

Exercise with pacemakers & ICDs

Dr. Ahmed Nabil, MD
Lecturer of Cardiology
Ain Shams University



- It is well known that physical activity reduces cardiovascular morbidity and mortality through a wide variety of mechanisms, although it is unclear whether the intensity of physical activity in competitive athletes promotes health benefits beyond those of moderate activities.
- Physical activity also contributes to psychological well-being in those affected by cardiovascular disease

- When first introduced, pacemakers were simply life-saving devices that provided a fixed pacing rate during bradycardic episodes.
- During the last years, significant advances in the field of cardiac pacing have resulted in the introduction of pacemakers capable of varying pacing rates in response to metabolic and physical stimuli.

- The advances in rate-response technology and the increasing rate of pacemaker implantation underscores the need for an understanding of current pacemaker technology and how these devices impact on the principles of exercise prescription for patients with pacemakers

Before a pacemaker-dependent patient starts a cardiac rehabilitation program, an exercise test should be performed for

- Verification of proper pacemaker function, including
 - a) adapted changes in rate
 - b) reliable sensing and pacing, which might change with breathing, changes in posture and with motion
 - c) preservation of AV synchrony
- Evaluation of residual symptoms or development of new, exercise-induced symptomatology
- Programming and optimization of specific parameters that vary as a function of the heart rate (AV delays and adaptable PVARP)
- Find electrophysiologic changes due to exercise (retrograde conduction present during exercise and absent at rest)

Programmable parameters before exercise

- Atrioventricular synchronization during exercise
 - The Maximum Tracking Rate (2:1 block point)
- Specific programming to preserve atrioventricular synchronization during exercise
 - Adaptable atrioventricular delay
 - PVARP → auto
 - Maximum synchronous rate
 - Atrial sensitivity → requires a flawless quality of atrial sensing
- Rate responsive pacing

ATRIOVENTRICULAR SYNCHRONIZATION DURING EXERCISE

- **The Maximum Tracking Rate (2:1 block point)**
- It must be set as high as possible to enable the 1:1 tracking of the sinus P waves over the entire range of rates that might be observed in any given patient.
- The TARP duration (AV delay + PVARP) must, therefore, be shortened during exercise, which can be achieved by programming an automatic shortening of AV delay and PVARP during exercise

- **Adaptable atrioventricular delay (A-V delay)**
- In the healthy heart, the PR interval shortens physiologically during exercise
- The adaptation of the AV delay that can occur when the pacemaker operates in DDDR, DDD, DDIR or VDD modes, simulates physiological response to exercise.

RATE RESPONSIVE PACING

- Some patients suffer from chronotropic insufficiency and inadequate increase in heart rate during physical activity. This inability to increase the heart rate with exercise can be associated with symptoms such as dyspnea, fatigue or limited exercise capacity.

Pacemakers include sensors capable of monitoring the activity level and accelerate the pacing rate accordingly.

- Its aim, in the presence of chronotropic insufficiency, is to ensure an increase in cardiac output that is, as physiologic as possible, and corresponding to the instantaneous metabolic needs imposed by exercise.
- Each device manufacturer offers its particular sensor and programming of the rate responsiveness.

- Monitoring of physical activity by a piezoelectric quartz or by an accelerometer, and minute-ventilation, using the bio-impedance technique.

General Recommendations during Exercise

- **Carry Medical ID at All Times**
- **Always Wear a Heart Monitor**
- Pacemakers typically have a rate cutoff, and getting too close to this upper limit should be avoided.
- Typically, it is advised to maintain at least a 10 bpm margin between exercise heart rate and the cutoff limit. If heart rate accelerates too quickly, patient is advised to tone down his workout and breathe deeply to lower his heart rate to a safe level before resuming exercise.

- A safe workout should always include both a warm up and cool down period.
- Advise patient not to jump right into a run and not to sit down right away after a workout.
- Start and end any run with a light walk.
- If strength exercises are being done, 5-10 light minutes on the exercise bike to cool down after workout is preferred.



- **Avoid Full Contact Sports**
- A pacemaker won't limit from most forms of exercise, but contact sports should be avoided.
- Taking hits or falling can dislodge pacemaker or shift the leads intracardiac.
- Rhythmic activities like walking, running, cycling or swimming are much safer.

AHA/ACC Scientific Statement

**Eligibility and Disqualification Recommendations
for Competitive Athletes With Cardiovascular Abnormalities:
Task Force 9: Arrhythmias and Conduction Defects**
A Scientific Statement From the American Heart Association and
American College of Cardiology

- **Generally, athletes with permanent pacemakers should be cleared for athletic participation if there are no limiting structural heart conditions or symptoms (Class I; Level of Evidence C).**
- **Athletes who are completely pacemaker dependent should not engage in sports in which there is a risk of collision that could result in damage to the pacemaker system (Class I; Level of Evidence C).**

AHA/ACC Scientific Statement

**Eligibility and Disqualification Recommendations
for Competitive Athletes With Cardiovascular Abnormalities:
Task Force 9: Arrhythmias and Conduction Defects**
A Scientific Statement From the American Heart Association and
American College of Cardiology

- **Athletes treated with a pacemaker who are not pacemaker dependent may participate in sports with a risk of collision or trauma if they understand and accept the risk of damage to the pacemaker system and they have no structural heart disease that precludes participation (Class I; Level of Evidence C).**
- **For athletes with permanent pacemakers, protective equipment should be considered for participation in contact sports that have the potential to damage the implanted device (Class I; Level of Evidence C).**

ICDs & Exercise



- The use of implantable cardioverter-defibrillators (ICDs) for primary and secondary prevention of sudden cardiac death (SCD) has increased in the last two decades due to their proven efficacy in treating life-threatening cardiac arrhythmias.
- The two most widely accepted guidelines used for determining the eligibility to participate in competitive sports are from the United States-36th Bethesda conference (BC #36), and Europe-the ESC expert consensus document.
- These documents were published in 2005, and contain recommendations made based on the available scientific data, as well as individual and collective judgment and experience of the panel participants.

- Current international guidelines recommend only moderate, leisure-time physical activity in patients with an ICD, thus making athletes with ICDs ineligible for most competitive sports except those classified as so-called **class IA** sports (billiards, bowling, cricket, curling, golf, and riflery)



- For athletes with ICDs, all moderate and high intensity sports are contraindicated and only **class IA** sports are permitted
- Athletes with ICDs/pacemakers should not engage in competitive sports with a danger of bodily collision/physical contact because such trauma may damage the ICD/pacemaker system.

- Despite these very restrictive guidelines, many athletes with ICDs and normal left ventricular function have a strong passion to continue their participation in organized, and often high intensity sports, thereby posing a medical and ethical dilemma for the treating physician.

Potential Risks

- Intense physical exertion increases the risk of SCD by almost 2.5 times in patients with underlying arrhythmogenic cardiac disease.
- ICD efficacy in terminating a potentially lethal arrhythmia under the extreme conditions of competitive sports, with the associated metabolic and autonomic changes, as well as possible myocardial ischemia, is unknown.
- Sports with physical contact may result in damage to the ICD, thereby preventing its normal function.

Potential Risks

- In athletes with left hand dominance, extreme arm movements can cause ICD lead fracture due to costo-clavicular crush.
- A variety of conditions that occur during exercise like sinus tachycardia, SVT with rapid conduction, T wave over sensing during exercise, or noise due to lead failure may lead to an increased frequency of inappropriate shocks in athletes with ICDs.
- The transient loss of consciousness from exercise-induced arrhythmias or inappropriate/appropriate ICD shocks may pose a serious risk of severe injury or death to the athlete as well as the spectators.

Potential Risks

- Inappropriate shocks can have a negative psychological impact on the athlete.
- Catecholamines released during exercise may undermine the salutary effect of antiarrhythmic drugs and also exacerbate underlying conditions and may possibly lead to life threatening VT storm and repeated shocks from the device.

Safety of Sports for Athletes With Implantable Cardioverter-Defibrillators

Results of a Prospective, Multinational Registry

Rachel Lampert, MD; Brian Olshansky, MD; Hein Heidbuchel, MD; Christine Lawless, MD;
Elizabeth Saarel, MD; Michael Ackerman, MD; Hugh Calkins, MD; N.A. Mark Estes, MD;
Mark S. Link, MD; Barry J. Maron, MD; Frank Marcus, MD; Melvin Scheinman, MD;
Bruce L. Wilkoff, MD; Douglas P. Zipes, MD; Charles L. Berul, MD; Alan Cheng, MD; Ian Law, MD;
Michele Loomis, APRN; Cheryl Barth, BS; Cynthia Brandt, MD; James Dziura, PhD;
Fangyong Li, MS; David Cannom, MD

- Contrary to the theoretical concerns and expectations by some for increased risk of danger to the host and damage to the device, the results from a multi-national, prospective, observational registry of **372** athletes with ICDs participating in organized sports activities showed no deaths or shock related injuries or generator malfunctions. (follow up of 2.2 years)

Circulation. 2013;127:2021–2030.

Safety of Sports for Athletes With Implantable Cardioverter-Defibrillators

Results of a Prospective, Multinational Registry

Rachel Lampert, MD; Brian Olshansky, MD; Hein Heidbuchel, MD; Christine Lawless, MD; Elizabeth Saarel, MD; Michael Ackerman, MD; Hugh Calkins, MD; N.A. Mark Estes, MD; Mark S. Link, MD; Barry J. Maron, MD; Frank Marcus, MD; Melvin Scheinman, MD; Bruce L. Wilkoff, MD; Douglas P. Zipes, MD; Charles I. Berul, MD; Alan Cheng, MD; Ian Law, MD; Michele Loomis, APRN; Cheryl Barth, BS; Cynthia Brandt, MD; James Dziura, PhD; Fangyong Li, MS; David Cannom, MD

- In addition, the incidence of lead malfunction was not higher in athletes with ICDs compared to published rates in non-athletes.
- Many athletes with ICDs can engage in vigorous competitive sports without physical injury or failure to terminate the arrhythmia despite the occurrence of both inappropriate and appropriate shocks in a small number.

Circulation. 2013;127:2021–2030.


Review

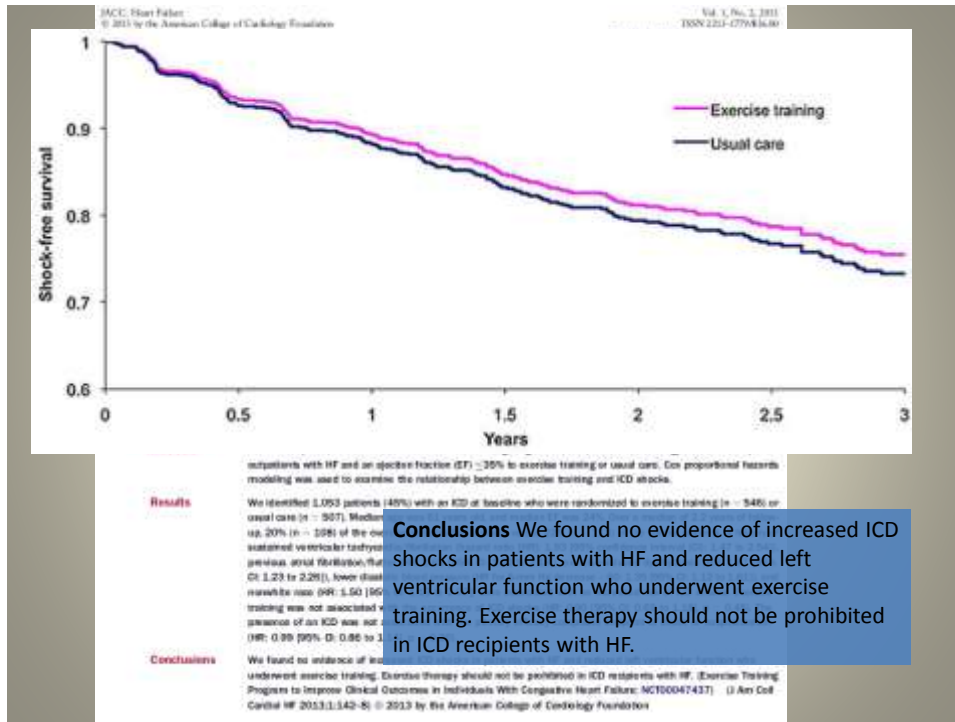
Exercise training and cardiac rehabilitation in patients with implantable cardioverter defibrillators: a review of current literature focusing on safety, effects of exercise training, and the psychological impact of programme participation

Kjeril Isaksson^{1,2}, Ingvild Margareta Morken^{1,2}, Peter Scott

Conclusion: Based on the current literature, ET in patients with an ICD seems to be safe and is not associated with increased risk of shocks. ET improves aerobic capacity in ICD patients, while effects on anxiety, depression and quality of life are still under debate.

ABSTRACT
Background: Indications for implantable cardioverter defibrillators (ICDs) have been widened considerably during the last decade due to the well-documented effect in the heart failure population. Exercise training (ET) has a I A recommendation in heart failure. However, data on safety and efficacy of ET in patients with ICDs is sparse. ICD shocks are associated with reduced quality of life and increased mortality. Whether ET may have a beneficial effect in heart failure patients with an ICD is not well documented.
Methods: This review is based on a systematic search in the Pub Med database using the terms 'exercise training', 'implantable cardioverter defibrillator', and 'cardiac rehabilitation'.
Results: Nine studies were identified comprising 1889 patients. The average duration of exercise-based cardiac rehabilitation (CR) was 9.6 weeks. Ten ICD therapies (seven shocks) were reported in the 834 patients with ICD during ET. Between exercise sessions and during follow up, 100 events were recorded including 166 shocks. Three studies (2 randomized) showed that the control group representing sedentary patients were more prone to ICD discharge than patients undergoing CR/ET. In all studies the ICD patients improved their aerobic fitness following ET. Few studies report data on the effect of ET on anxiety and depression.
Conclusion: Based on the current literature, ET in patients with an ICD seems to be safe and is not associated with increased risk of shocks. ET improves aerobic capacity in ICD patients, while effects on anxiety, depression and quality of life are still under debate.

European Journal of Preventive Cardiology
 Volume 19(10) 2014
 © The European Society of Cardiology 2014
 Reprints and permissions:
 sagepub.com/journalsPermissions.nav
 DOI: 10.1177/204798811426424
 epc.sagepub.com




ICD programming: can we reduce inappropriate shocks?

- Programming additional differentiating parameters to improve the device's specificity in picking up ventricular arrhythmias as:
 - sudden onset
 - instability
 - wide-complex morphology
- but → decreased sensitivity

so may be reserved as a second line option in patients with a high frequency of inappropriate shocks

ICD programming: can we reduce inappropriate shocks?

- At least one attempt of anti-tachycardia pacing (ATP) to stop arrhythmias in the ventricular fibrillation (VF) zone while the device is charging
- Increasing the VF zone threshold to >210 to 220 beats per minute
- Extending the detection time at these rates.

ICD programming: can we reduce inappropriate shocks?

- Using long-term ECG recordings to calculate rate responsiveness during training and availing dual sensors (minute ventilation + activity) to help differentiate physical activities.

Is there any role for S-ICD ???

- There has been a considerable interest in the newest generation subcutaneous ICD (S-ICD) systems.
- Studies on S-ICDs indicate a high efficacy but relatively low specificity and this could translate to a significant increase in the number of inappropriate shocks in these individuals.
- Another limitation to S-ICDs would be their inability to pace and therefore these cannot be used in athletes with potentially pace-terminable arrhythmias.

AHA/ACC Scientific Statement

**Eligibility and Disqualification Recommendations
for Competitive Athletes With Cardiovascular Abnormalities:
Task Force 9: Arrhythmias and Conduction Defects**
A Scientific Statement From the American Heart Association and
American College of Cardiology

- **Participation in sports classified as IA for athletes with an ICD is reasonable if they are free of episodes of ventricular flutter or ventricular fibrillation requiring device therapy for 3 months (Class IIa; Level of Evidence C).**

AHA/ACC Scientific Statement

**Eligibility and Disqualification Recommendations
for Competitive Athletes With Cardiovascular Abnormalities:
Task Force 9: Arrhythmias and Conduction Defects**
A Scientific Statement From the American Heart Association and
American College of Cardiology

- **Participation in sports with higher peak static and dynamic components than class IA may be considered if the athlete is free of episodes of ventricular flutter or ventricular fibrillation requiring device therapy for 3 months.**
- **The decision regarding athletic participation should be made with consideration of, and counseling of, the athlete regarding the higher likelihood of appropriate and inappropriate shocks and the potential for device-related trauma in high-impact sports (*Class IIb; Level of Evidence C*).**

Take Home Message

- Athletes with pacemakers & ICDs are faced with many physical and psychological challenges posed by their passion to pursue exercise and training despite the restrictive recommendations based on expert opinion, rather than objective evidence.
- Proper programming maneuvers along with recent advances in device technology & exercise algorithms can give us more room for better exercise lifestyle for many patients.

Take Home Message

- Current international guidelines for athletes with underlying heart disease recommend only moderate, leisure-time physical activity in patients with an ICD. Thus, making athletes with ICDs ineligible for most competitive sports.

Take Home Message

- The efficacy of ICDs in terminating a potentially lethal arrhythmia under the extreme conditions of competitive sports associated with metabolic and autonomic changes like catecholamine surges, dehydration, electrolyte derangements, and myocardial ischemia is unknown.
- However, no athletic deaths have occurred in nearly 400 athletes with ICDs in over three years of follow-up (ICD Safety Registry).

Take Home Message

- There are various data from registry based studies and surveys demonstrating the relative safety of athletes engaging in vigorous physical activity or organized sporting activities.
- Inappropriate shocks from the ICDs and potential damage to the integrity of the ICD system during intense physical activity remains as an area of concern for athletes and clinicians.

THANK YOU