011). Management of Sternal Precautions Following Median Sternotomy by Physical Therapists in Australia: A Web-Based Survey. *Physical Therapy, 92*(1), 83-97.