Benefits of Immersion and Aquatic Exercise in Patients with Cardiac Disease

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Introduction

- Exercise is a well-known cardiovascular protective factor in patients with ischemic heart disease and/or chronic heart failure.
  (Herhan et al. 2011, Taylor et al. 2014)

- Many patients with cardiac disease have comorbidities that hinder exercise on land.
  (Dahlström et al. 2005, Holmström et al. 2013)

- Aquatic exercise (training in warm water) could be appropriate for elderly patients who find it difficult to exercise on land.

Introduction

- Water immersion cause a move of blood from the periphery to the intra-thoracic circulation.
  Arborelius et al. 1972

- Due to the hydrostatic induced volume shift, water immersion has been considered as a challenge for patients with ischemic heart disease and chronic heart failure.
  ESC-guidelines. 2001, Meyer et al. 2004

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The European Journal of Heart Failure 5 (2003) 527–535

The European Journal of Heart Failure

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Hydrotherapy—a new approach to improve function in the older patient with chronic heart failure

Åsa Cider[a,*], Maria Schaufelberger[a], Katharina Stibrant Sunnerhagen[b], Bert Andersson[a]

Study population

25 patients (8 females)

Age 73±5.2 years

Ejection fraction 31±8.3 %

Exercise program

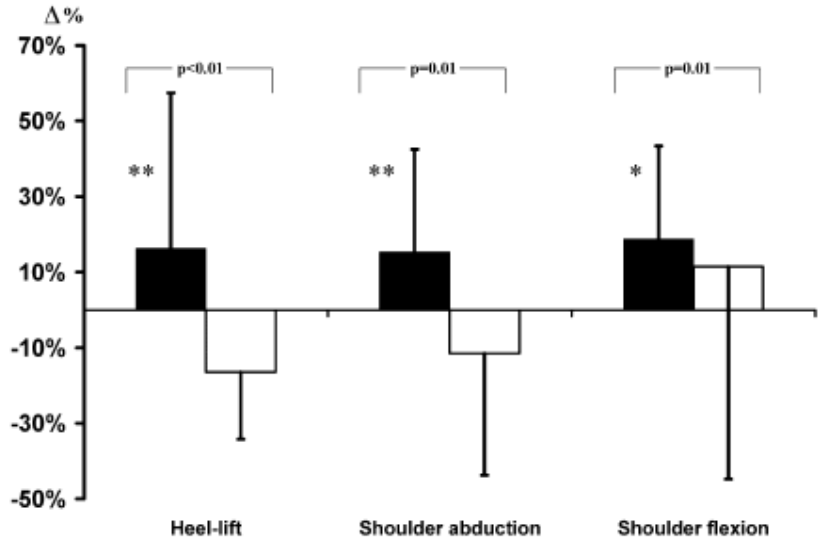
Frequency: 3 times per week for 8 weeks

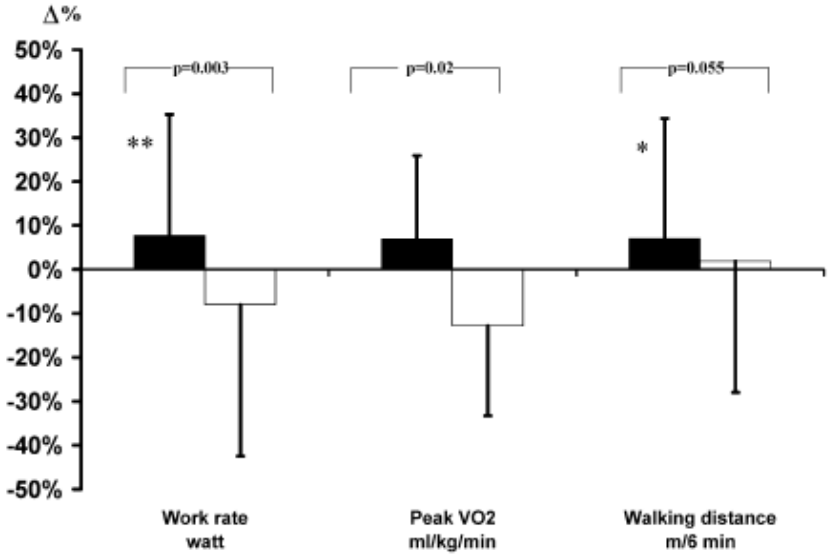
Intensity:40-80% of heart rate reserve

Time/occation:45 minutes

Type: Aquatic exercise;
combined aerobic and muscular resistance training in 33-35° C

Results





Cider et al 2003

Evidence-Based Complementary and Alternative Medicine
Volume 2012, Article ID 349209, 8 pages
doi:10.1155/2012/349209

Research Article

Aquatic Exercise Is Effective in Improving Exercise Performance in Patients with Heart Failure and Type 2 Diabetes Mellitus

Cider Åsa,[1,2] Schaufelberger Maria,[3] Stibrant Sunnerhagen Katharina,[1] and Andersson Bert[3]

Table 1: Demographic data of patients with chronic heart failure and type 2 diabetes mellitus.

Variables	Training ($n = 10$)	Control ($n = 10$)	P value
Age (years)	65.8 ± 5.8	69 ± 8.2	ns
Sex (F/M)	2/8	2/8	ns
Weight (kg)	93.6 ± 16.2	86.6 ± 24.2	ns
Height (cm)	176.1 ± 10	174 ± 8.8	ns
Duration of CHF (years)	5.3 ± 2.6	6.0 ± 5.2	ns
Duration of 2DM (years)	7.2 ± 5.8	6.9 ± 4.4	ns
LVEF (%)	34.1 ± 9.8	34.8 ± 9.1	ns
Etiology of CHF (IHD/DCM/HT)	8/1/1	4/4/2	ns
NYHA class (II/III)	5/5	3/7	ns

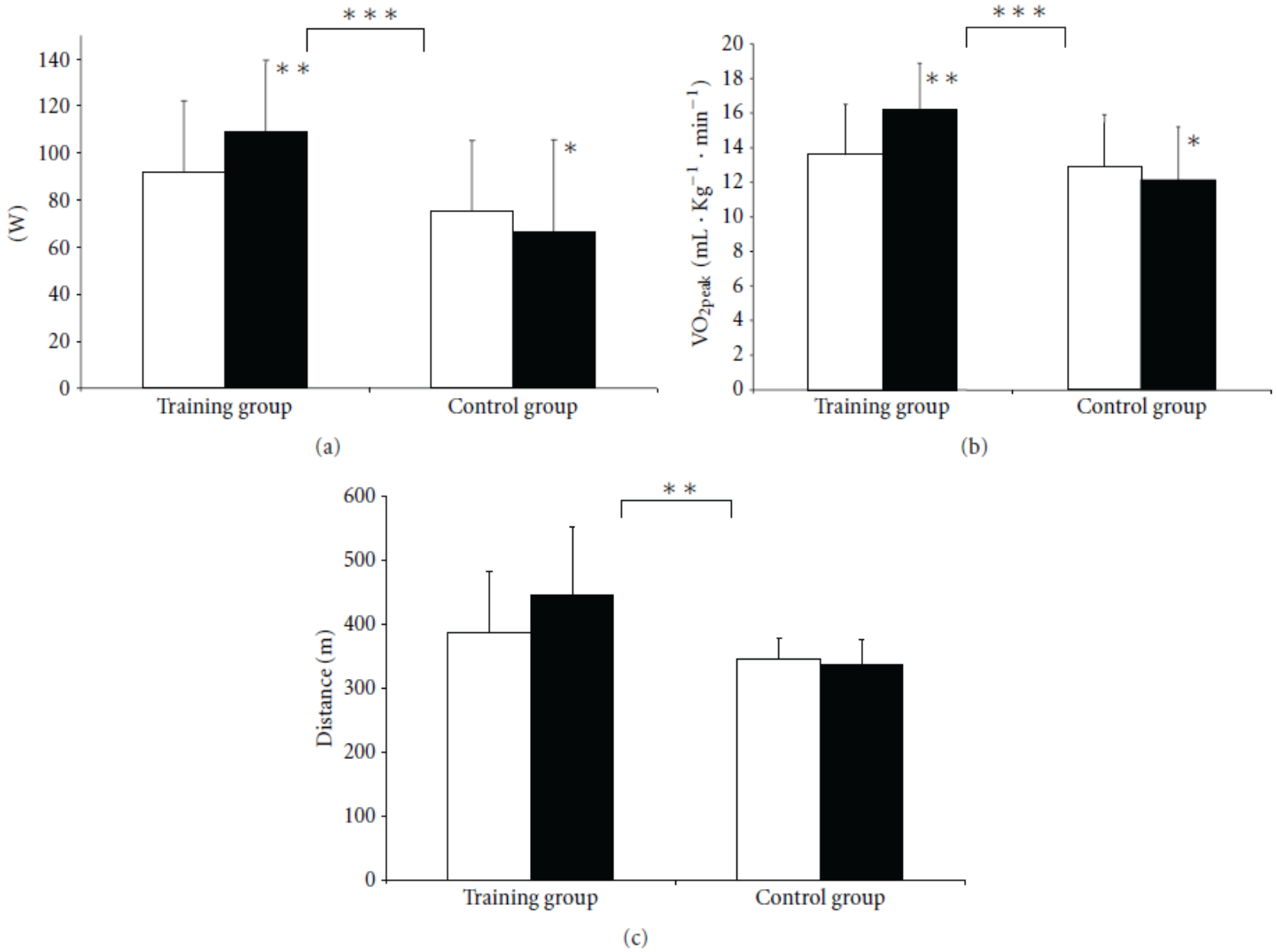


FIGURE 2: Work rate (a), peak oxygen uptake VO_{2peak} (b), and distance walked (c) in six minute walk test before □ (n = 10 and 10) and after ■ (n = 8 and 9) eight weeks of aquatic exercise.

Clin Physiol Funct Imaging (2005) **25**, pp313–317

Cardiorespiratory effects of warm water immersion in elderly patients with chronic heart failure

Åsa Cider[1], Katharina Stibrant Sunnerhagen[2], Maria Schaufelberger[1] and Bert Andersson[1]

Gas analysis measurement

Studypopulation

12 patients (3 female)
Age : 64±6 years

12 healthy age and sex matched persons

Gasanalyses measurements in patients with CHF

	Patients with CHF (n=12)						Healthy subjects (n=12)					
	Rest		Exercise		Recovery		Rest		Exercise		Recovery	
	Land	Water	Land	Water	Land	Water	Land	Water	Land	Water	Land	Water
$V0_2$ ml/kg/min	3.1(0.5)	2.9(0.6)††	6.5(1.3)	6.5(2.1)	3.2(0.7)	3.5(0.8)†	3.0(0.5)	3.3(0.6)	7.0(1.6)	8.3(2.1)*	2.7(0.7)	3.5(0.7)**
VCO_2 l/min	188(35)	182(42)†	390(74)	421(170)	208(41)	250(69)†	184(36)	225(40)*	422(140)	523(166)**	178(54)	269(58)**
VE l/min	10.1(1.9)	9.4(2.1)*	21.9(14.5)	19.6(8.8)†	11.1(1.9)	12.0(2.5)†	8.5(1.6)	10.0(2.3)*	15.7(3.5)	23.1(14.4)**	8.4(1.9)	11.4(1.8)**
RF breaths/min	18(4)	19(5)	24(4)	27(6)*	19(5)	20(4)*	15(4)	16(5)	20(4)	23(5)*	16(5)	18(4)
RER	0.82(0.05)	0.86(0.06)*	0.83(0.05)	0.86(0.12)	0.88(0.05)	0.97(0.1)*	0.8(0.04)	0.86(0.07)*	0.78(0.04)	0.79(0.06)	0.86(0.05)	0.98(0.1)**
02-kinetics (τ)			0.8(0.3)	1.0(0.2)*	0.9(0.5)	1.4(0.3)*			1.0(0.3)	1.5(0.2)*	1.0(0.4)	1.4(0.5)*

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The European Journal of Heart Failure 8 (2006) 308 – 313

The European Journal of Heart Failure

www.elsevier.com/locate/ejheart

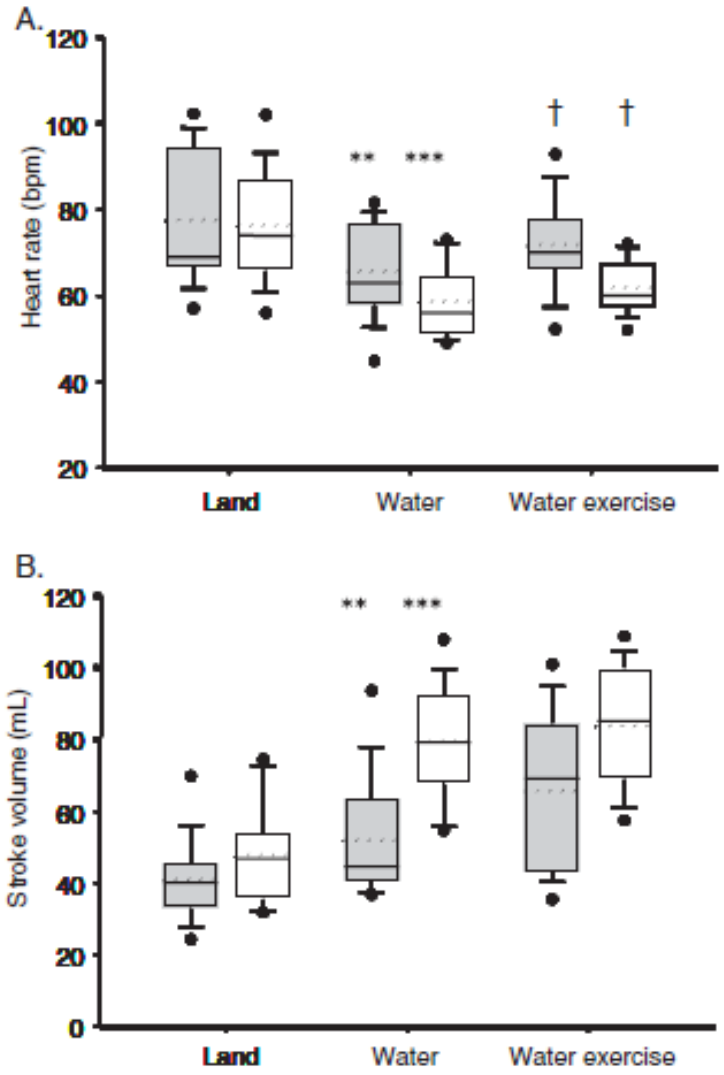
Immersion in warm water induces improvement in cardiac function in patients with chronic heart failure

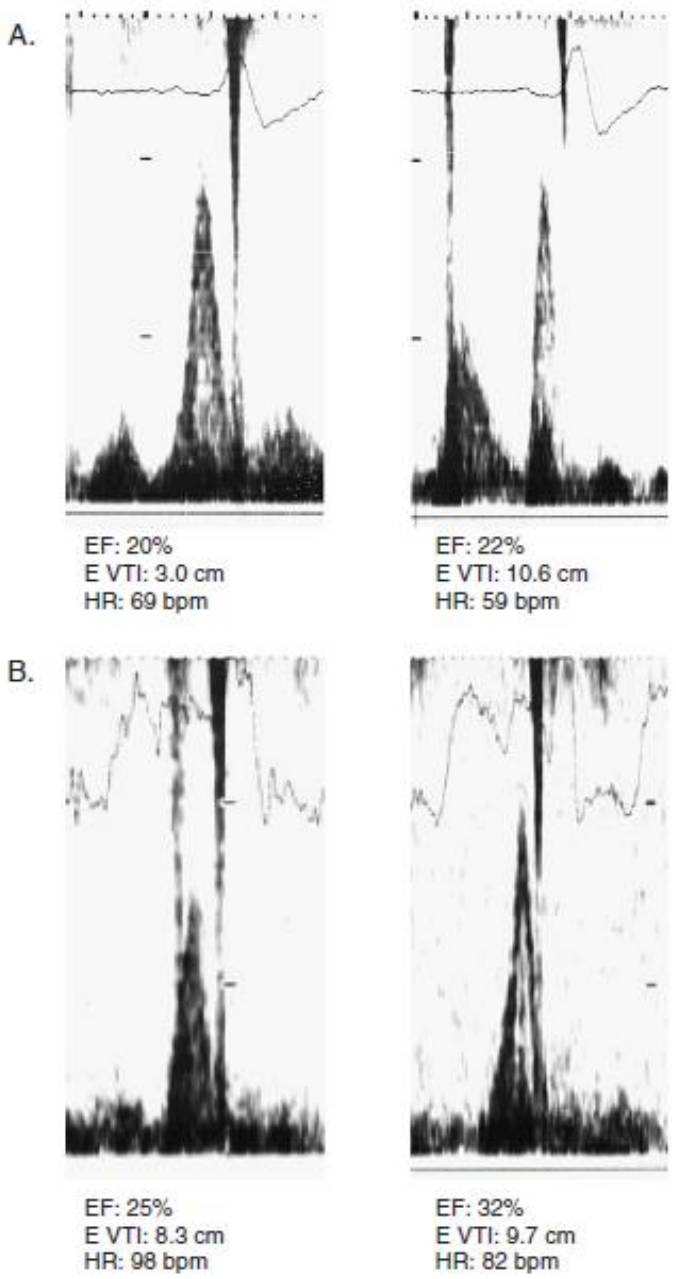
Åsa Cider *, Bente Grüner Sveälv, Margareta Scharin Täng, Maria Schaufelberger, Bert Andersson

13 patients with CHF mean age 72(6) years, EF 32(7)% and 13 healthy matched persons were assessed with echocardiography on land and in water.

Echocardiographic measurement in water

Results


A.
Heart rate (bpm)
120
100
80
60
40
20
**
***
†
†
Land
Water
Water exercise
B.
Stroke volume (mL)
120
100
80
60
40
20
0
**
***
Land
Water
Water exercise


A.
EF: 20%
E VTI: 3.0 cm
HR: 69 bpm
EF: 22%
E VTI: 10.6 cm
HR: 59 bpm
B.
EF: 25%
E VTI: 8.3 cm
HR: 98 bpm
EF: 32%
E VTI: 9.7 cm
HR: 82 bpm

Cardiovascular Ultrasound

BioMed Central

Research

Open Access

Benefit of warm water immersion on biventricular function in patients with chronic heart failure

Bente Grüner Sveälv*[1], Åsa Cider[2], Margareta Scharin Täng[1], Eva Angwald[1], Dimitris Kardassis[1] and Bert Andersson[1]

Cardiovascular Ultrasound 2009, 7:33 doi:10.1186/1476-7120-7-33

Patients/Methods

- 18 Patients (5 women)
- NYHA II-III
- Age 69±8 years
- LVEF 40±8%
- Peak VO_2 14.6±4.5 mL/Kg/min
- Echocardiography on land and in 34º C warm water

The protocol consisted of three observed sessions:

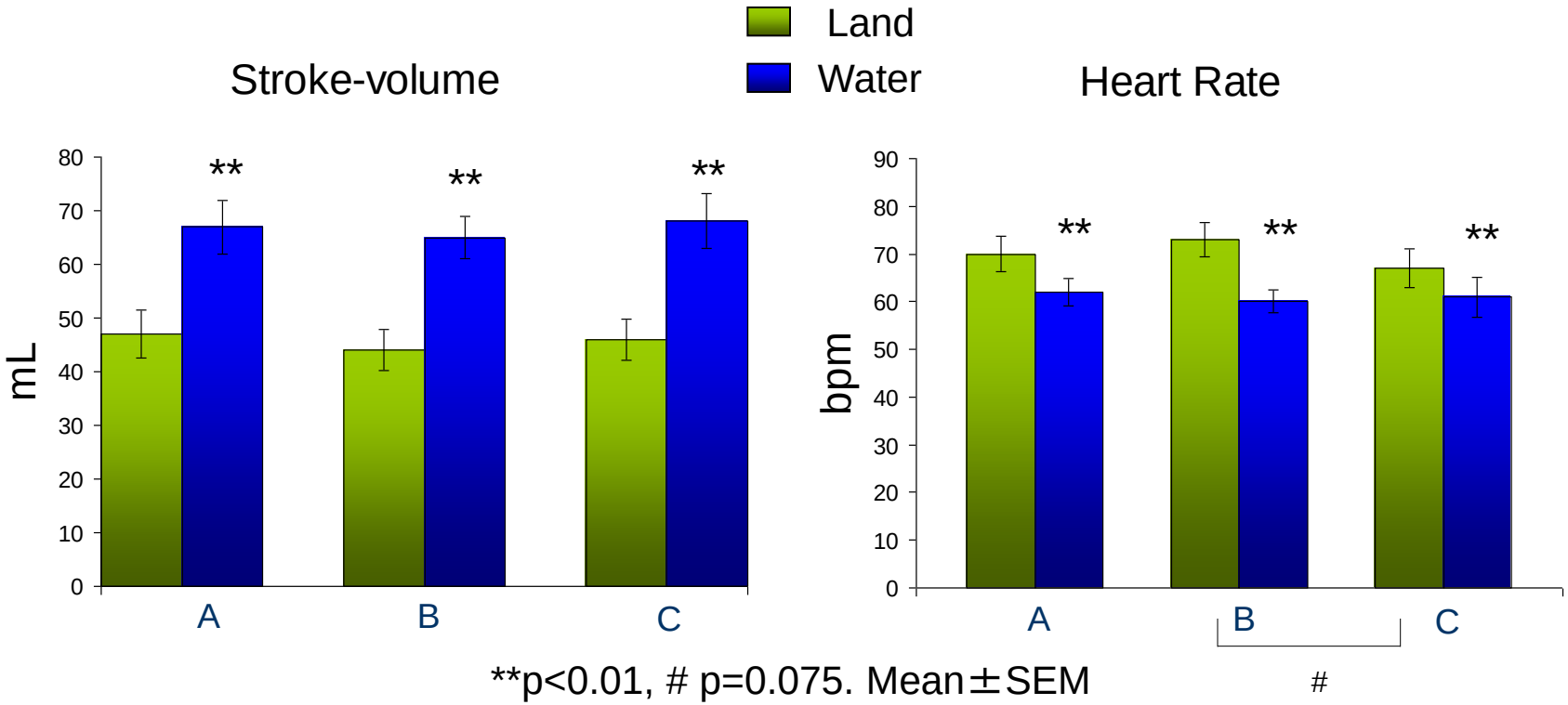
(1) baseline (acute effect),

(2) After 8 weeks without exercise (control period),

(3) After 8 weeks of hydrotherapy, twice weekly, 45 min in a heated pool, 33-34˚ C at 40–70% of maximal heart rate reserve.

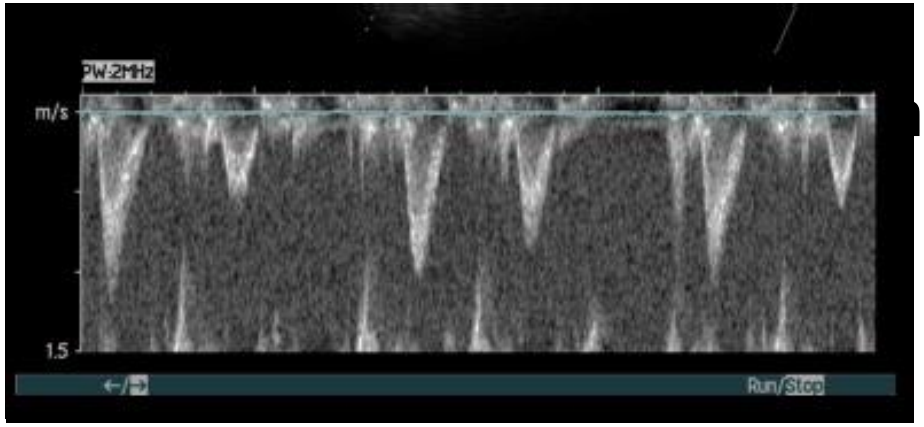
The patient has given her consent to present the photo

Land vs warm water

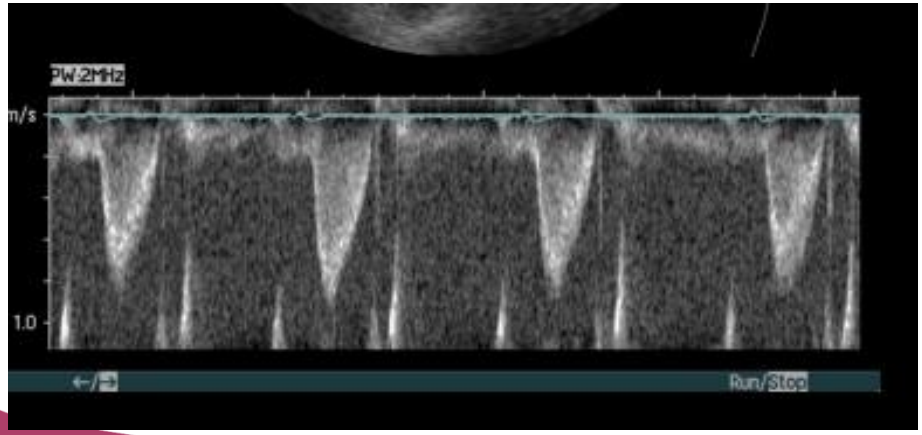


**p<0.01, # p=0.075. Mean±SEM

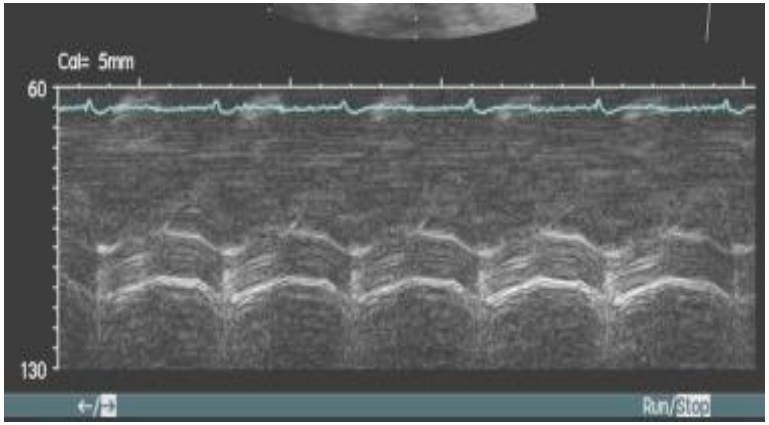
A:Baseline (acute effect)
B:After 8 weeks without exercise (control period)
C:After 8 weeks with exercise



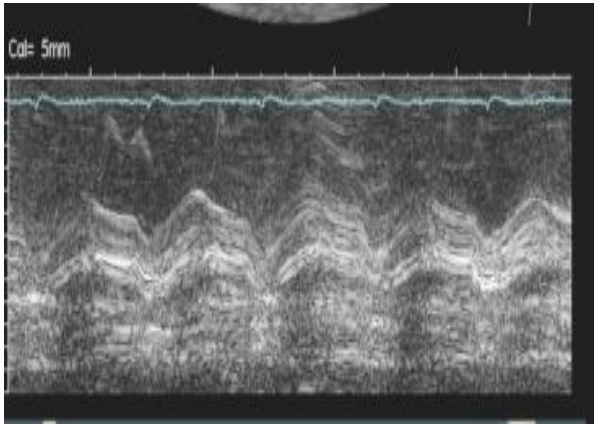
LAND
LVOT VTI 13.6 cm
Stroke volume 57mL
HR 74
CO 4.2L/min



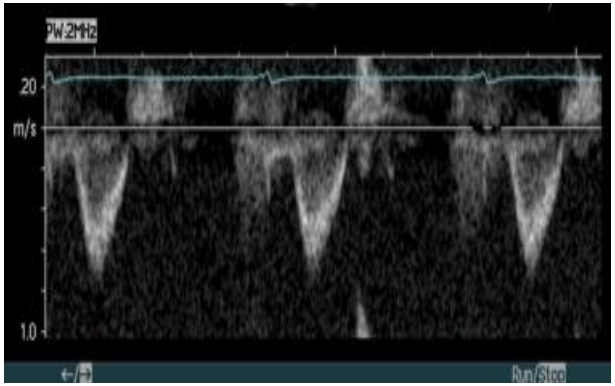
WARM WATER IMMERSION
LVOT VTI 20.9 cm
Stroke volume 88mL
HR 58
CO 5.1 L/min



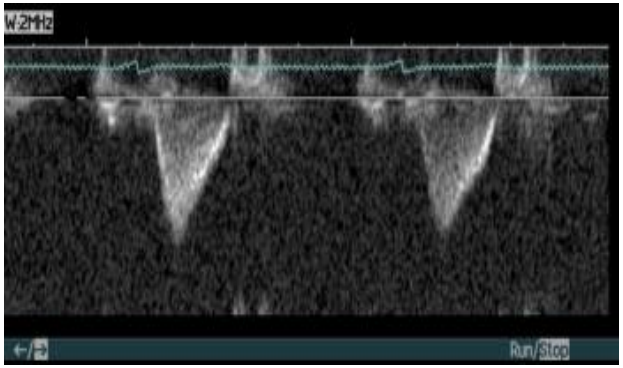
AVP septal land 5.7mm



AVP septal H_2O 10.4mm



LVOT VTI land 10.5cm, HR 70



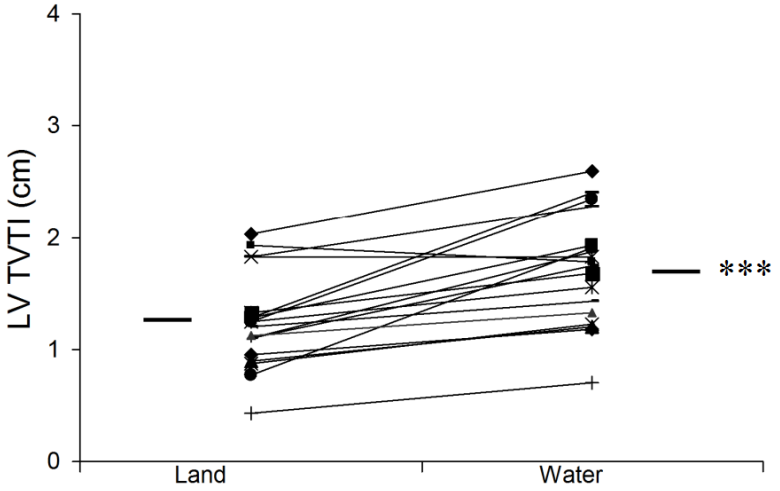
LVOT VTI H2O 17.4cm, HR 60

Table 3: Echocardiograhic data between three sessions on land and during warm water immersion (n = 12)

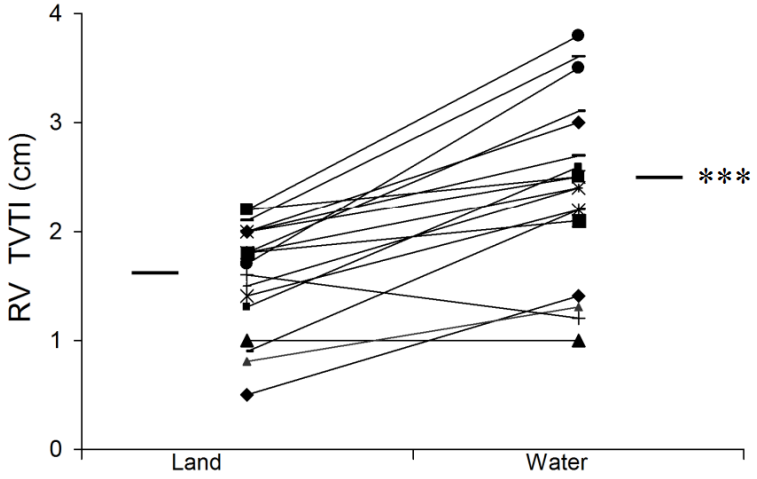
	A	B	C
LV TVTI s (cm) land	1.3. ± 0.4	1.3 ± 0.4	1.3 ± 0.4
LV TVTI s (cm) WWI	2.0 ± 0.3**	2.0 ± 0.3**	1.9 ± 0.4**
LVEDV (mL) land	122 ± 40	114 ± 40	110 ± 41
LVEDV (mL) WWI	151 ± 59*	145 ± 56*	142 ± 41**
RV TVTI s (cm) land	1.8. ± 0.5	1.8 ± 0.5	1.9 ± 0.5
RV TVTI s (cm) WWI	2.8 ± 0.6**	2.9 ± 0.7**	2.8 ± 0.8**
PCWP (mmHg) land	9.5 ± 3.6	9.7 ± 4.0	10.1 ± 4.2
PCWP (mmHg) WWI	12.3 ± 6.0**	11.7 ± 4.7*	12.2 ± 4.4*
SVR (RU) land	30 ± 7	30 ± 5	30 ± 7
SVR (RU) WWI	21 ± 5**	23 ± 5**	21 ± 5**

Data are mean ± SD
*p < 0.05; **p < 0.01, land vs. warm water immersion.
There were no significant differences between the sessions.
A: Baseline, B: After 8 weeks of control period without changes in daily lifestyle,
C: After 8 weeks of hydrotherapy twice weekly.
Bpm, beat per minute; LV, left ventricular; LVEDV, left ventricular enddiastolic volume; PCWP, pulmonary capillary wedge pressure; RU, resistant unit; RV, right ventricle; SV, stroke volume; SVR, systemic vascular resistance; TVTI, tissue velocity time integral; WWI; warm water immersion.

A. Left ventricular tissue velocity time integral



B. Right ventricular tissue velocity time integral.



Journal of Geriatric Cardiology (2012) 9: 408–410

Case Report · Open Access ·

Is hydrotherapy an appropriate form of exercise for elderly patients with biventricular systolic heart failure?

Bente Grüner Sveälv[1], Margareta Scharin Täng[1], Åsa Cider[2]

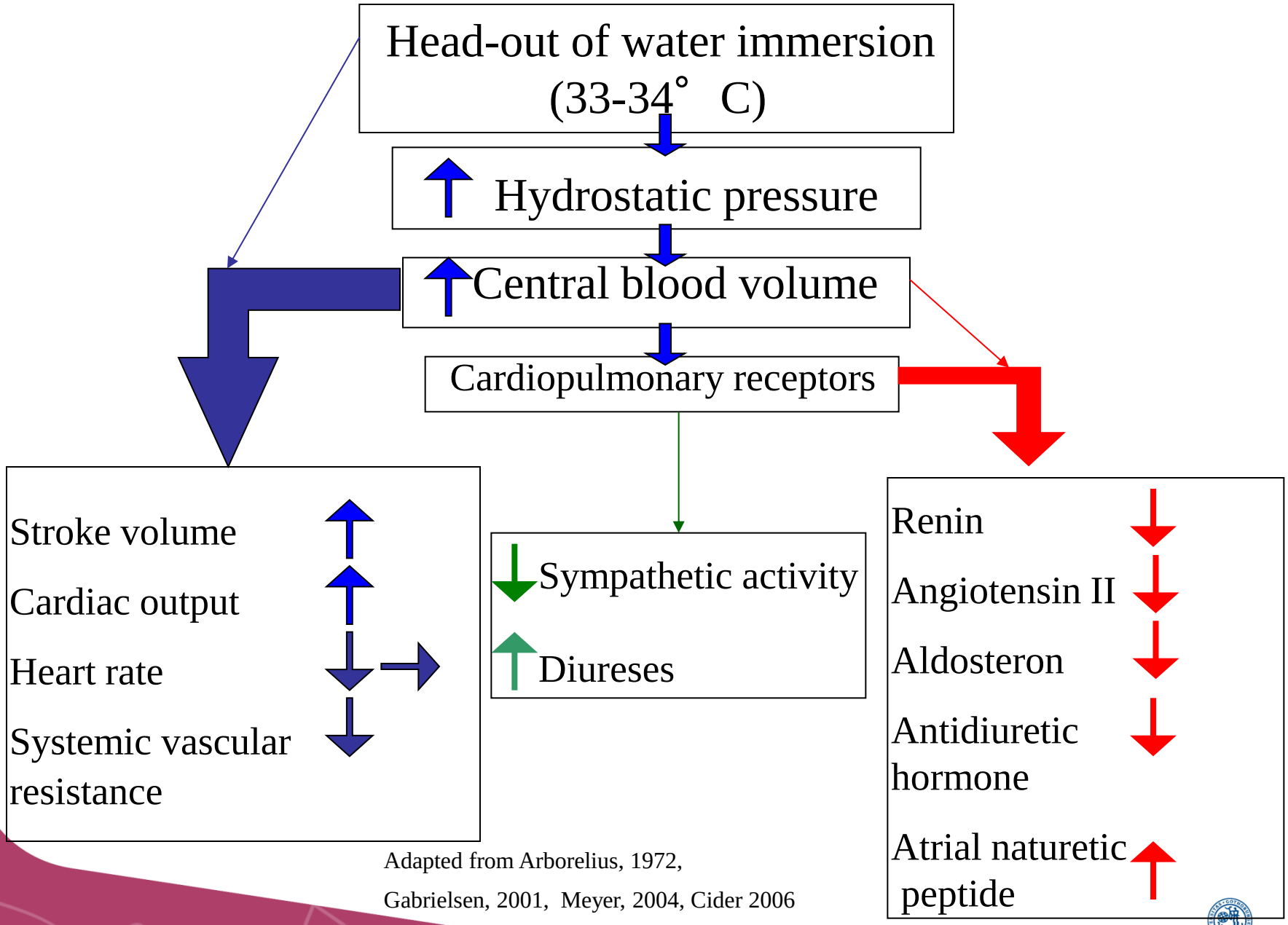
[1]*The Wallenberg Laboratory, Department of Molecular and Clinical Medicine, Institute of Medicine at Sahlgrenska Academy, University of Gothenburg, Bruna Stråket 16, SE-413 45 Gothenburg, Sweden*

[2]*Physiotherapy and Occupational Department, Institute of Neuroscience and Physiology/Physiotherapy at Sahlgrenska Academy, University of Gothenburg, Vita stråket 13, SE-413 45 Gothenburg, Sweden*

Table 1. Demographic data of the patient.

Age (yrs)	82
NYHA class	III
Duration of heart failure (yrs)	14
Weight (kg)	73
Height (cm)	178
Heart rate (beats/min)	93
Systolic blood pressure (mmHg)	98
Diastolic blood pressure (mmHg)	60
LVEF (%)	22
TV pressure gradient (mmHg)	18
Peak oxygen uptake (mL/kg per minute)	9.9
Beta blocker (metoprolol, mg)	50
ACEI (ramipril, mg)	10
Diuretics (furosemid, mg)	40
Statins (pravastatin, mg)	40
Anticoagulants (warfarin, mg)	2.5

ACEI : angiotensin-converting enzyme inhibitors; LVEF: left ventricular ejection fraction; TV: tricuspid valve.



Adapted from Arborelius, 1972,
Gabrielsen, 2001, Meyer, 2004, Cider 2006

International Journal of Cardiology 148 (2011) 199–203

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Hydrotherapy added to endurance training versus endurance training alone in elderly patients with chronic heart failure: A randomized pilot study

Giuseppe Caminiti *, Maurizio Volterrani, Giuseppe Marazzi, Anna Cerrito, Rosalba Massaro, Barbara Sposato, Arianna Arisi, Giuseppe Rosano

Centre for Clinical and Basic Research, Cardiovascular Research Unit, Department of Medical Sciences, IRCCS San Raffaele Roma, via della Pisana 235, 00163, Roma, Italy

Table 1
Baseline features of patients of CT and ET groups.

	CT ($N=11$)	ET ($N=10$)
Age, years	67 ± 6	69 ± 8
Cause of heart failure		
Ischemic heart disease	8	6
Idiopathic dilated cardiomyopathy	3	4
BMI	27.8 ± 2	27.2 ± 3
NYHA II/III	7/4	6/4

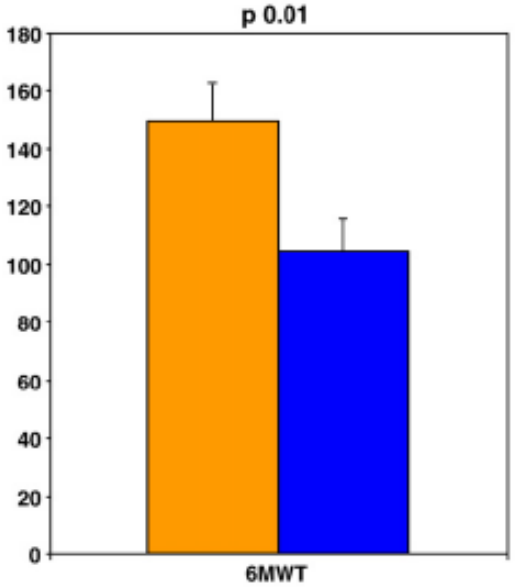


Fig. 1. Delta (baseline vs 24 weeks) of distance walked at 6 MWT in the CT group (light bars) and ET group (dark bars).

Conclusion

- Aquatic exercise was well tolerated by ”all” patients.
- Acute warm water immersion reduce heart rate, which, together with a decrease in afterload, resulted in increases in systolic and diastolic biventricular function.
- Exercise in warm water is an acceptable regime that improve aerobic and muscular function for patients with chronic heart failure.
- However more studies are needed and these should also include investigations of patients that react differently compared to the mean values.

Thank you for your attention !
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