SDC Table 3: Studies Included with VAD Implantation

Study	Design/Sample	Intervention	Outcomes	Results	Summary/Conclusions
Laoutaris et al (2011)[51]	**Design:** prospective 2:1 RCT (n=15) **Sample:** Bridge to transplant with LVAD or biVAD 5.6 months after implant **LVAD:** EXCOR VAD 86.6% INCOR VAD BiVAD **Gender:** % (n): Male: 93.3% (14) Female: 6.7% (1) **Age:** (mean ± SD): 38.3 ±15.9y **Diagnoses:** Dilated cardiomyopathy 100% both groups **LVEF**% (mean ± SD): NR **Dropout rate:** EX: 28.6%	**EX**: moderate intensity aerobic exercise 45min – 3 to 5x/wk for 10 wk + high intensity inspiratory muscle training 2-10 times x wk for 10 wk, walk every day (n=10) **C**: walk every day (n=5)	**12 wk:** **Exercise capacity** PeakVO_2 (mL/kg/min) Exercise time: (min) 6MWD (m) **Dyspnea** Borg dyspnea rating at end of 6MWD (6-20) **QOL** MLHFQ **Pulmonary function** FEV_1% predicted FVC%	**12 wk:** **Exercise capacity** PeakVO_2 EX: 19.3±4.5 C:14.8±4.2 P=.10 Exercise time EX: 10.1±1.9 C:8.4±2.9 P=.10 6MWD EX: 527±76 C: 448±55 P=.10 **Dyspnea** EX: 10.5±0.9 C:10.6±0.5 P=.80 **QOL** MLHFQ EX: 38.2±11.6 C: 50.8±10.3 P=.30 **Pulmonary function** FEV_1% predicted EX: 83.8+14.3 C: 76+18 P=.10	**Level of Evidence:** II **Jadad score** = 5 **Strengths** - All outcomes measured by assessor blinded to group allocation **Limitations** - Small sample size - Differing types of LVAD in sample, large number had heart transplant soon after participation

	C: 28.6%			FVC% EX: 85.4+9.5 C: 76.1+26 P=0.10 **Adverse Events** None	
Hayes et al (2012)[52]	**Design:** Prospective RCT (n=14) **Sample:** LVAD bridge to transplantation, 32 d after LVAD **LVAD type:** Ventricular Assist, LVAD centrifugal pump (n=14) **Gender:** n (%): Male: 12 (85.7%) Female: 2(14.3%) **Age** (mean ± SD) EX: 48.7 ± 14.5y C: 45.9 ±14.6y **Diagnoses:** -idiopathic DCM – 9 (64.3%) -Ischemic CM – 5 (35.7%)	**Intervention:** **EX:** aerobic exercise +strengthening + mobilization: 1h - 3x/ wk at 50% peakVO_2 x 8 wk (n=7) **C:** mobilization: alone (n=7), daily walking to Borg RPE=13.	**8 wk:** **Exercise capacity** PeakVO_2 (mL/kg/min) 6MWD (m) **QOL** SF-36: PCS SF-36: MCS	**8 wk:** **Exercise capacity** PeakVO_2 EX: 14.8±4.9 C: 15.3±4.4 P=.43 6MWD EX: 531±31 C: 489±95 P=.25 **QOL** SF-36 PCS EX: 53.7±23.8 C: 47.7±9.4 P=.11 SF-36 MCS EX: 64.1±22.8 C: 58.3±10.2 P=.30 **Adverse events** None	**Level of Evidence: II** **Jadad score** = 5 **Strengths** - All outcomes measured by assessor blinded to group allocation **Limitations** - Small sample size - 1 type of LVAD used in all patients - Low intensity of the exercise - Predominance of males

	LVEF% (mean ± SD) EX: 16.0±5.0 C: 13.3±4.4 **Dropout rate:** EX: 0% C: 0%				
Kugler et al (2012)[53]	**Design:** Non-randomized prospective study (n= 70) consecutive patients **Sample**: HF patients, bridge to transplant, 6 wk after implantation Ischemic cardiomyopathy EX: 43.9 C: 49.1 Dilated cardio-moyopathy EX:56.1% C:47.3% **LVAD:** bridge to transplantation 54.8% Heartmate II 45.2% Heartware	EX group: dietary counseling + weight management + psychosocial counseling + home conditioning with bicycle using baseline CPET test (n=34) C group: usual care, no interventions (n=36)	**6 mo:** **Exercise capacity** PeakVO_2 (mL/kg/min) % predicted **Psychosocial outcomes** SF-36 PCS SF-36 MCS HADS-A HADS-D **BMI (kg/m^2)** **12 months: Same as 6 months** **18 months: Same as 6 months**	**6 mo:** **Exercise capacity** PeakVO_2 EX: 62.5% C: 58% P=NR **Psychosocial** SF-36 PCS EX: 39 C: 38 P=NR SF-36 MCS EX: 50.5 C: 51 P=NR HADS-A EX: 4.5 C: 5.5 P=NR HADS-D EX: 5 C: 4.5 P=NR	**Level of Evidence:** III **Jadad score:** NA **Strengths** - Longer term follow-up - Largest sample among all the exercise studies in patients with LVAD **Limitations** - No numerical values of outcomes presented in the paper, except BMI - Single center individualized exercise not described - Training volumes not reported. - Single individual delivered interventions - Baseline was completed at 6 wk post-LVAD - Many significance values between groups not reported.

	Gender: %(n): Male: EX: 85.4% C: 87.5% **Age:** (mean ± SD) EX: 52±2 C: 51±2 **Diagnoses:** **LVEF%:** (mean ± SD): NR **Dropout rate**: EX: 29.4% C: 28.6%			**BMI** EX: 24.8 C: 26.2 P=.70 **12 mo:** **Exercise capacity** PeakVO_2 EX: 66 C: 61.5 MD P=NR **Psychosocial** SF-36 PCS EX: 39.5 C: 35 P=NR SF-36 MCS EX: 51 C: 50.5 P=NR HADS-A EX: 4.9 C: 6.1 P=NR HADS-D EX: 4.8 C:4.8 P=NR **BMI** EX: 25.3 C: 27.4 P=.32	

				18 mo: **Exercise capacity** PeakVO_2 EX: 68 C: 62.5 P=.01 **Psychosocial** SF-36 PCS EX: 40 C: 35 P=.54 SF-36-MCS EX: 50 C: 50 P= .37 HADS-A EX: 5 C: 6.5 P=.03 HADS-D EX: 4.5 C:4.9 P=.34 **BMI** EX: 24.4 (22.5-28.7) C:29.7 (24.4-30.9) P= .02 **Adverse Events** NR	
Karapolat et	**Design:**	**EX:** Hospital aerobic	**8 wk:**	**8 wk:**	**Level of Evidence: VI**

al (2013)[54]	Retrospective pre-post design (n=11) **Sample:** LVAD as a bridge transplantation Dilated HF: 54.6% **LVAD**: 3=Berlin Heart EXCOR VAD 8=HeartWare VAD. 2.8 mo after implant **Gender** n (%): Female: 14.3% Male: 85.7% **Age** (mean ± SD) 45.57±14.05y **LVEF%** (mean ± SD): NR **Dropout rate:** NR	exercise: 90 min, 3x week x 8 wk + flexibility exercise + strengthening exercise upper and lower extremity) + relaxation exercise	**Exercise capacity** $PeakVO_2$ **Pulmonary function test (PFT)** FEV_1 FVC **QOL** SF-36 PF SF-36 MH **Psychological** Spielberger STAI BDI	**Exercise capacity** $PeakVO_2$ Pre: 14.68+3.63 Post: 15.13±3.42 P=.93 **PFT** FEV_1 Pre: 67.74+30.95 Post: 77.94±26.94 P=.26 FVC Pre: 72.02+25.29 Post:82.18+22.78 P=.43 **QOL** SF-36 PF Pre: 38.57±36.37 Post: 56.67 ±25.23 P=.85 SF-36 MH Pre: 66.86±13.80 Post: 82.67±16.91 P=.33 **Psychological** STAI State Pre: 48.00±2.77 Post:45.64±6.95 P=.49 STAI Trait	**Jadad score** = NA **Strengths** **Limitations** - Small sample size - Dropout rates: only reported for LVAD participants

				Pre: 48.14±4.88 Post:42.83±5.42 P=.35 BDI Pre: 11.29±7.39 Post:5.00±6.03 P=.89 **Adverse Events** NR	
Kerrigan et al (2014)[10]	**Design:** prospective RCT uneven 2:1 EX:UC (n= 26) **Sample:** continuous-flow LVAD implanted 1-6 mo **LVAD type**: continuous flow (HeartMate II or HeartWare) **Gender:** n(%) Female: 7(26.9) Male: 19(73.17) **Age:** (mean ± SD) EX: 53±13 C:60±12 **Ethnicity**	**EX**: CR=aerobic exercise 30 min at training intensity 3x week x 6 wk at 60% to 80% of heart rate reserve (n=18) **C:** Usual care, no exercise prescription (n=8)	**6 wk:** **Exercise capacity** PeakVO_2 (mL/kg/min) 6MWD (m) Treadmill time (min) **QOL** KCCQ summary score **Peak torque** Single-leg isokinetic strength	**6 wk:** **Exercise capacity** Peak VO_2 EX:11.9±0.43 C: 9.9 ±0.14 P=.27 6MWD EX: 402.4±89.3 C: 356.0±51.6 P=.24 Treadmill time EX: 11.0±2.1 C: 7.4±2.9 P=001 **QOL** KCCQ EX: 75 C: 65 P=.005 **Peak Torque**	**Level of Evidence: II** **Jadad score** = 5 **Strengths:** - All outcomes measured by a assessor blinded to group allocation **Limitations:** **-** Small sample size

	AA 14 (77%) **Diagnoses:** - Non-ischemic: 18 (69.2%) -Ischemic: 8 (30.7%) **LVEF%:** (mean ± SD): EX:21±7 C: 21±9 **Dropout rate:** EX: 11.1% C: 12.5%			Single-leg isokinetic strength EX: 100 C: 92 P=.016 **Adverse events** 1 ER visit due to VT causing syncope within 1 hr of exercise	
Marko et al (2015)[55]	**Design:** Single group retrospective use of rehabilitation data between 2010-2012 (n=41); outcomes only reported on n=15 **Sample:** LVAD patient completing cardiac rehabilitation. 48 ±38 d post-LVAD implantation 71% had ICD **LVAD:** Heart Ware = 32 Heartmate II = 9	**EX:** Rehabilitation program and medical training therapy walking and gymnastics, with goal of reaching Borg rating of 13 **Aerobic training:** 3 min bicycling with no load at the beginning and at the end of the session**;** alternating periods of high and low intensity **Strength training:** leg muscles with 12 repetitions used	**1 mo:** **Exercise capacity** PeakVO2 (mL/min/kg) (n=15) METs NT-proBNP	**1 mo:** **Exercise capacity** PeakVO_2 Pre: 11.3+4.12 Post: 14.51±5.20 P=.007 METs Pre: 3.2+1.2 Post: 4.2±1.5 P=.007 NT-proBNP Pre: 4076±3678 Post: 2362±1430 P=NR; 27% reduction **Adverse Events** 1 nonsustained VT	**Level of Evidence:** VI **Jadad score** = NR **Strengths:** **Limitations:** - PeakVO_2 available on a small portion of the sample n=15 only - Not all patients had the same training protocol. - Timing of outcome measures NR

	Gender: (n)%: Female: 8(20) Male: 33(80) **Age:** (mean ± SD) 54.8±11.6 y **Diagnoses:** (mean ± SD) Ischemic: 19 (43) Idiopatheci:17 (41) Other: 5 (16) **LVEF** (mean ± SD): NR **Dropout rate:** NR	Total training period was 32 d/person.		during cycling	

Final List VAD

Total: 6 Studies

Laoutaris ID, Dritsas A, Adamopoulos S, et al. Benefits of physical training on exercise capacity, inspiratory muscle function, and quality of life in patients with ventricular assist devices long-term postimplantation. *Eur J Cardiovasc Prev Rehabil.* 2011;18(1):33-40.

Hayes K, Leet AS, Bradley SJ, Holland AE. Effects of exercise training on exercise capacity and quality of life in patients with a left ventricular assist device: a preliminary randomized controlled trial. *J Heart Lung Transplant.* 2012;31(7):729-734.

Kugler C, Malehsa D, Schrader E, et al. A multi-modal intervention in management of left ventricular assist device outpatients: dietary counselling, controlled exercise and psychosocial support. *Eur J Cardiothorac Surg.* 2012;42(6):1026-1032.

Karapolat H, Engin C, Eroglu M, et al. Efficacy of the cardiac rehabilitation program in patients with end-stage heart failure, heart transplant patients, and left ventricular assist device recipients. *Transplant Proc.* 2013;45(9):3381-3385.

Kerrigan DJ, Williams CT, Ehrman JK, et al. Cardiac rehabilitation improves functional capacity and patient-reported health status in patients with continuous-flow left ventricular assist devices: the Rehab-VAD randomized controlled trial. *JACC Heart Fail.* 2014;2(6):653-659.

Marko C, Danzinger G, Käferbäck M, et al. Safety and efficacy of cardiac rehabilitation for patients with continuous flow left ventricular assist devices. *Eur J Prev Card.* 2015;22(11):1378-1384.

Table abbreviations: AA, African American; BDI, Beck Depression Inventory; biVAD, biventriculat assist device; BMI, body mass index; C, control group; CR, cardiac rehabilitation; CM, cardiomyopathy; CPET, cardiopulmonary exercise test; DCM, dilated cardiomyopathy; ER, emergency room; EX, exercise intervention; HADS-A, Hospital Anxiety Depression Scale; HADS-D, Hospital Anxiety Depression Scale-Depression; HF, heart failure; FEV_1, forced expiratory volume in 1 sec; FVC, forced vital capacity; LVAD, left ventricular assist device; MLHFQ, Minnesota Living with Heart Failure Questionnaire; NR, not reported; RCT, randomized controlled trial; SD, standard deviation; SF-36 MCS, Short Form-36 item Mental Composite Summary; SF-36 MH, Short Form-36 item Mental Health; SF-36 PCS, Short Form-36 item Physical Composite Score; SF-36 PF, Short Form-36 item Physical Function; STAI, State-Trait Anxiety Inventory; UC, usual care; VO_2, oxygen uptake; VT, vemntriculat tachycardia; 6MWD, 6-minute walk distance.