A Systematic Review of Exercise Training in Cardiac Implantable Devices

Cynthia M. Dougherty ARNP, PhD, FAAN
Charles and Gerda Spence Professor
Biobehavioral Nursing and Health Informatics
University of Washington
Nurse Practitioner, VA Puget Sound Health Care System
Seattle, WA USA
Disclosures

• There are no financial conflicts to disclose
• There was no sponsorship or commercial support received for this presentation

Objectives

• Review issues related to exercising with a cardiac implanted device (CID)
• Outline differences in exercise outcomes by type of CID
• Describe specific outcomes by cardiac device type: ICD, CRT, VAD
Exercise in Heart Disease

- Exercise training improves health status, survival and quality of life
- Those with cardiac implanted devices (CID)s have specific issues with exercise
  - ICD: implantable cardioverter defibrillator
  - CRT-P or CRT-D: cardiac resynchronization pacemaker or defibrillator
  - VAD: ventricular assist device
Issues with Exercise and CIDs

- **ICD**: Fear of exercise because of potential to get ICD shocks, clinicians not familiar with prescribing and monitoring safe exercise, need careful HR monitoring during exercise

- **CRT**: 1/3 do not have improved symptoms, begin in debilitated state, SOB and fatigue not improved with exercise, high exertion requires pacemaker adjustments

- **VAD**: functionally debilitated at time of VAD, no BP measurements, careful titration of VAD speed needed with high levels of exercise, remain with reduced exercise capability due to VAD speed
Purpose

• Outline the benefits of exercise in those with CID from inception through September 2016.
  • Identify the number of exercise intervention studies for ICD, CRT, and VAD
  • Assess the efficacy of exercise based interventions alone or in combination with psychoeducational components
    • Exercise capacity and adverse events
    • Quality of Life (QoL)
    • Psychological outcomes
Design

- Comprehensive literature search dating from beginning of PubMed through 2016
- Protocol used the AMSTAR-“A measurement tool to assess systematic review” criteria
- Exercise training must have included an aerobic or resistance exercise component, supervised or unsupervised, in a home, outpatient, or community setting
  - Exercise could start in hospital
- Psychoeducational components could contain education, mental health, self-management skills
Sample

- Inclusion Criteria:
  - Published articles of exercise with any 1 of the CIDS
  - Human subjects only
  - English language in peer reviewed journal
  - Adults > 18 years old

- Exclusion Criteria
  - Editorials, commentaries, conference abstracts, opinions, protocols
  - Focus solely on exercise testing
  - Exercise performed only in the inpatient setting
Search Strategy/Data Extraction

- PubMed, EMBASE, Cinahl, Web of Science, Cochrane and PEDro databases searched
- Keywords: ICD, CRT, VAD, exercise, aerobic exercise rehabilitation, resistance exercise, cardiopulmonary rehabilitation, exercise therapy
- Titles were independently screened and assessed for eligibility by 2 authors
- Search results imported into database, duplicates removed
- Abstracts were reviewed and further assessed
- Full text articles were obtained
- Consort diagram constructed
- Data extracted by 2 authors and verified by 3rd author
Figure 1. Flow chart for the results of the literature search

Identification

Records identified through Database searching (n=3991)
(ICD= 1015, CRT=1630, and VAD=1346)

3570 records rejected due to:
- Not an exercise intervention
- Case Study
- Conference paper
- Systematic Review
- Cardiopulmonary exercise testing

Screening

Title screened (n=421) included
(ICD= 159, CRT=114; and VAD=148)

225 titles rejected:
- Did not reflect the aim of the study
- Duplicates

Abstracts screened (n=196) included
(ICD=51, CRT=54, VAD= 91)

149 abstracts rejected because of:
- Not an exercise intervention
- Either poster session, editorial comment, conference paper, or systematic Review
- Inpatient rehabilitation
- - No full text in English
- - Progressive mobilization
- - Not an exercise intervention program
- - Cardiopulmonary exercise test
- - Physiotherapy
- - No full text in English
- - Poster session, editorial comment, conference paper, or systematic review

Eligibility

Full-text articles assessed for eligibility (n=47): ICD=29, CRT=6, VAD= 12

20 records excluded after full text articles reviewed due to:

ICD (excluded n=12):
- Preliminary study with full study already included (n=1)
- No analysis with only ICD sample (n=2)
- Not an exercise intervention (n=6)
- No results (n=1)
- Moved to VAD (n=1)
- Inpatient intervention (n=1)

CRT (excluded n=2):
- No analysis with only Pacemaker (n=1)
- Pacemaker but not CRT (n=1)

VAD (excluded n=6)
- Not an exercise intervention program (n=3)
- Conference paper (n=1)
- No full text (n=1)
- No data related to the post VAD exercise period (n=1)

Included

Studies included (n=24)* (ICD=14, CRT=4, VAD=6)
Search Outcomes

- 3991 articles were found
  - ICD=1015, CRT=1630, VAD=1346
- 421 abstracts reviewed, duplicates removed
  - 196 screened for eligibility (ICD=51, CRT=54, VAD=91)
- 47 full text articles reviewed
  - 24 (ICD=16, CRT=5, VAD=6) were included in final results
- Reference lists and accompanying papers searched
- No attempt to search conference abstracts, conference titles, editorials, newspapers of other grey literature
- Quality of papers were assessed using Jadad criteria (0-5)
Results-All

- Studies published 1998-2016, most studies complete in last 10 years, 24 total in the review
- 14 RCTs, 5 retrospective designs, 3 pre-post test designs and 1 case control and 1 prospective non-randomized study
- Quality of RCTs were higher in the VAD population
- Average level of evidence was 3.0 indicating well designed studies that were not necessarily randomized
- 5308 participants, 2702 exercised, range 10-2331
- Average age 56±10.1 years, majority male and Caucasian
- LVEF=23.7%, Drop-out rate 17% (1-31%)
- VAD-all BTT
- Duration of follow-up was right after completion (3 months), to 24 months
Results-All

- Majority of exercise was aerobic-walking, cycling, running
- Duration: 1.5-12 months, average 3 months
- Training was 3-5x/week, 30-90 minute duration, intensity 50-90% of peakVO$_2$ HR
- 1 yoga intervention
- All VAD interventions in cardiac rehab settings
- Resistance exercise in 1 VAD and 2 ICD studies
- Usual care was a ‘no exercise recommendation’ group
- Multi-component interventions contained support groups, education, and psychological interventions
Results-All

• 20/24 primary outcome was peakVO₂ (ml/kg/min)
  • Average increase in peakVO₂ in all = 2.61 (2.2-3.2) ml/kg/min
• 15 studies reported QoL outcomes (6 ICD, 4 CRT, 5 VAD)
• 10 studies reported psychological outcomes (7 ICD, 1 CRT, 2 VAD)
  • ICD: 1 study demonstrated improved QoL and 2 studies improved anxiety and depression
  • CRT: 1 study demonstrated improved QoL, and 1 depression not changed
  • VAD: 2 studies demonstrated improved QoL and 1 study improved depression
Results-All

- Adverse Events
  - ICD shocks associated with exercise were low (ICD=2.2%, CRT=not reported, VAD=1.1%)
  - All cause mortality was low
    - ICD=1 not related to exercise
    - CRT=1
    - VAD=0
  - All cause hospitalization
    - ICD=13-67%, includes those with CRT
    - CRT=26% vs no CRT=15%
    - VAD=not reported
Results-ICD

- 14 unique studies, 2681 patients, 1353 exercised
- 7 RCTs, 2 retrospective, 1 case control, 1 non-randomized
- 59.7±10.7 years old, male (75%), LVEF%=29.4%
- Aerobic exercise 2-12 months, average 3 months, 60-90% of maximum HR
- 9/14 average improved peak\(\text{VO}_2\) = 2.4 ml/kg/min when compared to UC, statistically significant
- ICD shocks with exercise 0-20%, average 2.2%
- ATP therapies 1.1-2.2%
- Limitations: most studies focused on safety, small sample sizes, male participants, conducted in cardiac rehab settings, few resistance exercise interventions
Results-CRT

- 4 unique studies, 2447 patients, 1217 exercised, HF Action comprised large portion of patients

- 4 RCTs

- 60.7±5.9 years old, male (83%), LVEF%=24.8%

- Aerobic exercise 3-5 months, average 3.6 months, 60-90% of maximum HR, no resistance exercise

- Average improved peakVO₂ = 3.2 ml/kg/min when compared to UC, statistically significant

- AE not reported, 1 reported delay in starting exercise to prevent lead dislodgement

- Limitations: few studies, small sample sizes, male participants, no resistance exercise interventions, none comparing CRT to no CRT
Results-VAD

- 6 unique studies, 169 patients, 121 exercised
- 3 RCTs, 3 retrospective
- 45.5±13.8 years old, male (85%), LVEF%=17%
- Aerobic exercise 6-12 weeks, 1 study 18 months, 50-80% of maximum HR
- All BTT
- Average improved peak\( \text{VO}_2 \) = 2.2 ml/kg/min when compared to UC, statistically significant
- 1-VT associated with exercise, 1-syncope with exercise
- Limitations: small sample sizes, male participants, low training volumes, all in cardiac rehabilitation
Conclusions/Future Research

• Exercise training is safe and effective with CID at moderate to high intensity
• Exercise improves cardiopulmonary outcomes with few adverse events
• Exercise has variable effects on QoL and psychological outcomes
• Future research
  • More diverse samples
  • Translational research designs
  • Destination Therapy (DT) for VAD population
  • Measure costs and patient centered outcomes
Interdisciplinary Team


