

Kardiovaskularni implantabilni elektronički uređaji i elektromagnetska interferencija – tema koja je još uvijek aktualna

Cardiovascular Implantable Electronic Devices and Electromagnetic Interference – Still a Hot Issue

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RECEIVED: August 2, 2015
ACCEPTED: August 5, 2015



SAŽETAK: U našem svakodnevnom životu postalo je gotovo nemoguće ne biti u interakciji, aktivno ili pasivno, s različitim uređajima koji su izvori elektromagnetskih polja i kao takvi potencijalni uzroci elektromagnetske interferencije (EMI). Bolesnici s ugrađenim kardiovaskularnim implantabilnim uređajima (CIED) za liječenje aritmija čine specifičnu rizičnu skupinu na koju ovakvi signali mogu štetno utjecati. Valja imati na umu da je opseg ovoga problema (EMI u bolesnika s CIED-om) relativno malen – ali značajan; a kada se dogodi, u većini slučajeva, prolazne je prirode i lako se može izbjeći. No, ističe se važnost detaljnog razgovora s bolesnikom koji ima CIED, imajući na umu njegove specifične situacije i potrebe. Liječnici bi trebali biti svjesni i upoznati s najčešćim interakcijama EMI-ja i CIED-a.

SUMMARY: In our daily life it has become almost impossible not to interact, either actively or passively, with various devices that are sources of electromagnetic fields and thereby a potential cause of electromagnetic interference (EMI). Patients with cardiovascular implantable electronic devices (CIED) for treatment of arrhythmias represent a specific risk group that can be adversely affected by these signals. The scope of this problem (EMI in CIED recipients) is relatively small – but relevant, and when issues occur, in most cases they are of a transitory nature and can easily be avoided. However, it is of utmost importance to discuss the issue with patients that have a CIED, bearing in mind their specific situations and needs. Physicians should be aware of and familiarized with the most common interactions between EMI and CIED.

KLJUČNE RIJEČI: kardiovaskularni implantabilni elektronički uređaj, elektrostimulator, implantabilni kardioverter defibrilator, elektromagnetska interferencija.

KEYWORDS: cardiovascular implantable electronic device, pacemaker, implantable cardioverter defibrillator, electromagnetic interference.

CITATION: *Cardiol Croat.* 2015;10(7-8):176–178. | DOI: <http://dx.doi.org/10.15836/ccar.2015.176>

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Živimo u svijetu u kojemu je u našem svakodnevnom životu postalo gotovo nemoguće ne biti u interakciji, aktivno ili pasivno, s različitim uređajima koji su izvori elektromagnetskih polja i kao takvi potencijalni uzroci elektromagnetske interferencije (EMI). Iako se čini da to ne uzrokuje probleme u većine ljudi, postoje različite zabrinutosti za specifične rizične skupine na koje ovakvi signali mogu štetno utjecati.

Jedna od takvih skupina jesu bolesnici s kardiovaskularnim implantabilnim elektroničkim uređajima (CIED) za liječenje aritmija poput elektrostimulatora (PM) i implantabilnih kardiover-

We live in a world where in our daily life it has become almost impossible not to interact, either actively or passively, with various devices that are sources of electromagnetic fields and thereby a potential cause of electromagnetic interference (EMI). While this does not seem to cause problems for most people, there are various concerns for specific risk groups that can be affected adversely by these signals.

One of such groups is patients with cardiovascular implantable electronic devices (CIED) for treatment of arrhythmias as pacemakers (PM) and implantable cardioverter defibrilla-

terskih defibrilatora (ICD). Nadalje, spomenuti uređaji postaju sve složeniji što se tiče njihovih funkcija i broja komponenti koje je potrebno ugraditi, što je vidljivo iz sve većega broja ugrađenih uređaja za srčanu resinkronizacijsku terapiju – elektrostimulatora (CRT-P) i implantabilnih kardioverterskih defibrilatora (CRT-D). Primjera radi, prema zadnjim dostupnim podacima koje je objavila organizacija EUCOMED iz 2014. godine, u 2013. god. samo u Europi bilo je ukupno 1260 bolesnika na milijun stanovnika kojima je ugrađen takav uređaj (PM, ICD, CRT-P, CRT-D).¹ Uz taj broj, moramo imati na umu i to da su brojnim bolesnicima takvi uređaji ugrađeni već prije i da godinama žive s njima.

U našem svakodnevnom radu bolesnici nas često pitaju o sveprisutnim uređajima koji mogu biti znatan izvor elektromagnetskih signala te bismo ih kao takve trebali izbjegavati. Specifične zabrinutosti koje navode naši bolesnici vezane su za korištenje uređajima za osobnu uporabu, kućanskim aparatima, uredskim aparatima, aparatima u trgovinama, uređajima za zabavu, putovanja i okoliš, stomatološke i medicinske pretrage i postupke. Nažalost, profesionalna znanstvena društva još uvijek nemaju adekvatne smjernice koje se bave ovom temom.

Nastavno na zabrinutosti bolesnika s ugrađenim CIED-om, pokazalo se da EMI može štetno utjecati na funkciju uređaja za liječenje poremećaja srčanog ritma, uzrokujući pri tome ili privremenu (EMI izvori iz okoliša, koji uzrokuju prolazne i reverzibilne poremećaje rada) ili pokatkad čak i trajnu malfunkciju sustava za elektrostimulaciju (rizik je prisutan, iako niskoga stupnja, s izvorima EMI-ja u medicinskom okruženju, poput snimanja magnetnom rezonancijom). U najgorim slučajevima to može potencijalno dovesti do događaja sa smrtnim ishodom (npr. EMI može uzrokovati „oversensing“ u elektrostimulatoru u bolesnika s asistolijom, što može uzrokovati inhibiciju elektrostimulacije ili neadekvatnu isporuku šoka kod ICD ili CRT-D uređaja zbog toga što CIED [krivo] smatra da je EMI životno ugrožavajuća ventrikulska tahiaritmija – pri čemu će obje situacije, barem u teoriji, rezultirati pojavom sinkope i/ili smrti).

U literaturi su do sada objavljeni podatci koji pokazuju utjecaj EMI-ja na CIED iz različitih izvora, poput mobilnih telefona, uređaja za sprječavanje krađe, uređaja za daljinsko upravljanje, nepropisno spojenih/uzemljenih uređaja koji dolaze u kontakt s tijelom, uređaja za reprodukciju MP3 datoteka, indukcijskih pećnica te mnogih drugih uređaja.²⁻⁷ Nadalje, sve veći globalni naponi oko pojačanja sigurnosnih pregleda u proteklom su desetljeću također skrenuli pozornost na uporabu detektora metala (koji stvaraju magnetsko polje koje može utjecati na funkciju CIED-a); danas se upotrebljuju u mnogim sredinama kako bi otkrili prisutnost željeznih i drugih opasnih predmeta.^{8,9} Također se čini da i uporaba tablet računala čini određenu prijetnju za takve bolesnike.¹⁰ Još jedna važna skupina izvora EMI-ja jesu oni koje susrećemo u okolišu radnoga mjesta ili industrije, poput visokonaponskih instalacija, transformatora, uređaja za zavarivanje, električnih motora i mnogih drugih. Zadnji, ali ne i najmanje važni, jesu izvori koje možemo naći u medicinskom okruženju: uređaji za snimanje magnetnom rezonancijom, elektrokauteri, defibrilacija, neurostimulatori, uređaji za TENS, radiofrekventna kateterska ablacija te terapijska dijatermija.

tors (ICD). Furthermore, these devices tend to become more complex in their functions and required number of implanted components, as can be seen from increasing implant rates of cardiac resynchronization therapy pacemakers (CRT-P) and cardiac resynchronization therapy implantable cardioverter defibrillators (CRT-D). As an example, according to latest available data published by EUCOMED in 2014, in 2013 just in Europe there were in total 1260 patients per million of inhabitants who received such devices (PM, ICD, CRT-P, CRT-D).¹ One also has to bear in mind all those patients that have already had those devices implanted earlier, and have already been living with them for years.

In our daily work, we are often asked by our patients about ubiquitous objects which can serve as a relevant source of electromagnetic signals and should therefore be avoided. Specific concerns as voiced by our patients include (but are not limited to): personal devices, kitchen and household appliances, office and store appliances, entertainment devices, travelling and environment, and dental and medical tests and procedures. Unfortunately, professional scientific societies have still not been able to provide adequate guidelines in this issue.

Regarding the concerns of CIED patients, it has been shown that the function of these cardiac rhythm devices can be impaired by EMI, causing either temporary (environmental sources of EMI, resulting in temporary and reversible dysfunctions) or sometimes even permanent system malfunction (the risk is present, although low, with medical environment sources of EMI, such as magnetic resonance imaging). In worst cases, this could potentially lead to fatal events (for example EMI could cause oversensing in a PM device in a patient with asystole, leading to inhibition of pacing or causing inadequate ICD or CRT-D device shocks due to device's misinterpretation of EMI as life threatening ventricular tachyarrhythmia – both resulting, in theory at least, in syncope and/or death).

So far, there have been studies on EMI affecting CIED from sources such as cellular phones, anti-theft devices, various remote controls, improperly wired/grounded appliances coming into contact with the body, MP3 players, induction ovens, and many other devices.²⁻⁷ Furthermore, increasing global efforts to intensify security screening measures in the past decade have also brought into focus the use of metal detectors (which create a magnetic field that might interfere with the function of CIED); they are nowadays routinely used in many settings to detect ferrous and other dangerous items.^{8,9} It would also seem that the use of tablet computers can pose certain threats for those patients as well.¹⁰ Another important group of sources of EMI is those which are encountered in workplace and/or industrial environments, such as high voltage power lines, transformers, welders, electric motors, and many others. Last, but not least, are those sources found in medical environments: magnetic resonance image scanners, electrosurgery, defibrillation, neurostimulators, TENS devices, radiofrequency catheter ablation, and therapeutic diathermy.

The most common advice given to PM patients comes from information provided by device manufacturers and regulatory institutions where, in general, it is recommended for patients with CIED to keep a "safety distance" of 15-20 cm or more between CIED and sources of EMI (the more powerful

Najčešći savjet koji se daje bolesnicima s PM-om dolazi na osnovi informacija koje daju proizvođači uređaja i regulacijske institucije, gdje se općenito za sve bolesnike s CIED-om preporučuje održavati „sigurnu udaljenost“ od 15 do 20 cm ili više između CIED-a i izvora EMI-ja (što je jači izvor, to bi trebala biti veća udaljenost). Bolesnicima s PM-om i ICD-om često se savjetuje da značajne izvore EMI-ja izbjegavaju ili potpuno ili, kada to nisu u mogućnosti, da barem pokušaju održati spomenutu „sigurnu udaljenost“.

Važno je istaknuti kako su proizvođači uređaja dizajnirali CIED-ove tako da ispravno funkcioniraju u blizini većine kućanskih aparata i opreme te se stoga ne očekuje da će se bolesnici susresti s poteškoćama kada su im izloženi tijekom normalne svakodnevne uporabe. Isto bi trebalo vrijediti i za različite medicinske dijagnostičke/terapijske uređaje i alate.

No, potreban je oprez jer su u našem svakodnevnom životu prisutni različiti uređaji, pri čemu se čini da je upotreba nekih poput detektora metala (velikih i ručnih) sigurna,^{8,9} dok neki mogu pokatkad uzrokovati neočekivane probleme.^{5-7,10}

U zaključku se može reći da je opseg ovoga problema (EMI u bolesnika s CIED-om) relativno malen – ali bitan; a kada se dogodi, u većini je slučajeva prolazne prirode i lako se može izbjeći. No, nužno je naglasiti važnost detaljnog razgovora s bolesnikom koji ima CIED, imajući na umu njegove specifične situacije i potrebe. Liječnici bi trebali biti svjesni i upoznati s najčešćim interakcijama EMI-ja i CIED-a.

the source, the greater this distance should be). Patients with pacemakers and implantable cardioverter defibrillators are often advised to avoid relevant sources of EMI, either completely or, when being unable to do so, at least to try to keep the “safe distance” mentioned above.

It is important to note that device manufacturers have designed CIEDs so that they should function properly in vicinity of most household appliances and equipment, and therefore it is not expected that patients will encounter difficulties when they are exposed to them during normal daily use. The same should apply for various medical diagnostic/therapeutic devices and tools.

However, caution is needed as there are various devices present in our daily life, and while there are those that seem to be safe for use, such as gate metal detectors or handheld metal detectors,^{8,9} some of them can sometimes cause unexpected problems.^{5-7,10}

In conclusion, it could be said that the scope of this problem (EMI in CIED recipients) is relatively small – but relevant, and when issues occur, in most cases they are of a transitory nature and can easily be avoided. However, it is of utmost importance to have discuss the issue with patients that has a CIED, bearing in mind their specific situations and needs. Physicians should be aware of and familiarized with most common interactions of EMI and CIED.

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