Pacientes com DCEI: o que eles podem e não podem fazer?

DR LUIZ ANTONIO BATISTA DE SÁ
Importância

Meio ambiente

Procedimentos/Equipamentos médicos
10kHz – 1GHz
Fig. 1. Rate of misperceptions about the safety of daily activities among patient with pacemakers.
Como afeta?

- CDI: terapias inapropriadas
- Inibição
- Fc fixa
- Irregularidade
The rhythm was interpreted as ventricular tachycardia and the patient given intravenous amiodarone. This resulted in hypotension, whereupon he was given a DC shock while still conscious. His tachycardia persisted and he received further intravenous amiodarone, followed by magnesium sulphate, sotalol, and finally 11 further DC shocks this time under appropriate anesthesia. Following this, the blood pressure was unrecordable and amiodarone and adrenaline infusions were commenced. The patient was transferred to a tertiary hospital, hypotensive, unconscious and intubated, but now with the monitor removed in a stable paced rhythm. The 12-lead ECG, off the monitor is made...
Electromagnetic interference in implantable cardioverter defibrillators: present but rare

Gesa von Olshausen¹ · Ina-Christine Rondak² · Carsten Lennerz³ ·
Verena Semmler³ · Christian Grebmer³ · Tilko Reents³ · Sonia Ammar-Busch³ ·
Alessandra Buiatti³ · Felix Bourier³ · Isabel Deisenhofer³ · Christof Kolb³

✓ 0,62% por paciente por ano
✓ 0,04% por paciente por ano
<table>
<thead>
<tr>
<th>Factors influencing EMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controllable factors</td>
</tr>
<tr>
<td>1. Programmed parameters</td>
</tr>
<tr>
<td>Sensitivity settings</td>
</tr>
<tr>
<td>Sensing polarity</td>
</tr>
<tr>
<td>Pacing mode</td>
</tr>
<tr>
<td>Refractory periods</td>
</tr>
<tr>
<td>Blanking periods</td>
</tr>
<tr>
<td>Committed crosstalk detection window</td>
</tr>
<tr>
<td>Sensor settings</td>
</tr>
<tr>
<td>2. Distance and position of the patient</td>
</tr>
<tr>
<td>3. Duration of the exposure</td>
</tr>
<tr>
<td>Less Controllable Factors</td>
</tr>
<tr>
<td>1. Intensity of the EMI field</td>
</tr>
<tr>
<td>2. Nonprogrammable device characteristics and settings</td>
</tr>
<tr>
<td>3. Frequency of the signals</td>
</tr>
<tr>
<td>4. Zener diode</td>
</tr>
<tr>
<td>5. Lead configuration</td>
</tr>
<tr>
<td>6. Access codes, parity links, and reed switch closure</td>
</tr>
<tr>
<td>Item</td>
</tr>
<tr>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Bingo Wand</td>
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<tr>
<td>Casino slot machines</td>
</tr>
<tr>
<td>Electric Guitars</td>
</tr>
<tr>
<td>Electric Speakers</td>
</tr>
<tr>
<td>Electric Toy Trains</td>
</tr>
<tr>
<td>Electric Golf Cart</td>
</tr>
<tr>
<td>Laser Tag</td>
</tr>
<tr>
<td>Radio Controlled Model cars, Airplanes, Boats etc.</td>
</tr>
<tr>
<td>Rifle / Shot Guns</td>
</tr>
<tr>
<td>Tatoo Machine</td>
</tr>
</tbody>
</table>

Electromagnetic Interference of Pacemakers
• Geral
  ❖ Não manipular equipamentos mal aterrados
  ❖ Evitar detectores de metais (bancos, aeroportos)
  ❖ Evitar soldas elétricas e alarmes anti-roubo
  ❖ Evitar imãs: colchões, lixadeiras e furadeiras portáteis
  ❖ MP3 (ipod) (fones de ouvido) - 3 cm de distância
  ❖ Vibrações causadas por aparelhos eletrodomésticos como barbeadores elétricos, escovas dentais elétricas, aparadores de grama, perfuradores elétricos e vibradores para massagem, podem influir no circuito de sensibilidade dos marca-passos dotados de sensores para movimento, como nos acelerômetros e principalmente nos cristais piezoeletricos.
  ❖ Não deixar telefone celular sobre o marca-passo, utilizando-o do lado oposto – 15 cm
Figure 1. ECG showing the effect of inappropriate triggering of a dual-chamber pacemaker in a patient while the patient was standing by an EAS device in a department store. The patient experienced a brief sensation of palpitation as the pacemaker tracked noise sensed on the atrial lead. The ventricular paced rate increased to the upper rate limit and was slightly irregular. The top tracing is the surface ECG, the middle tracing is the intracardiac atrial electrogram, and the bottom tracing is the pacemaker marker channel. AP, atrial paced beat; AR, atrial sensed beat during a refractory period; AS, atrial sensed beat; VP, ventricular pacing.
SUMMARY
Electronic Interference (EMI) is the disruption of normal operation of an electronic device when it is in the vicinity of an electromagnetic field created by another electronic device.

Polar heart rate monitors are commonly used to monitor heart rate during normal daily activity or during exercise activities such as running and cycling. This article provides a brief overview of the Polar heart rate monitor components and describes the potential interactions between the monitor and Boston Scientific's St. Jude Medical implantable pacemakers and defibrillators. It also provides suggestions to minimize potential interference.

Effects of Heart Rate Monitors on St. Jude Medical Implantable Cardiac Rhythm Devices

Background
A heart rate monitor consists of a transmitter and a wrist receiver. The transmitter is strapped around the patient's chest and detects and sends the heart rate to the wrist receiver, which displays the heart rate for the user. St. Jude Medical performed informal testing on a heart rate monitor from a heart rate monitor manufacturer (Polar) to determine if transmission of information between the components of the heart rate monitor would affect the ability of St. Jude Medical pacemakers and implantable cardioverter defibrillators (ICDs) to sense intrinsic activity, pace in the absence of intrinsic activity, and appropriately detect and diagnose arrhythmias.

Potential Effects
During testing, the Polar A1 heart rate monitor did not cause any damage or reprogramming to the test pacemaker or ICD. Under normal operating conditions, heart rate monitors should not cause interference with the performance of St. Jude Medical pacemakers and ICDs. A search of literature showed no reports of any interference.

Recommendations
Although we cannot guarantee the effect of any heart rate monitor on a pacemaker or ICD, we do not anticipate any interference.
What are the procedures if I have an internal or external medical device, such as a pacemaker or metal implant?

Advanced imaging technology can facilitate your screening and reduces the likelihood of a pat-down. Inform the TSA officer that you have an artificial knee, hip, other metal implant or a pacemaker, defibrillator or other internal medical device. You should not be screened by a walk-through metal detector if you have an internal medical device such as a pacemaker. Consult with your physician prior to flying.

If you choose to not be screened through the advanced imaging technology or you alarm the walk-through metal detector, you will undergo a pat-down screening.
Are Hand-Held Metal Detectors Used in Airports Safe for People With Pacemakers and Defibrillators?

What is the problem and what is known about it so far?
Pacemakers and implantable defibrillators are 2 common examples of cardiac rhythm devices. Cardiac rhythm devices use small bursts of electricity to help people’s hearts beat regularly. In rare cases, nearby electronic devices, such as cell phones and MP3 players, can cause cardiac rhythm devices to malfunction.

INTERFERENCE WITH CARDIAC PACEMAKERS BY CELLULAR TELEPHONES

DAVID L. HAYES, M.D., PAUL J. WANG, M.D., DWIGHT W. REYNOLDS, M.D., N.A. MARK ESTES III, M.D., JOHN L. GRIFFITH, PH.D., REBECCA A. STEFFENS, M.P.H., GEORGE L. CARLO, PH.D., GRETCHEN K. FINDLAY, B.S., AND CLAUDINE M. JOHNSON, M.A.
But based on current research, cell phones would not seem to pose a significant health problem for the vast majority of pacemaker wearers. Still, people with pacemakers may want to take some simple precautions to be sure that their cell phones don’t cause a problem.

- Hold the phone to the ear opposite the side of the body where the pacemaker is implanted to add some extra distance between the pacemaker and the phone
- Avoid placing a turned-on phone next to the pacemaker implant (e.g. don’t carry the phone in a shirt or jacket pocket directly over the pacemaker)
Não se preocupe!!

- RX
- ECG
- EEG
- USG
- Tomografia (angiotomo)
- Mamografia
- Densitometria
- PET SCAN
Cuidados

• Cardioversão - desfibrilação
• Eletrocautério
• Radiação ionizante
• Ressonância nuclear magnética
• Litotripsia
• Eletromiografia
Cardioversão

• Pode causar
  
  ➢ Dano permanente ao gerador
  
  ➢ Dano tecido cardíaco em contato com eletrodo

• Cuidados:
  
  • Evitar sobre o Gerador
  
  • Eixo perpendicular ao eletrodo
  
  • Reavaliação após o procedimento
Electrical cardioversion of patients with implanted pacemaker or cardioverter defibrillator (CIED) related complications of cardioversion

Complications associated with ECV of PM/ICD patients were reported to have occurred in 11/1809 pts (0.6%, range 0–4%). In 9 patients, a temporary elevation of the pacing threshold was observed, and in 2 patients, a transient exit block was reported. All complications were deemed not life threatening by the reporting centers.
Eletrocautério

- **Tipos**
  - **Unipolar**
    - Corrente elétrica entre região cirúrgica e placa de aterramento
    - Mais potente – corte
    - Aterramento distante do gerador
  - **Bipolar**
    - Corrente elétrica circunscrita região cirúrgica e eletrocautério
    - Menos potente – mais delicado (coagulação)

- **Riscos**
  - Inibição
  - Reversão assíncrona
  - Aumento da Fc ventricular (MP DDD)
  - Aumento do limiar
  - Deflagração de terapias inapropriadas (CDI)

Menon D.K et al. British Journal of Anaesthesia vol. 88 2002
Reversão Assíncrona
Orientações

• Monitorização Oximétrica e ECG
• Evitar o uso do eletrocautério a menos de 15 cm do gerador de pulsos
• Utilizar a menor energia possível para a eletrocirurgia
• Dispor do ou contar com a presença do programador do marca-passo
• Utilizar o eletrocautério de forma intermitente, em pulsos de curta duração
• Na ausência de competição, programar o marca-passo para um modo assincrônico. Na impossibilidade de programação recomenda-se a colocação de um imã sobre o gerador de pulso.
• No caso de CDI, o imã desabilita terapias
• Utilizar o bisturi bipolar que reduz de forma significativa a área de interferência
• Caso seja necessário o uso de bisturi unipolar, posicionar a placa do eletrodo indiferente de forma que a corrente elétrica do cautério não atravesse a região entre o gerador de pulsos e a ponta do cabo-eletrodo
• Posicionar a placa do eletrodo indiferente o mais próximo possível da área a ser operada de forma a reduzir a região de interferência, observando a recomendação anterior
• Logo após o procedimento, reavaliar e reprogramar o gerador, fazendo a avaliação dos limiares de comando e de sensibilidade e a verificação das condições da bateria
• Radiação Ionizante (radioterapia)

✓ Perda de comando
✓ Oversensing
✓ Aumento da FC
✓ Terapia inapropriada
• **Ressonância Nuclear Magnética**
  • Inibição de saída do marca-passo
  • Aquecimento
  • Vibração
  • Estimulação assincrônica
  • Indução de fibrilação atrial
  • Indução de fibrilação ventricular
  • Funcionamento inadequado do modo *switch*
  • Estimulação atrial rápida
  • Estimulação ventricular rápida
  • Alteração da programação com potencial dano ao circuito do marca-passo ou deslocamento do sistema.
  • Aquecimento dos eletrodos que deve ser considerado quando expomos pacientes a RM, sendo este o fator causal do desconforto precordial durante a realização do exame e da mudança no limiar de comando do MP.

**WARNING:** Certain implants, devices, or objects may be hazardous to you and/or may interfere with the MR procedure (i.e., MRI, MR angiography, functional MRI, MR spectroscopy). Do not enter the MR system room or MR environment if you have any question or concern regarding an implant, device, or object. Consult the MRI Technologist or Radiologist BEFORE entering the MR system room. The MR system magnet is ALWAYS on.
A physician, nurse practitioner, or physician assistant with cardiac device expertise and training in advanced cardiac life support was in attendance. Blood pressure, pulse oximetry, and cardiac rhythm were monitored with an MRI-compatible system from the time of device reprogramming until restoration of baseline values.

CONCLUSIONS

In this study, device or lead failure did not occur in any patient with a non-MRI-conditional pacemaker or ICD who underwent clinically indicated nonthoracic MRI at 1.5 tesla, was appropriately screened, and had the device reprogrammed in accordance with the prespecified protocol. (Funded by St. Jude Medical and others; MagnaSafe ClinicalTrials.gov number, NCT00907361.)
# 2017 HRS expert consensus statement on magnetic resonance imaging and radiation exposure in patients with cardiovascular implantable electronic devices

Julia H. Indik, MD, PhD, FHRS, FACC, FAHA (Chair), J. Rod Gimbel, MD (Vice-Chair), Haruhiko Abe, MD, Ricardo Alkmim-Teixeira, MD, PhD,

<table>
<thead>
<tr>
<th>COR</th>
<th>LOE</th>
<th>Recommendations</th>
<th>Reference</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>A</td>
<td>MR conditional devices should be considered MR conditional only when the product labeling is adhered to, which includes programming the appropriate “MR mode” and scanning with the prerequisites specified for the device.</td>
<td>32–36,39,42</td>
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Win-Kuang Shen, MD, FHRS, Jerold S. Shinbane, MD, FHRS,
Wee Siong Teo, MBBS (NUS), FRCP (Edin), FHRS,
William Uribe, MD, FHRS,

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<th>Recommendations</th>
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<tbody>
<tr>
<td>IIa</td>
<td>B-NR</td>
<td>It is reasonable for patients with an MR nonconditional CIED system to undergo MR imaging if there are no fractured, epicardial, or abandoned leads; the MRI is the best test for the condition; and there is an institutional protocol and a designated responsible MR physician and CIED physician.</td>
<td>9,13,49,55,56,58–63,65, 67–69,72,77–79</td>
</tr>
<tr>
<td>Is it safe to use....?</td>
<td>Education Group</td>
<td>Group without education</td>
<td>Within education group</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------</td>
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<tr>
<td></td>
<td>Before education (n:28)</td>
<td>After education (n:28)</td>
<td></td>
</tr>
<tr>
<td>hair dryers, electrical shavers, electrical knife</td>
<td>4 (14.3)</td>
<td>12 (42.9)</td>
<td>23 (24.7)</td>
</tr>
<tr>
<td>TV, Radio, remote controls</td>
<td>3 (10.7)</td>
<td>22 (78.6)</td>
<td>49 (52.7)</td>
</tr>
<tr>
<td>Computers, CD/DVD or music players</td>
<td>3 (10.7)</td>
<td>17 (60.7)</td>
<td>44 (47.3)</td>
</tr>
<tr>
<td>electrical lamps, switch buttons</td>
<td>6 (21.4)</td>
<td>23 (82.1)</td>
<td>46 (49.5)</td>
</tr>
<tr>
<td>microwave ovens</td>
<td>1 (3.6)</td>
<td>11 (39.3)</td>
<td>18 (19.4)</td>
</tr>
<tr>
<td>magnetic pads, pillows, mattress</td>
<td>3 (10.7)</td>
<td>12 (42.9)</td>
<td>42 (45.2)</td>
</tr>
<tr>
<td>electrical muscles stimulators (such as ab stimulator)</td>
<td>6 (21.4)</td>
<td>14 (50)</td>
<td>41 (44.1)</td>
</tr>
<tr>
<td>treadmills or electrical powered bicycles</td>
<td>2 (7.1)</td>
<td>10 (35.7)</td>
<td>21 (22.6)</td>
</tr>
<tr>
<td>cellular phones</td>
<td>6 (21.4)</td>
<td>16 (57.1)</td>
<td>28 (30.1)</td>
</tr>
<tr>
<td>passing through security gates in airports</td>
<td>28 (100)</td>
<td>2 (7.1)</td>
<td>12 (12.9)</td>
</tr>
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Rehabilitation Research and Practice
Volume 2018, Article ID 5689353
https://doi.org/10.1155/2018/5689353
Messagens finais

Infinitos produtos

Interferência com DCEI com algum produto pode acontecer (relato de caso)

Inúmeras variáveis

MAS DEFINITIVAMENTE: INTERFERÊNCIA CLINICAMENTE RELEVANTE É RARO!!!
Obrigado!