ABSTRACT

HUENERBEIN, H. A. Guidelines for prescribing upper body exercise following open heart surgery. MS in Adult Fitness/Cardiac Rehabilitation, December 1995, 35pp. (J. Porcari)

This study determined current practices in prescribing upper body stretching, aerobic, and resistance training exercises for patients following open heart surgery. Data were obtained through the use of questionnaires with 20 cardiac rehabilitation directors, 84 cardiac rehabilitation participants, and 10 cardiac surgeons in Wisconsin. Guidelines based on the average responses suggest that open heart surgery patients begin upper body stretching exercises 9 days, enter Phase II cardiac rehabilitation 18 days, begin resistance training 24 days, perform arm ergometry 25 days, use the Airdyne at 28 days, and use the rowing machine 45 days postprocedure. Guidelines were most often set by a registered nurse (35%), exercise specialist (22%), or a cardiac surgeon (20%). Typically, guidelines were determined by the patient’s comfort level based on sternal healing, exercise tolerance, and their heart rate and blood pressure responses. The majority of participants perceived the exercises prescribed for them to be appropriate and few experienced pain or problems during activity. These results indicate that the guidelines suggested by the professionals in the field of cardiac rehabilitation, although variable, appear to meet the needs of cardiac patients.
GUIDELINES FOR PRESCRIBING UPPER BODY EXERCISE FOLLOWING OPEN HEART SURGERY

A MANUSCRIPT STYLE THESIS PRESENTED TO THE GRADUATE FACULTY UNIVERSITY OF WISCONSIN-LA CROSSE

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE MASTER OF SCIENCE DEGREE

BY HEIDI ANN HUENERBEIN DECEMBER 1995
COLLEGE OF HEALTH, PHYSICAL EDUCATION, AND RECREATION
UNIVERSITY OF WISCONSIN—LA CROSSE

THESIS FINAL ORAL DEFENSE FORM

Candidate: Heidi Ann Huenerbein

We recommend acceptance of this thesis in partial fulfillment of this candidate’s requirements for the degree:

Master of Science in Adult Fitness/Cardiac Rehabilitation

The candidate has successfully completed her thesis final oral defense.

[Signatures and dates]

This thesis is approved by the College of Health, Physical Education, and Recreation.

[Signatures and dates]
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I would like to thank all of my family and friends for their support and faith in me when I needed them most. I love you all...

I would like to dedicate this to the brightest angel in heaven, my mom, Mrs. Lois "Loi" Huenerbein. She gave me unconditional love and support throughout my life. I love you and miss you.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF APPENDICES</td>
<td>v</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>METHODS</td>
<td>3</td>
</tr>
<tr>
<td>Cardiac Rehabilitation Directors</td>
<td>3</td>
</tr>
<tr>
<td>Cardiac Rehabilitation Participants</td>
<td>3</td>
</tr>
<tr>
<td>Cardiac Surgeons</td>
<td>3</td>
</tr>
<tr>
<td>PROCEDURES</td>
<td>4</td>
</tr>
<tr>
<td>COLLECTION OF DATA</td>
<td>4</td>
</tr>
<tr>
<td>DATA ANALYSIS</td>
<td>5</td>
</tr>
<tr>
<td>RESULTS</td>
<td>6</td>
</tr>
<tr>
<td>Cardiac Rehabilitation Directors</td>
<td>6</td>
</tr>
<tr>
<td>Cardiac Rehabilitation Participants</td>
<td>8</td>
</tr>
<tr>
<td>Cardiac Surgeons</td>
<td>10</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>12</td>
</tr>
<tr>
<td>SUMMARY AND CONCLUSION</td>
<td>14</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>15</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>16</td>
</tr>
</tbody>
</table>
# LIST OF APPENDICES

<table>
<thead>
<tr>
<th>APPENDIX</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. QUESTIONNAIRE FOR CARDIAC REHABILITATION DIRECTOR</td>
<td>16</td>
</tr>
<tr>
<td>B. QUESTIONNAIRE FOR CARDIAC REHABILITATION PARTICIPANT</td>
<td>19</td>
</tr>
<tr>
<td>C. QUESTIONNAIRE FOR CARDIAC SURGEON</td>
<td>22</td>
</tr>
<tr>
<td>D. COVER LETTER FOR CARDIAC REHABILITATION DIRECTOR</td>
<td>25</td>
</tr>
<tr>
<td>E. REVIEW OF RELATED LITERATURE</td>
<td>27</td>
</tr>
</tbody>
</table>
Guidelines for Prescribing Upper Body Exercise Following Open Heart Surgery

INTRODUCTION

The cardiovascular responses of healthy persons to dynamic upper body exercise have been clearly described in numerous studies. The responses and use of upper body exercise in patients following open heart surgery are, however, less well defined. Cardiovascular responses to upper body exercise in this population are important, given that many patients return to work and need to perform activities of daily living that require the use of the arms.

Immediately following surgery (Phase I), patients are prescribed exercises that involve active-resistive range of motion and stretching to help prevent chest wall adhesions and to deter lean body mass loss that are frequently associated with prolonged bed rest. These exercises, along with supervised ambulation, also help to reduce anxiety and depression while improving self-efficacy and confidence.

During early outpatient (Phase II) cardiac rehabilitation, open heart surgery patients have initially been encouraged to perform primarily lower body aerobic exercise, while upper body exercise has been a variable entity because of the potential risks associated with it. The main concerns have been that sternal healing and chest
soreness preclude the onset of upper body exercises and that the rate pressure product (RPP) associated with arm work may become excessive due to exaggerated heart rate and blood pressure responses. Upper body aerobic exercises using arm crank ergometers, shoulder wheel, and Airdyne bicycle as well as resistance training all involve substantial movement of the shoulder, back, and upper body musculature which may influence sternal healing. Due to the variability of these factors, there are no definite guidelines as to the initiation date for upper body exercise in open heart patients.

Another complicating factor is that recommendations have been made, depending on the facility, by primary care physicians, cardiologists, exercise physiologists, physical therapists, and nurses. Due to these varying opinions, the recommendations for beginning upper body exercise may range from 3 to 16 weeks after open heart surgery. These discrepancies as to the onset and the lack of guidelines for prescribing upper body exercise created the need for this study.

The purpose of this study was to establish appropriate guidelines for post-open heart patients to begin upper extremity resistance and aerobic exercises based on a consensus of current practice in the field of cardiac rehabilitation.
METHODS

It was the intent of this study to determine current practice in prescribing upper body exercises for patients following open heart surgery. This was done based on the practices and clinical experiences of cardiac rehabilitation (CR) program directors, cardiac patients, and cardiac surgeons.

Cardiac Rehabilitation Directors

Ten Phase II programs in each of the five regional areas in Wisconsin were selected from the 1994 WISCVPR Membership Directory. Program directors from these sites were sent a questionnaire (see Appendix A) to complete and return for analysis.

Cardiac Rehabilitation Participants

Cardiac rehabilitation patients from each of the aforementioned 50 Phase II sites were given questionnaires (see Appendix B) to complete and return for analysis. Ten questionnaires were sent to the Program Directors of these sites to distribute. If more were needed, the director could duplicate the questionnaire for patients. Eligible patients must have undergone open heart surgery and been participants in the Phase II program for at least one month.

Cardiac Surgeons

The selection of cardiac surgeons was accomplished by using a small sampling from Wisconsin. The Wisconsin Health Organization Provider Directory was used to select eight
surgeons from Southeastern Wisconsin. Each of the surgeons from this region were mailed a questionnaire. Hospitals from Eau Claire, Green Bay, La Crosse, and Madison were also contacted to obtain the names of cardiac surgeons who perform open heart surgery, and three from each were mailed questionnaires. Therefore, 20 cardiac surgeons were mailed questionnaires (see Appendix C).

PROCEDURES

The questionnaires used in this study were designed to evaluate current prescriptions for upper extremity exercises for post-open heart CR patients.

The development of the questionnaires was accomplished with the assistance of the Director of the La Crosse Exercise and Health Program at the University of Wisconsin-La Crosse and a member of the Exercise Physiology Department at Lutheran Hospital, La Crosse, WI.

COLLECTION OF DATA

Once the questionnaires were complete, the final version of each was reproduced and mailed with a cover letter (see Appendix D) detailing the purpose of the study and all necessary information to complete and return the questionnaire. The questionnaires were mailed with a self-addressed stamped return envelope. Questionnaires were also mailed to cardiac surgeons. An explanation of the study was included at the top of the questionnaire.
DATA ANALYSIS

The responses in this study were compared with and include those of CR program directors, open heart CR patients, and cardiac surgeons. These current practices and opinions need to be considered when developing guidelines for open heart patients to begin upper extremity exercises after surgery.

Organization of the questionnaire results was accomplished by tabulating responses into categories and determining percentage counts for each question. The results are presented in a table that portrays the percentage of directors who answered questions similarly as well as the percentage of cardiac patients who answered similarly to other patients. Questionnaire data from the surgeons were interpreted and compared in a similar manner.
RESULTS

Based on data collected from 20 CR director questionnaires, 84 CR participant questionnaires, and 10 cardiac surgeon questionnaires from Wisconsin, several conclusions were reached regarding upper body exercise guidelines.

Cardiac Rehabilitation Directors

On the average, most cardiac patients began upper body stretching exercises within 6-7 days following open heart surgery, typically during their hospital stay (Phase I). Patients entered Phase II CR an average of 14-15 days following their cardiac surgery. During Phase II rehabilitation, patients performed arm ergometry at approximately 25 days, the Airdyne at 26 days, and the rowing machine at 32 days postprocedure, respectively. The most common types of upper body exercises performed during Phase II included the Airdyne (30%), bicep curls (24%), tricep extensions (20%), arm ergometer (16%), and the rowing machine (10%).

A wide variety of guidelines were used for determining the initiation date for upper body stretching exercises. Most guidelines included following surgeon recommendations, or patient tolerance based on sternal healing. Occasionally the American Association of Cardiovascular and Pulmonary Rehabilitation and American College of Sports Medicine (ACSM) guidelines were followed in prescribing these guidelines.
Guidelines for determining the onset of upper body aerobic exercises included use of the patient’s comfort level based on sternal healing, use of the Airdyne bike 3-6 weeks post-operatively, surgeon guidelines of 6-8 weeks after surgery, or contraindications that would not permit safety of an activity.

Guidelines for determining the onset of upper body resistance training included the need for a stable sternum, dumbbells totalling no more than 10 pounds during the second or third Phase II visit, the use of ACSM guidelines, or in general, waiting 2-6 weeks following surgery. These guidelines were typically set by a registered nurse (35%), exercise physiologist or exercise specialist (22%), cardiac surgeon (20%), cardiologist (17%), certified athletic trainer (3%), or the medical director (3%).

When resistance training was used during Phase II CR, the guidelines that were used to determine the progression of weight and repetitions used were somewhat variable. Most often, patient tolerance, comfort, and energy levels were considered. A patient’s ability to easily do 15-20 repetitions of low weight was also used, as were blood pressure, heart rate, and ratings of perceived exertion responses. ACSM guidelines were used least frequently as a basis for resistance training. Prior to beginning a resistance training program, the appropriate original weight needs to be determined for each patient. The original weight
was most often determined by using the patient’s comfort level and previous conditioning activities. Initially, guidelines included the use of 1-8 pound hand weights, a trial and error method based on patient perceptions, lifting 20% of maximum weight or up to 15 pounds. Another method was to simply choose the lightest weight to teach proper lifting technique and progress from there. The original weight was most often set by the exercise physiologist or a registered nurse (70%), then set by either the CR staff (15%) or the department policy (15%).

In general, most CR directors (75%) reported that patients do not typically complain of sternal pain or problems with upper body movements or lifting. When chest pain was expressed by a patient, it was primarily when they had begun upper body exercise before four weeks postoperatively. They were then instructed to go cautiously, or stop resistance training until the patient felt comfortable. When the patient felt discomfort, the surgeon was notified of the situation.

**Cardiac Rehabilitation Participants**

On average, most CR participants began early range of motion and upper body stretching at approximately 14 days after their cardiac surgery. Participants recalled entering Phase II CR an average of 22 days following their procedure. During Phase II, participants performed Airdyne at an average of 25 days, arm ergometry at approximately 28 days, and the
rowing machine at an average of 47 days following surgery. Resistance training, including bicep curls, tricep extensions, lateral wall pulls, bench press, and upright rowing, was most often initiated approximately 29-32 days postsurgery.

The majority of participants felt that most of the activities (specifically the Airdyne bike, arm ergometer, and upper body stretching exercises) were appropriate and beneficial during their Phase II CR program. The rowing machine and bench press were stated as inappropriate activities and ones which they either disliked or felt discomfort while doing. The Airdyne bike was an activity that many patients felt discomfort doing because of leg pain, cramping in the thighs, knee problems, or an uncomfortable seat.

The majority of patients perceived the time until the onset of upper body training exercises to be appropriate (85%), while some stated it was too early (7.5%) or that it was too late (7.5%).

In general, most cardiac rehabilitation patients (80%) stated that they did not experience chest pain or problems during activities prescribed for them in Phase II. When pain was experienced, it was stated as either a "pulling" of the pectoral muscle or a direct pain in the sternal incision.

Guidelines that were given to begin upper body exercises for home use after hospital discharge included a 10 pound
weight restriction, the use of easy range of motion stretches, and frequent monitoring of their heart rate.

Guidelines given to begin upper body exercises in CR included demonstrations of proper techniques and monitor their heart rate before and after exercise. Patients were instructed to proceed slowly and to stop if it hurt, and to only progress as they were able.

*Cardiac Surgeons*

On the average, cardiac surgeons recommended that open heart surgery patients begin upper extremity exercises 6 days after their procedure. Activities that were specifically suggested were complete range of motion and minor stretching with either bare arms or light hand weights.

During Phase II, cardiac surgeons recommended resistance training, using light dumbbells, and arm ergometry be initiated at 23 days, the Airdyne bike, with the use of arms, at approximately 32 days, and the rowing machine at 55 days. Physicians recommended against strenuous upper body exercise sooner than 2 months or longer if they experienced poor incisional healing or unstable sternum, dysrhythmias, or irregular heart rate or blood pressure responses during exercise.

Guidelines for upper extremity exercises were based on a variety of methods. Surgeons based their recommendations on common sense, risk stratification, or overall cardiac status and fitness of the patient. Surgeons also stated time-weight
variations, which in general were: no lifting over 5 pounds for 4 weeks, no lifting over 10 pounds for the next 8 weeks, and no lifting over 25 pounds for 3 months. Cardiac surgeons also stressed reliance on exercise physiologists and recommendations of the cardiac rehabilitation staff in general.

Eighty percent of surgeons received updates on patient progression of upper extremity exercises. Generally they received them in either the initial report sent after the first Phase II visit or as part of the monthly progress report. Often (70%) the pain and comfort level of the patients during the Phase II period had been discussed with the cardiac surgeons. Incisional discomfort was most specifically discussed with the surgeon post-operatively.

Since sternal healing plays such a major role in the initiation of upper extremity exercises, it is important to know how long complete sternal healing takes to ensure safety for each patient. The majority of cardiac surgeons (60%) agreed that it takes 6 weeks for a good, strong union of the sternum. Several surgeons (30%) stated that 80% of healing is complete in 12 weeks, and one surgeon stated that sternal healing is complete in 2-3 weeks.
The average values for data collected are summarized in Table 1.

Table 1. Means, standard deviations, and ranges of upper body exercises following open heart surgery.

<table>
<thead>
<tr>
<th></th>
<th>Cardiac Participant N = 84</th>
<th>Cardiac Director N = 20</th>
<th>Cardiac Surgeon N = 10</th>
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</thead>
<tbody>
<tr>
<td>Stretching</td>
<td>14 ± 2.2 (5-22)</td>
<td>6 ± 1.1 (2-15)</td>
<td>5 ± .8 (2-10)</td>
</tr>
<tr>
<td>Arm ergometer</td>
<td>28 ± 2.9 (19-42)</td>
<td>25 ± 2.1 (17-38)</td>
<td>23 ± .9 (19-33)</td>
</tr>
<tr>
<td>Airdyne</td>
<td>25 ± 1.8 (19-34)</td>
<td>26 ± 3.4 (15-38)</td>
<td>32 ± 3.4 (23-48)</td>
</tr>
<tr>
<td>Rower</td>
<td>47 ± 5.8 (26-68)</td>
<td>32 ± 2.3 (24-48)</td>
<td>55 ± 4.1 (42-70)</td>
</tr>
<tr>
<td>Resis. tr.</td>
<td>31 ± 4.7 (16-53)</td>
<td>18 ± 1.1 (14-29)</td>
<td>23 ± .9 (20-33)</td>
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Note. Recommended number of days post-procedure, all values are mean ± standard deviation.

DISCUSSION

The results of this study found that upper body exercise guidelines are varied, but do appear to follow a pattern that allows for safe and healthy exercising.

Immediately following surgery, cardiac surgeons and cardiac rehabilitation directors recommend starting upper extremity stretching exercise within 6-7 days post-procedure. Patients recalled starting them an average of 14 days post-procedure. The purpose of these early range of motion stretching exercises has been to prevent chest wall
adhesions, reduce anxiety and depression, and to improve self-confidence and self-efficacy. In my experience, most open heart patients receive range of motion and stretching exercises as early as 2-3 days following surgery. The data collected in this study appear to show that patients, on average, begin this much later than this, although they did perceive it as appropriate.

Cardiac rehabilitation directors have recommended early outpatient (Phase II) rehabilitation an average of 14-15 days following open heart surgery to help improve the cardiovascular condition of patients to help them return to work and improve the quality of their life. Although recommended earlier, patients have actually been shown to enter Phase II an average of 22 days post-procedure. During Phase II, upper body exercises using the arm ergometer, Airdyne, rowing machine, and resistance training equipment were all recommended by cardiac surgeons and CR directors in the same time frame in which they were performed by the patients. Since patients expressed that the initial time frames were appropriate 85% of the time, we can conclude that these are safe and reasonable guidelines for upper body exercises in cardiac patients following open heart surgery.

The main concerns of upper body exercises in this population have been that sternal healing and chest soreness preclude the onset of these exercises. Cardiac patients (80%) stated that they did not experience chest pain or problems
during the upper body exercises prescribed for them following open heart surgery. When pain was experienced, it was a vague muscle pulling that usually faded in time as the patient became stronger.

A complicating factor in determining guidelines is who actually determines them and due to varying opinions from professionals in the field, confusion exists regarding the initiation date for upper body exercises. These guidelines were most often set by a registered nurse or the exercise specialist or physiologist. Cardiac surgeons and cardiologists frequently expressed confidence in the cardiac rehabilitation staff to make competent decisions for these guidelines.

SUMMARY AND CONCLUSION

Based on the data collected in this study, it appears that current practice in the field of cardiac rehabilitation in prescribing upper body exercise is appropriate. The guidelines suggested by professionals in the field appear to meet the needs of the cardiac patient by encouraging safe and productive exercises that help them recover and progress to a healthful life.
REFERENCES


APPENDIX A

QUESTIONNAIRE FOR CARDIAC REHABILITATION DIRECTOR
QUESTIONNAIRE FOR CARDIAC REHABILITATION DIRECTOR

Guidelines for Prescribing Upper Body Exercise Following Open Heart Surgery

Please answer questions to the best of your knowledge as they apply to the rehabilitation of open heart patients, including both bypass and valve replacement patients, at your facility.

1. On average, how many days post-procedure do open heart patients enter Phase II rehabilitation? ________ days

2. On average, how many days post-procedure do open heart patients begin exercise with the upper extremities?

   Non-resistance (stretching) ________ days

   Resistance
      Dynabands ________ days
      Freeweights (Dumbbells) ________ days
      Machine weights ________ days
      Other (please specify) ________ days

   Aerobic
      Schwinn Airdyne (or similar bike) ________ days
      Arm ergometer ________ days
      Rowing machine ________ days
      Other (please specify) ________ days

3. What types of upper extremity exercises do participants at your facility typically perform? Mark all that apply.

   Aerobic
      Rowing machine ________
      Arm ergometry ________
      Airdyne bike ________
      Shoulder wheel ________
      Other (please specify) ________

   Resistance training
      Bicep curls ________
      Tricep extension ________
      Bent over rowing ________
      Upright rowing ________
      Bench press ________
      Lateral wall pull ________
      Other (please specify) ________
4. What guidelines are used to determine the initiation date for upper extremity stretching exercises? ____________________________

What guidelines are used to determine the onset of upper body aerobic exercises? ________________________

What guidelines are used to determine onset of upper body resistance training exercises? ______________

5. Who typically sets these guidelines? Mark all that apply.
   Cardiologist __________
   Cardiac surgeon __________
   Exercise Physiologist __________
   Physical Therapist __________
   Occupational Therapist __________
   Registered Nurse __________
   Other (please specify) __________

6. If resistance training is used, what guidelines are used to determine progression of weight and repetitions used in training? ____________________________

How is the original weight determined? ____________________________

Who sets the original weight? ____________________________

How many repetitions do you typically use? ____________________________

7. Do patients typically complain of sternal pain/noise with upper arm movement or lifting? YES NO I DO NOT KNOW

If so, what type of action is typically taken? ____________

Thank you very much for your time.
APPENDIX B

QUESTIONNAIRE FOR CARDIAC REHABILITATION PARTICIPANT
QUESTIONNAIRE FOR CARDIAC REHABILITATION PARTICIPANT

Please take a couple minutes to fill out this questionnaire using your perceptions from when you first began upper body exercises after open heart surgery. Please remember this questionnaire is confidential, so do not put your name on it.

1. How many days after your open heart surgery did you enter the Phase II Cardiac Rehabilitation program? _____ days

2. How many days after your surgery did you begin upper body exercise? Please disregard the exercises you did not do.

Stretching _____ days

Aerobic
Airdyne bike (or similar) _____ days
Rowing machine _____ days
Shoulder wheel _____ days
Arm ergometry _____ days
Other (please specify) _____ days

Resistance training
Bicep curls _____ days
Tricep extension _____ days
Lateral wall pull _____ days
Bench press _____ days
Upright rowing _____ days
Other (please specify) _____ days

3. If you performed these exercises, did you feel they were appropriate?
List those that you felt were appropriate ________________

List those that you did not feel were appropriate ______

4. Did you experience any chest pain or problems with the exercise prescribed for you? YES NO
Please explain ________________________________
5. Which exercise(s) did you find beneficial? ___________________________

Which exercise(s) did you dislike or find discomfort doing? ___________________________

6. How did you perceive the onset of upper body training exercises after open heart surgery?

____ too early    ____ on time    ____ too late

7. What guidelines were you given to begin upper body exercises?

In cardiac rehabilitation? ___________________________

For home use after hospital discharge? ___________________________

Thank you very much for your time.
APPENDIX C

QUESTIONNAIRE FOR CARDIAC SURGEON
Dear

I am a graduate student in the Adult Fitness/Cardiac Rehabilitation program at the University of Wisconsin - La Crosse. I would appreciate 5-10 minutes of your time to contribute your professional knowledge to a study I am conducting. The purpose of my study is to determine current practice regarding the use of upper extremity exercise for patients following open heart surgery to ultimately develop guidelines based on the data collected. Please respond and return the questionnaire in the stamped envelope enclosed as soon as possible.

1. How many days after surgery do you recommend open heart patients begin upper extremity exercises?


2. Do you allow your patients to begin upper extremity exercises at all in Phase II CR, or do you have a time frame for which you recommend certain exercises? For example:

Airdyne bike
Shoulder wheel
Rowing machine
Arm ergometry
Resistance training

Do you feel there any absolute contraindications to upper body exercise?


3. On what basis do you set your guidelines for weight training?


4. Do you receive updates on patient progression of upper extremity exercises specifically? Are pain/comfort levels discussed with you?


5. In your estimation, how long does complete sternal healing take?


6. Would you like to make any additional comments?


Thank you for your time.

Sincerely,

Heidi A. Huenerbein
Graduate Student, University of Wisconsin-La Crosse
APPENDIX D

COVER LETTER FOR CARDIAC REHABILITATION DIRECTOR
To

I am writing to request your assistance. I am a graduate student in the Adult Fitness/Cardiac Rehabilitation program at the University of Wisconsin-La Crosse. I would like to include your professional opinions as well as the current practices of your facility in a study I am conducting. The study will attempt to determine what is currently being done in prescribing guidelines for open heart patients to begin upper extremity exercises in a Cardiac Rehabilitation program. The literature on this topic appears to be variable, suggesting the onset be anywhere from 3 to 15 weeks after surgery.

The enclosed questionnaires address the issue of developing guidelines for prescribing upper extremity exercises. Along with the questionnaire for you to fill out, I have enclosed ten questionnaires for open heart rehabilitation participants to fill out pertaining to their perceptions of the appropriateness of the onset of upper extremity exercises. If you have more than ten participants in the Phase II program who would be interested in completing the survey, please duplicate the questionnaire as needed. Please encourage all of the participants who have participated in your phase II cardiac rehabilitation program for at least two weeks to fill out the questionnaire enclosed.

Please respond and return the questionnaires in the large stamped envelope enclosed by June 23, 1995.

Thank you for your participation.

Sincerely,

Heidi A. Huenerbein
Student, AF/CR M.S. Program
University of Wisconsin-La Crosse

Enclosures:
Questionnaire for CR Director
Questionnaire for CR Participant (10)
APPENDIX E

REVIEW OF RELATED LITERATURE
REVIEW OF RELATED LITERATURE

In the past, patients with cardiac problems were generally told to refrain from upper body exercise, primarily resistance training since it had been widely presumed that sternal healing and chest soreness precluded upper body exercise and that it elevated rate pressure product (RPP).\textsuperscript{1,2} Within the past ten years, resistance training has become increasingly popular, along with the Airdyne bike and arm ergometer, and has proven to be efficacious for improving muscular strength and body composition in many populations, including cardiac patients. In a study by Stewart, Mason and Kelemen,\textsuperscript{1} it was found that programs which offer a wide variety of exercises, including upper body training, have a greater influence on psychological and motivational components than programs that offer exclusively aerobic conditioning activities.

Cardiovascular Responses to Upper Body Exercise

Heart rate, blood pressure, and RPP are all variables that need to be monitored when cardiac patients begin upper body exercises. Because of concerns that RPP may become excessive due to increased heart rate and systolic blood pressure, upper body exercise has primarily been proscribed for patients with cardiac disease.\textsuperscript{3} The American College of Sports Medicine (ACSM)\textsuperscript{4} acknowledges that resistance training will result in an increased RPP, primarily through a high systolic blood pressure, with lesser contribution of heart rate. Stewart\textsuperscript{5} confirms that a lower
heart rate during resistance exercise, despite the increase in systolic blood pressure, actually imposes a lower myocardial oxygen demand than aerobic activity. The increase in diastolic blood pressure associated with upper body exercise may also facilitate adequate coronary perfusion even in the face of an apparently high RPP. Although moderate levels of resistance training has not been shown to exacerbate heart rate and blood pressure responses beyond clinically acceptable levels, ACSM recommends that RPP be monitored periodically to ensure that patients do not exceed the RPP at which symptoms or electrocardiographic (EKG) changes occurred during exercise testing.

Normal Course Following Open Heart Surgery

The loss of lean body mass (LBM) accompanying bed rest has been a consistent observation since many body composition changes occur within the first few days of bed rest following surgery. Shaw et al. found that typical ward activities, such as sitting in a chair, feeding oneself, using a bedside commode, and moderate supervised ambulation can deter post-operative LBM loss and may be all that is required to prevent chest wall adhesions. Since normal hospital stay for uncomplicated patients ranges from 3 to 5 days, it is advantageous for patients to be referred to Phase II immediately after hospital discharge to continue recovery. Coronary patients are more easily influenced and educated at this time because of fear and anxiety about their health and longevity.
Current literature supports a Phase II training program that is varied in nature and includes a combination of upper and lower body exercise training. During Phase II, patients are encouraged to perform 10 to 15 minutes of continuous upper body exercise along with 30 to 45 minutes of continuous lower body exercise. Although upper body resistance training has become increasingly popular in the past decade, concern still exists for associated risks. Due to the variability of these risks, guidelines for initiating upper body resistance training range from 3 to 16 weeks following surgery.

Irwin and Stephen-Tecklin suggest that upper body training be initiated as soon as 3 to 4 weeks after open heart surgery. The only limiting factor they recognized was that chest soreness and bone healing must preclude aggressive arm work. Squires and Squires et al. concluded that selected cardiac patients can perform upper body strength training activities within 4 to 8 weeks after cardiac events, such as a myocardial infarction or bypass surgery, as a beneficial adjunct to traditional forms of aerobic exercise. ACSM states that low level resistance training may be initiated as early as 7 to 8 weeks following a cardiac event as long as a symptom-limited exercise test has been performed and the patient does not have any abnormal hemodynamic responses or ischemic changes on the EKG during the test. The American Association of Cardiovascular and Pulmonary Rehabilitation recommends that the onset be 3 to 6 weeks after a myocardial infarction or coronary bypass surgery.
On the more conservative side of prescribing upper body exercise, studies done by Stewart, Kelemen, Sparling and Cantwell and Verrill et al. state that upper body resistance training should not be started until the patient has been in a cardiac rehabilitation program for at least 12 weeks. It has been discussed that this time period allows for sufficient clinical observation, patient education, and cardiorespiratory and musculoskeletal adaptations to occur prior to resistive training. Kelemen and Sparling and Cantwell also confirm that resistance training should not be performed until 4 months after the cardiac event. Although researchers disagree on the onset of upper body exercise following open heart surgery, they all agree that it has been shown to be hemodynamically safe with considerable benefit and relatively minimal risk.

**Benefits of Upper Body Exercise**

Although cardiac rehabilitation programs have primarily shown the physiological benefits of aerobic exercise, resistive training has proven a beneficial adjunct in promoting physical strength and psychological well-being. In the study done by Verrill et al., the overall improvements in upper body strength allowed the cardiac patient to perform everyday activities at a lower energy cost and with greater efficiency of movement. Resistance training has also been shown to contribute to better overall health by preventing musculoskeletal disorders, particularly problems of the lower back, maintaining desirable body weight, modifying risk factors for coronary artery disease
(CAD), and improving self-image and self-efficacy.\textsuperscript{5}

Stewart, Mason, and Kelemen\textsuperscript{1} suggested that programs offering a wide variety of exercises, including resistance training activities, will have a greater influence of psychological and motivational components than programs emphasizing single activities such as walking and jogging. Higher patient confidence levels have been reported with strength-specific tasks in cardiac impaired populations.\textsuperscript{11}

By placing weight training in a circuit format, it is possible to challenge the skeletal muscles and the cardiovascular system, thereby promoting development of strength and cardiovascular endurance.\textsuperscript{5} This apparent improvement in strength and cardiovascular endurance should enable the individual to better perform both occupational and leisure tasks while decreasing the risk of injury. Kelemen\textsuperscript{10} reported that resistance training, in the form of circuit weight training, using moderate weight sets at 30-50\% of one repetition maximum, can be a safe and effective method for exercise conditioning in cardiac and hypertensive populations.

Haen nel, Quinney, and Kappagoda\textsuperscript{13} found that hydraulic circuit training (HCT) in cardiac patients offered a potential advantage over other forms of resistance training. The passive nature of HCT minimizes the risk of muscular and joint strain which can result from the lifting and lowering of weights in other forms of weight training. HCT is performed in an interval manner, which reduces the need for a sustained stress on the
cardiovascular system. HCT provides a sufficient intensity stimulus to improve both cardiovascular fitness and muscular strength and endurance.

When prescribed appropriately, resistive training can increase overall strength, cardiovascular endurance, and psychological well-being and may favorably alter selected risk factors for the development of CAD.9,12 Upper body resistance training appears to be a beneficial adjunct to aerobic exercises that have traditionally been performed in a Phase II program, with minimal risk and considerable benefit.
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ABSTRACT

HUENERBEIN, H. A. Guidelines for prescribing upper body exercise following open heart surgery. MS in Adult Fitness/Cardiac Rehabilitation, December 1995, 35pp. (J. Porcari)

This study determined current practices in prescribing upper body stretching, aerobic, and resistance training exercises for patients following open heart surgery. Data were obtained through the use of questionnaires with 20 cardiac rehabilitation directors, 84 cardiac rehabilitation participants, and 10 cardiac surgeons in Wisconsin. Guidelines based on the average responses suggest that open heart surgery patients begin upper body stretching exercises 9 days, enter Phase II cardiac rehabilitation 18 days, begin resistance training 24 days, perform arm ergometry 25 days, use the Airdyne at 28 days, and use the rowing machine 45 days postprocedure. Guidelines were most often set by a registered nurse (35%), exercise specialist (22%), or a cardiac surgeon (20%). Typically, guidelines were determined by the patient's comfort level based on sternal healing, exercise tolerance, and their heart rate and blood pressure responses. The majority of participants perceived the exercises prescribed for them to be appropriate and few experienced pain or problems during activity. These results indicate that the guidelines suggested by the professionals in the field of cardiac rehabilitation, although variable, appear to meet the needs of cardiac patients.
GUIDELINES FOR PRESCRIBING UPPER BODY
EXERCISE FOLLOWING OPEN
HEART SURGERY

A MANUSCRIPT STYLE THESIS PRESENTED
TO
THE GRADUATE FACULTY
UNIVERSITY OF WISCONSIN-LA CROSSE

IN PARTIAL FULFILLMENT
OF THE REQUIREMENT FOR THE
MASTER OF SCIENCE DEGREE

BY
HEIDI ANN HUENERBEIN
DECEMBER 1995
COLLEGE OF HEALTH, PHYSICAL EDUCATION, AND RECREATION
UNIVERSITY OF WISCONSIN-LA CROSSE

THESIS FINAL ORAL DEFENSE FORM

Candidate: Heidi Ann Huenerbein

We recommend acceptance of this thesis in partial fulfillment of this candidate's requirements for the degree:

Master of Science in Adult Fitness/Cardiac Rehabilitation

The candidate has successfully completed her thesis final oral defense.

[Signatures and dates]

This thesis is approved by the College of Health, Physical Education, and Recreation.

[Signatures and dates]

Dean of UW-L Graduate Studies
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I would like to express sincere appreciation and thanks to my thesis chairperson, Dr. John Porcari, whose knowledge and sense of humor made this year challenging, yet a lot of fun. I also thank my other committee members, Dr. William Floyd and Dr. John Unbehaun for the time and effort they contributed to this project. I would like to offer a special thank you to Tracy Herrewig for her knowledge in the field of cardiac rehabilitation and her help in designing the questionnaires.

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I would like to thank all of my family and friends for their support and faith in me when I needed them most. I love you all.

I would like to dedicate this to the brightest angel in heaven, my mom, Mrs. Lois "Loi" Huenerbein. She gave me unconditional love and support throughout my life. I love you and miss you.
TABLE OF CONTENTS

ACKNOWLEDGEMENTS ........................................ iii
LIST OF APPENDICES ....................................... v
INTRODUCTION ................................................ 1
METHODS ..................................................... 3
  Cardiac Rehabilitation Directors ..................... 3
  Cardiac Rehabilitation Participants ................. 3
  Cardiac Surgeons ......................................... 3
PROCEDURES ................................................ 4
COLLECTION OF DATA ....................................... 4
DATA ANALYSIS ............................................ 5
RESULTS ..................................................... 6
  Cardiac Rehabilitation Directors ..................... 6
  Cardiac Rehabilitation Participants ................. 8
  Cardiac Surgeons ......................................... 10
DISCUSSION ............................................... 12
SUMMARY AND CONCLUSION .............................. 14
REFERENCES ............................................... 15
APPENDICES ............................................... 16
## LIST OF APPENDICES

<table>
<thead>
<tr>
<th>APPENDIX</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. QUESTIONNAIRE FOR CARDIAC REHABILITATION DIRECTOR</td>
<td>16</td>
</tr>
<tr>
<td>B. QUESTIONNAIRE FOR CARDIAC REHABILITATION PARTICIPANT</td>
<td>19</td>
</tr>
<tr>
<td>C. QUESTIONNAIRE FOR CARDIAC SURGEON</td>
<td>22</td>
</tr>
<tr>
<td>D. COVER LETTER FOR CARDIAC REHABILITATION DIRECTOR</td>
<td>25</td>
</tr>
<tr>
<td>E. REVIEW OF RELATED LITERATURE</td>
<td>27</td>
</tr>
</tbody>
</table>
Guidelines for Prescribing Upper Body Exercise Following Open Heart Surgery

INTRODUCTION

The cardiovascular responses of healthy persons to dynamic upper body exercise have been clearly described in numerous studies.\(^1\)\(^-\)\(^3\) The responses and use of upper body exercise in patients following open heart surgery are, however, less well defined. Cardiovascular responses to upper body exercise in this population are important, given that many patients return to work and need to perform activities of daily living that require the use of the arms.

Immediately following surgery (Phase I), patients are prescribed exercises that involve active-resistive range of motion and stretching to help prevent chest wall adhesions and to deter lean body mass loss that are frequently associated with prolonged bed rest. These exercises, along with supervised ambulation, also help to reduce anxiety and depression while improving self-efficacy and confidence.\(^4\)

During early outpatient (Phase II) cardiac rehabilitation, open heart surgery patients have initially been encouraged to perform primarily lower body aerobic exercise, while upper body exercise has been a variable entity because of the potential risks associated with it. The main concerns have been that sternal healing and chest
soreness preclude the onset of upper body exercises and that the rate pressure product (RPP) associated with arm work may become excessive due to exaggerated heart rate and blood pressure responses. Upper body aerobic exercises using arm crank ergometers, shoulder wheel, and Airdyne bicycle as well as resistance training all involve substantial movement of the shoulder, back, and upper body musculature which may influence sternal healing. Due to the variability of these factors, there are no definite guidelines as to the initiation date for upper body exercise in open heart patients.

Another complicating factor is that recommendations have been made, depending on the facility, by primary care physicians, cardiologists, exercise physiologists, physical therapists, and nurses. Due to these varying opinions, the recommendations for beginning upper body exercise may range from 3 to 16 weeks after open heart surgery. These discrepancies as to the onset and the lack of guidelines for prescribing upper body exercise created the need for this study.

The purpose of this study was to establish appropriate guidelines for post-open heart patients to begin upper extremity resistance and aerobic exercises based on a consensus of current practice in the field of cardiac rehabilitation.
METHODS

It was the intent of this study to determine current practice in prescribing upper body exercises for patients following open heart surgery. This was done based on the practices and clinical experiences of cardiac rehabilitation (CR) program directors, cardiac patients, and cardiac surgeons.

Cardiac Rehabilitation Directors

Ten Phase II programs in each of the five regional areas in Wisconsin were selected from the 1994 WISCVPR Membership Directory. Program directors from these sites were sent a questionnaire (see Appendix A) to complete and return for analysis.

Cardiac Rehabilitation Participants

Cardiac rehabilitation patients from each of the aforementioned 50 Phase II sites were given questionnaires (see Appendix B) to complete and return for analysis. Ten questionnaires were sent to the Program Directors of these sites to distribute. If more were needed, the director could duplicate the questionnaire for patients. Eligible patients must have undergone open heart surgery and been participants in the Phase II program for at least one month.

Cardiac Surgeons

The selection of cardiac surgeons was accomplished by using a small sampling from Wisconsin. The Wisconsin Health Organization Provider Directory was used to select eight
surgeons from Southeastern Wisconsin. Each of the surgeons from this region were mailed a questionnaire. Hospitals from Eau Claire, Green Bay, La Crosse, and Madison were also contacted to obtain the names of cardiac surgeons who perform open heart surgery, and three from each were mailed questionnaires. Therefore, 20 cardiac surgeons were mailed questionnaires (see Appendix C).

PROCEDURES

The questionnaires used in this study were designed to evaluate current prescriptions for upper extremity exercises for post-open heart CR patients.

The development of the questionnaires was accomplished with the assistance of the Director of the La Crosse Exercise and Health Program at the University of Wisconsin-La Crosse and a member of the Exercise Physiology Department at Lutheran Hospital, La Crosse, WI.

COLLECTION OF DATA

Once the questionnaires were complete, the final version of each was reproduced and mailed with a cover letter (see Appendix D) detailing the purpose of the study and all necessary information to complete and return the questionnaire. The questionnaires were mailed with a self-addressed stamped return envelope. Questionnaires were also mailed to cardiac surgeons. An explanation of the study was included at the top of the questionnaire.
DATA ANALYSIS

The responses in this study were compared with and include those of CR program directors, open heart CR patients, and cardiac surgeons. These current practices and opinions need to be considered when developing guidelines for open heart patients to begin upper extremity exercises after surgery.

Organization of the questionnaire results was accomplished by tabulating responses into categories and determining percentage counts for each question. The results are presented in a table that portrays the percentage of directors who answered questions similarly as well as the percentage of cardiac patients who answered similarly to other patients. Questionnaire data from the surgeons were interpreted and compared in a similar manner.
RESULTS

Based on data collected from 20 CR director questionnaires, 84 CR participant questionnaires, and 10 cardiac surgeon questionnaires from Wisconsin, several conclusions were reached regarding upper body exercise guidelines.

Cardiac Rehabilitation Directors

On the average, most cardiac patients began upper body stretching exercises within 6-7 days following open heart surgery, typically during their hospital stay (Phase I). Patients entered Phase II CR an average of 14-15 days following their cardiac surgery. During Phase II rehabilitation, patients performed arm ergometry at approximately 25 days, the Airdyne at 26 days, and the rowing machine at 32 days postprocedure, respectively. The most common types of upper body exercises performed during Phase II included the Airdyne (30%), bicep curls (24%), tricep extensions (20%), arm ergometer (16%), and the rowing machine (10%).

A wide variety of guidelines were used for determining the initiation date for upper body stretching exercises. Most guidelines included following surgeon recommendations, or patient tolerance based on sternal healing. Occasionally the American Association of Cardiovascular and Pulmonary Rehabilitation and American College of Sports Medicine (ACSM) guidelines were followed in prescribing these guidelines.
Guidelines for determining the onset of upper body aerobic exercises included use of the patient’s comfort level based on sternal healing, use of the Airdyne bike 3-6 weeks post-operatively, surgeon guidelines of 6-8 weeks after surgery, or contraindications that would not permit safety of an activity.

Guidelines for determining the onset of upper body resistance training included the need for a stable sternum, dumbbells totalling no more than 10 pounds during the second or third Phase II visit, the use of ACSM guidelines, or in general, waiting 2-6 weeks following surgery. These guidelines were typically set by a registered nurse (35%), exercise physiologist or exercise specialist (22%), cardiac surgeon (20%), cardiologist (17%), certified athletic trainer (3%), or the medical director (3%).

When resistance training was used during Phase II CR, the guidelines that were used to determine the progression of weight and repetitions used were somewhat variable. Most often, patient tolerance, comfort, and energy levels were considered. A patient’s ability to easily do 15-20 repetitions of low weight was also used, as were blood pressure, heart rate, and ratings of perceived exertion responses. ACSM guidelines were used least frequently as a basis for resistance training. Prior to beginning a resistance training program, the appropriate original weight needs to be determined for each patient. The original weight
was most often determined by using the patient's comfort level and previous conditioning activities. Initially guidelines included the use of 1-8 pound hand weights, a trial and error method based on patient perceptions, lifting 20% of maximum weight or up to 15 pounds. Another method was to simply choose the highest weight to teach proper lifting technique and progress from there. The original weight was most often set by the exercise physiologist or a registered nurse (70%), then set by either the CR staff (15%) or the department policy (15%).

In general, most CR directors (75%) reported that patients do not typically complain of sternal pain or problems with upper body movements or lifting. When chest pain was expressed by a patient, it was primarily when they had begun upper body exercise before four weeks postoperatively. They were then instructed to go cautiously, or stop resistance training until the patient felt comfortable. When the patient felt discomfort, the surgeon was notified of the situation.

Cardiac Rehabilitation Participants

On average, most CR participants began early range of motion and upper body stretching at approximately 14 days after their cardiac surgery. Participants recalled entering Phase II CR an average of 22 days following their procedure. During Phase II, participants performed Airdyne at an average of 25 days, arm ergometry at approximately 28 days, and the
rowing machine at an average of 47 days following surgery. Resistance training, including bicep curls, tricep extensions, lateral wall pulls, bench press, and upright rowing, was most often initiated approximately 29-32 days postsurgery.

The majority of participants felt that most of the activities (specifically the Airdyne bike, arm ergometer, and upper body stretching exercises) were appropriate and beneficial during their Phase II CR program. The rowing machine and bench press were stated as inappropriate activities and ones which they either disliked or felt discomfort while doing. The Airdyne bike was an activity that many patients felt discomfort doing because of leg pain, cramping in the thighs, knee problems, or an uncomfortable seat.

The majority of patients perceived the time until the onset of upper body training exercises to be appropriate (85%), while some stated it was too early (7.5%) or that it was too late (7.5%).

In general, most cardiac rehabilitation patients (80%) stated that they did not experience chest pain or problems during activities prescribed for them in Phase II. When pain was experienced, it was stated as either a "pulling" of the pectoral muscle or a direct pain in the sternal incision.

Guidelines that were given to begin upper body exercises for home use after hospital discharge included a 10 pound
weight restriction, the use of easy range of motion stretches, and frequent monitoring of their heart rate.

Guidelines given to begin upper body exercises in CR included demonstrations of proper techniques and monitor their heart rate before and after exercise. Patients were instructed to proceed slowly and to stop if it hurt, and to only progress as they were able.

**Cardiac Surgeons**

On the average, cardiac surgeons recommended that open heart surgery patients begin upper extremity exercises 6 days after their procedure. Activities that were specifically suggested were complete range of motion and minor stretching with either bare arms or light hand weights.

During Phase II, cardiac surgeons recommended resistance training, using light dumbbells, and arm ergometry be initiated at 23 days, the Airdyne bike, with the use of arms, at approximately 32 days, and the rowing machine at 55 days. Physicians recommended against strenuous upper body exercise sooner than 2 months or longer if they experienced poor incisional healing or unstable sternum, dysrhythmias, or irregular heart rate or blood pressure responses during exercise.

Guidelines for upper extremity exercises were based on a variety of methods. Surgeons based their recommendations on common sense, risk stratification, or overall cardiac status and fitness of the patient. Surgeons also stated time-weight
variations, which in general were: no lifting over 5 pounds for 4 weeks, no lifting over 10 pounds for the next 8 weeks, and no lifting over 25 pounds for 3 months. Cardiac surgeons also stressed reliance on exercise physiologists and recommendations of the cardiac rehabilitation staff in general.

Eighty percent of surgeons received updates on patient progression of upper extremity exercises. Generally they received them in either the initial report sent after the first Phase II visit or as part of the monthly progress report. Often (70%) the pain and comfort level of the patients during the Phase II period had been discussed with the cardiac surgeons. Incisional discomfort was most specifically discussed with the surgeon post-operatively.

Since sternal healing plays such a major role in the initiation of upper extremity exercises, it is important to know how long complete sternal healing takes to ensure safety for each patient. The majority of cardiac surgeons (60%) agreed that it takes 6 weeks for a good, strong union of the sternum. Several surgeons (30%) stated that 80% of healing is complete in 12 weeks, and one surgeon stated that sternal healing is complete in 2-3 weeks.
The average values for data collected are summarized in Table 1.

Table 1. Means, standard deviations, and ranges of upper body exercises following open heart surgery.

<table>
<thead>
<tr>
<th></th>
<th>Cardiac Participant N = 84</th>
<th>Cardiac Director N = 20</th>
<th>Cardiac Surgeon N = 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stretching</td>
<td>14 ± 2.2</td>
<td>6 ± 1.1</td>
<td>5 ± .8</td>
</tr>
<tr>
<td></td>
<td>(5-22)</td>
<td>(2-15)</td>
<td>(2-10)</td>
</tr>
<tr>
<td>Arm ergometer</td>
<td>28 ± 2.9</td>
<td>25 ± 2.1</td>
<td>23 ± .9</td>
</tr>
<tr>
<td></td>
<td>(19-42)</td>
<td>(17-38)</td>
<td>(19-33)</td>
</tr>
<tr>
<td>Airdyne</td>
<td>25 ± 1.8</td>
<td>26 ± 3.4</td>
<td>32 ± 3.4</td>
</tr>
<tr>
<td></td>
<td>(19-34)</td>
<td>(15-38)</td>
<td>(23-48)</td>
</tr>
<tr>
<td>Rower</td>
<td>47 ± 5.8</td>
<td>32 ± 2.3</td>
<td>55 ± 4.1</td>
</tr>
<tr>
<td></td>
<td>(26-68)</td>
<td>(24-48)</td>
<td>(42-70)</td>
</tr>
<tr>
<td>Resis. tr.</td>
<td>31 ± 4.7</td>
<td>18 ± 1.1</td>
<td>23 ± .9</td>
</tr>
<tr>
<td></td>
<td>(16-53)</td>
<td>(14-29)</td>
<td>(20-33)</td>
</tr>
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Note. Recommended number of days post-procedure, all values are mean ± standard deviation.

DISCUSSION

The results of this study found that upper body exercise guidelines are varied, but do appear to follow a pattern that allows for safe and healthy exercising.

Immediately following surgery, cardiac surgeons and cardiac rehabilitation directors recommend starting upper extremity stretching exercise within 6-7 days post-procedure. Patients recalled starting them an average of 14 days post-procedure. The purpose of these early range of motion stretching exercises has been to prevent chest wall
adhesions, reduce anxiety and depression, and to improve self-confidence and self-efficacy. In my experience, most open heart patients receive range of motion and stretching exercises as early as 2-3 days following surgery. The data collected in this study appear to show that patients, on average, begin this much later than this, although they did perceive it as appropriate.

Cardiac rehabilitation directors have recommended early outpatient (Phase II) rehabilitation an average of 14-15 days following open heart surgery to help improve the cardiovascular condition of patients to help them return to work and improve the quality of their life. Although recommended earlier, patients have actually been shown to enter Phase II an average of 22 days post-procedure. During Phase II, upper body exercises using the arm ergometer, Airdyne, rowing machine, and resistance training equipment were all recommended by cardiac surgeons and CR directors in the same time frame in which they were performed by the patients. Since patients expressed that the initial time frames were appropriate 85% of the time, we can conclude that these are safe and reasonable guidelines for upper body exercises in cardiac patients following open heart surgery.

The main concerns of upper body exercises in this population have been that sternal healing and chest soreness preclude the onset of these exercises. Cardiac patients (80%) stated that they did not experience chest pain or problems
during the upper body exercises prescribed for them following open heart surgery. When pain was experienced, it was a vague muscle pulling that usually faded in time as the patient became stronger.

A complicating factor in determining guidelines is who actually determines them and due to varying opinions from professionals in the field, confusion exists regarding the initiation date for upper body exercises. These guidelines were most often set by a registered nurse or the exercise specialist or physiologist. Cardiac surgeons and cardiologists frequently expressed confidence in the cardiac rehabilitation staff to make competent decisions for these guidelines.

SUMMARY AND CONCLUSION

Based on the data collected in this study, it appears that current practice in the field of cardiac rehabilitation in prescribing upper body exercise is appropriate. The guidelines suggested by professionals in the field appear to meet the needs of the cardiac patient by encouraging safe and productive exercises that help them recover and progress to a healthful life.
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APPENDIX A

QUESTIONNAIRE FOR CARDIAC REHABILITATION DIRECTOR
QUESTIONNAIRE FOR CARDIAC REHABILITATION DIRECTOR

Guidelines for Prescribing Upper Body Exercise Following Open Heart Surgery

Please answer questions to the best of your knowledge as they apply to the rehabilitation of open heart patients, including both bypass and valve replacement patients, at your facility.

1. On average, how many days post-procedure do open heart patients enter Phase II rehabilitation? ________ days

2. On average, how many days post-procedure do open heart patients begin exercise with the upper extremities?

   Non-resistance (stretching) ________ days

   Resistance
     Dynabands ________ days
     Freeweights (Dumbbell) ________ days
     Machine weights ________ days
     Other (please specify) ________ days

   Aerobic
     Schwinn Airdyne (or similar bike) ________ days
     Arm ergometer ________ days
     Rowing machine ________ days
     Other (please specify) ________ days

3. What types of upper extremity exercises do participants at your facility typically perform? Mark all that apply.

   Aerobic
     Rowing machine ________
     Arm ergometry ________
     Airdyne bike ________
     Shoulder wheel ________
     Other (please specify) ________

   Resistance training
     Bicep curls ________
     Tricep extension ________
     Bent over rowing ________
     Upright rowing ________
     Bench press ________
     Lateral wall pull ________
     Other (please specify) ________
4. What guidelines are used to determine the initiation date for upper extremity stretching exercises? _______________

What guidelines are used to determine the onset of upper body aerobic exercises? _______________

What guidelines are used to determine onset of upper body resistance training exercises? _______________

5. Who typically sets these guidelines? Mark all that apply.
   Cardiologist __________
   Cardiac surgeon __________
   Exercise Physiologist __________
   Physical Therapist __________
   Occupational Therapist __________
   Registered Nurse __________
   Other (please specify) __________

6. If resistance training is used, what guidelines are used to determine progression of weight and repetitions used in training? _______________

How is the original weight determined? _______________

Who sets the original weight? _______________

How many repetitions do you typically use? _______________

7. Do patients typically complain of sternal pain/noise with upper arm movement or lifting? YES NO I DO NOT KNOW

If so, what type of action is typically taken? _______________

Thank you very much for your time.
APPENDIX B

QUESTIONNAIRE FOR CARDIAC REHABILITATION PARTICIPANT
QUESTIONNAIRE FOR CARDIAC REHABILITATION PARTICIPANT

Please take a couple minutes to fill out this questionnaire using your perceptions from when you first began upper body exercises after open heart surgery. Please remember this questionnaire is confidential, so do not put your name on it.

1. How many days after your open heart surgery did you enter the Phase II Cardiac Rehabilitation program? _____ days

2. How many days after your surgery did you begin upper body exercise? Please disregard the exercises you did not do.

   Stretching _____ days

   Aerobic
   Air dyne bike (or similar) _____ days
   Rowing machine _____ days
   Shoulder wheel _____ days
   Arm ergometry _____ days
   Other (please specify) _______ days

   Resistance training
   Bicep curls _____ days
   Tricep extension _____ days
   Lateral wall pull _____ days
   Bench press _____ days
   Upright rowing _____ days
   Other (please specify) _______ days

3. If you performed these exercises, did you feel they were appropriate?
   List those that you felt were appropriate ________________

   List those that you did not feel were appropriate ____________

4. Did you experience any chest pain or problems with the exercise prescribed for you? YES NO
   Please explain ____________________________________________
5. Which exercise(s) did you find beneficial? 


Which exercise(s) did you dislike or find discomfort doing? 


6. How did you perceive the onset of upper body training exercises after open heart surgery?

____ too early    _____ on time    _____ too late 

7. What guidelines were you given to begin upper body exercises?

In cardiac rehabilitation? 


For home use after hospital discharge? 


Thank you very much for your time.
APPENDIX C

QUESTIONNAIRE FOR CARDIAC SURGEON
Dear

I am a graduate student in the Adult Fitness/ Cardiac Rehabilitation program at the University of Wisconsin - La Crosse. I would appreciate 5-10 minutes of your time to contribute your professional knowledge to a study I am conducting. The purpose of my study is to determine current practice regarding the use of upper extremity exercise for patients following open heart surgery to ultimately develop guidelines based on the data collected. Please respond and return the questionnaire in the stamped envelope enclosed as soon as possible.

1. How many days after surgery do you recommend open heart patients begin upper extremity exercises?

2. Do you allow your patients to begin upper extremity exercises at all in Phase II CR, or do you have a time frame for which you recommend certain exercises? For example:

Airdyne bike
Shoulder wheel
Rowing machine
Arm ergometry
Resistance training

Do you feel there any absolute contraindications to upper body exercise?

________________________________________________________

________________________________________________________
3. On what basis do you set your guidelines for weight training?

4. Do you receive updates on patient progression of upper extremity exercises specifically?

Are pain/ comfort levels discussed with you?

5. In your estimation, how long does complete sternal healing take?

6. Would you like to make any additional comments?

Thank you for your time.

Sincerely,

Heidi A. Huenerbein
Graduate Student,
University of Wisconsin-La Crosse
APPENDIX D

COVER LETTER FOR CARDIAC REHABILITATION DIRECTOR
To

I am writing to request your assistance. I am a graduate student in the Adult Fitness/Cardiac Rehabilitation program at the University of Wisconsin-La Crosse. I would like to include your professional opinions as well as the current practices of your facility in a study I am conducting. The study will attempt to determine what is currently being done in prescribing guidelines for open heart patients to begin upper extremity exercises in a Cardiac Rehabilitation program. The literature on this topic appears to be variable, suggesting the onset be anywhere from 3 to 16 weeks after surgery.

The enclosed questionnaires address the issue of developing guidelines for prescribing upper extremity exercises. Along with the questionnaire for you to fill out, I have enclosed ten questionnaires for open heart rehabilitation participants to fill out pertaining to their perceptions of the appropriateness of the onset of upper extremity exercises. If you have more than ten participants in the Phase II program who would be interested in completing the survey, please duplicate the questionnaire as needed. Please encourage all of the participants who have participated in your phase II cardiac rehabilitation program for at least two weeks to fill out the questionnaire enclosed.

Please respond and return the questionnaires in the large stamped envelope enclosed by June 23, 1995.

Thank you for your participation.

Sincerely,

Heidi A. Husnerbein
Student, AF/CR M.S. Program
University of Wisconsin-La Crosse

Enclosures:
Questionnaire for CR Director
Questionnaire for CR Participant (10)
APPENDIX E

REVIEW OF RELATED LITERATURE
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In the past, patients with cardiac problems were generally told to refrain from upper body exercise, primarily resistance training since it had been widely presumed that sternal healing and chest soreness precluded upper body exercise and that it elevated rate pressure product (RPP).\textsuperscript{1,2} Within the past ten years, resistance training has become increasingly popular, along with the Airdyne bike and arm ergometer, and has proven to be efficacious for improving muscular strength and body composition in many populations, including cardiac patients. In a study by Stewart, Mason and Kelemen,\textsuperscript{1} it was found that programs which offer a wide variety of exercises, including upper body training, have a greater influence on psychological and motivational components than programs that offer exclusively aerobic conditioning activities.

Cardiovascular Responses to Upper Body Exercise

Heart rate, blood pressure, and RPP are all variables that need to be monitored when cardiac patients begin upper body exercises. Because of concerns that RPP may become excessive due to increased heart rate and systolic blood pressure, upper body exercise has primarily been proscribed for patients with cardiac disease.\textsuperscript{3} The American College of Sports Medicine (ACSM)\textsuperscript{4} acknowledges that resistance training will result in an increased RPP, primarily through a high systolic blood pressure, with lesser contribution of heart rate. Stewart\textsuperscript{5} confirms that a lower
heart rate during resistance exercise, despite the increase in systolic blood pressure, actually imposes a lower myocardial oxygen demand than aerobic activity. The increase in diastolic blood pressure associated with upper body exercise may also facilitate adequate coronary perfusion even in the face of an apparently high RPP. Although moderate levels of resistance training has not been shown to exacerbate heart rate and blood pressure responses beyond clinically acceptable levels, ACSM\(^4\) recommends that RPP be monitored periodically to ensure that patients do not exceed the RPP at which symptoms or electrocardiographic (EKG) changes occurred during exercise testing.

**Normal Course Following Open Heart Surgery**

The loss of lean body mass (LBM) accompanying bed rest has been a consistent observation since many body composition changes occur within the first few days of bed rest following surgery. Shaw et al.\(^6\) found that typical ward activities, such as sitting in a chair, feeding oneself, using a bedside commode, and moderate supervised ambulation can deter post-operative LBM loss and may be all that is required to prevent chest wall adhesions. Since normal hospital stay for uncomplicated patients ranges from 3 to 5 days, it is advantageous for patients to be referred to Phase II immediately after hospital discharge to continue recovery.\(^3\) Coronary patients are more easily influenced and educated at this time because of fear and anxiety about their health and longevity.\(^7\)
Current literature supports a Phase II training program that is varied in nature and includes a combination of upper and lower body exercise training. During Phase II, patients are encouraged to perform 10 to 15 minutes of continuous upper body exercise along with 30 to 45 minutes of continuous lower body exercise. Although upper body resistance training has become increasingly popular in the past decade, concern still exists for associated risks. Due to the variability of these risks, guidelines for initiating upper body resistance training range from 3 to 16 weeks following surgery.

Irwin and Stephen-Tecklin suggest that upper body training be initiated as soon as 3 to 4 weeks after open heart surgery. The only limiting factor they recognized was that chest soreness and bone healing must preclude aggressive arm work. Squires and Squires et al. concluded that selected cardiac patients can perform upper body strength training activities within 4 to 8 weeks after cardiac events, such as a myocardial infarction or bypass surgery, as a beneficial adjunct to traditional forms of aerobic exercise. ACSM states that low level resistance training may be initiated as early as 7 to 8 weeks following a cardiac event as long as a symptom-limited exercise test has been performed and the patient does not have any abnormal hemodynamic responses or ischemic changes on the EKG during the test. The American Association of Cardiovascular and Pulmonary Rehabilitation recommends that the onset be 3 to 6 weeks after a myocardial infarction or coronary bypass surgery.
On the more conservative side of prescribing upper body exercise, studies done by Stewart,\textsuperscript{5} Kelemen,\textsuperscript{10} Sparling and Cantwell\textsuperscript{11} and Verrill et al.\textsuperscript{12} state that upper body resistance training should not be started until the patient has been in a cardiac rehabilitation program for at least 12 weeks. It has been discussed that this time period allows for sufficient clinical observation, patient education, and cardiorespiratory and musculoskeletal adaptations to occur prior to resistive training. Kelemen\textsuperscript{10} and Sparling and Cantwell\textsuperscript{11} also confirm that resistance training should not be performed until 4 months after the cardiac event. Although researchers disagree on the onset of upper body exercise following open heart surgery, they all agree that it has been shown to be hemodynamically safe with considerable benefit and relatively minimal risk.

**Benefits of Upper Body Exercise**

Although cardiac rehabilitation programs have primarily shown the physiological benefits of aerobic exercise, resistive training has proven a beneficial adjunct in promoting physical strength and psychological well-being. In the study done by Verrill et al.,\textsuperscript{12} the overall improvements in upper body strength allowed the cardiac patient to perform everyday activities at a lower energy cost and with greater efficiency of movement. Resistance training has also been shown to contribute to better overall health by preventing musculoskeletal disorders, particularly problems of the lower back, maintaining desirable body weight, modifying risk factors for coronary artery disease
(CAD), and improving self-image and self-efficacy.\textsuperscript{5}

Stewart, Mason, and Kelemen\textsuperscript{1} suggested that programs offering a wide variety of exercises, including resistance training activities, will have a greater influence of psychological and motivational components than programs emphasizing single activities such as walking and jogging. Higher patient confidence levels have been reported with strength-specific tasks in cardiac impaired populations.\textsuperscript{11}

By placing weight training in a circuit format, it is possible to challenge the skeletal muscles and the cardiovascular system, thereby promoting development of strength and cardiovascular endurance.\textsuperscript{5} This apparent improvement in strength and cardiovascular endurance should enable the individual to better perform both occupational and leisure tasks while decreasing the risk of injury. Kelemen\textsuperscript{10} reported that resistance training, in the form of circuit weight training, using moderate weight sets at 30-50\% of one repetition maximum, can be a safe and effective method for exercise conditioning in cardiac and hypertensive populations.

Haennel, Quinney, and Kappagoda\textsuperscript{13} found that hydraulic circuit training (HCT) in cardiac patients offered a potential advantage over other forms of resistance training. The passive nature of HCT minimizes the risk of muscular and joint strain which can result from the lifting and lowering of weights in other forms of weight training. HCT is performed in an interval manner, which reduces the need for a sustained stress on the
cardiovascular system. HCT provides a sufficient intensity stimulus to improve both cardiovascular fitness and muscular strength and endurance.

When prescribed appropriately, resistive training can increase overall strength, cardiovascular endurance, and psychological well-being and may favorably alter selected risk factors for the development of CAD.5,12 Upper body resistance training appears to be a beneficial adjunct to aerobic exercises that have traditionally been performed in a Phase II program, with minimal risk and considerable benefit.
REFERENCES


