

Technological innovations in cardiac electrostimulation:

Professional updating and cultural evolution of nurses

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Commentary

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Cardiology made enormous advances in the treatment of extremely severe diseases such as heart failure. Specifically, interventional cardiology has been enriched, over the years, with increasingly complex aids that have contributed in improving the quality of life and survival of patients suffering from this disease. These advances in technique compel the interventional cardiologist being constantly updated on new procedures and therapy. As a result, both the ward nurses and those supporting the cardiologist in the surgery room, must acquire the knowledge that allows them to be always in step with the fast-changing times.

The aim of this commentary is to underlining the importance of a continuous updating of nurses by emphasizing that their role has been changing over the years and that these professionals, along with the physicians, must stay up-to-date regarding technological innovations, within the limits of their specific skills.

Keywords: Heart failure; Cardiac Contractility Modulation; Nurse updating

Introduction

Nurses of interventional Cardiology unit must acquire more and more skills because of the evolution of technology and subsequently of the complexity of implantable devices. The acquisition of skills is a continuous process and requires constant effort. Therefore, not only the physician, who remains the main operator, must constantly update himself on new techniques and procedures, but also nurses who assist him in and out the operating room, must acquire the scientific mentality that allows them to get highly specialized technical knowledges. In the field of interventional cardiology, advances in technology made care approach increasingly complex, before, during and after an interventional procedure. In such a large and constantly evolving field, nurses should necessarily acquire all the skills for the assistance process and should consequently have the ability to analyze, decide and execute the most appropriate and safe care services, supported by solid evidence of effectiveness. Cardiac Contractility Modulation (CCM) therapy, delivered by OPTIMIZER SMART®, is part of the non-pharmacological therapy for treatment of heart failure with reduced or moderately reduced ejection fraction, in symptomatic patients (NYHA class II-IV) despite optimized medical therapy [1]. It is an important technological innovation for the treatment of this severe disease. The CCM acts by delivering a high-energy non-excitatory bipolar signal, synchronized with local electrical activity, in the ventricular absolute refractory period, by means of two active-fixation leads, placed on the IVS and spaced from each other by no more than 1 cm. Both leads can have a sensing and therapy delivery function. In the implantation phase, is very important to be meticulous in positioning the leads so that they have a sensing greater than 4 mV at the PSA. In the short and long term, this treatment increases left ventricular contractility. As result, the CCM therapy improves clinical status, functional capacity, quality of life and prevents hospital admissions of carefully selected patients [2]. The selection of the patient to whom implant this device, takes place by evaluating his quality of life and the frequency of hospitalizations for heart failure. Quality of life is assessed by the MLWHFQ questionnaire. A score over 30 in a patient in

NYHA II class is indicative of severe lack of autonomy and is a significant element in the decision to implant such device (Fig. 1). The interventional procedure does not differ from those implemented for the implantation of other cardiac devices. The difference is about the periodic checking of the implanted device, performed by the cardiologist with the help of a biomedical engineer, who analyze the data by a portable computer loaded with a specific software, by which, electrical parameters and therapy delivery time are tested. The therapy delivery time must be at least 7 hours per day and a parameter to pay attention to is the percentage of therapy delivery, which must be as high as possible and not fall below 80%. [3].

Discussion

Many papers describe implantation procedure and the role of nurses [4-5-6]. After the surgery, nurse takes the patient back to the ward and performs an ECG. Nurses who record the ECG should be able to understand whether the device is properly working or not. The typical ECG of a patient implanted with a CCM device shows a ‘spike’ in the absolute refractory period of cardiac cycle: the ‘R wave’ of QRS complex. (Fig. 2). Nurses should know that the presence of a ‘spike’ on the ‘R wave’ of the QRS complex is not a non-capturing sign or a sensing defect: it is the proper operating of the device itself. This knowledge is important in order not to alarm the patient and inappropriately alert the cardiologist. The day after implantation, nurses should check the surgical wound, evaluate whether there is a hematoma or not and if medical attention is required. Then the patient can undergo to a chest x-ray to evaluate the position of the leads and to exclude a PNx, if the subclavian vein puncture has been performed without echo guide [7]. OPTIMIZER SMART® is powered by a weekly-rechargeable battery through an induction mini-charger, rechargeable itself, delivered to the patient. At bedside, physician and nurses instruct the patient, with the assistance of biomedical engineer, regarding its use. It is important, in this phase, that nurses as well assist the patient and reassure him about the easiness of device recharging procedure. Patient should charge

the device battery weekly and it is advisable to suggest him to always recharging the device on the same day and at the same time, specifying however that it is not a life-saving device, but an electrical therapy provider. This avoids the worry of postponing or anticipating the charging process. Nurses get involved in many ways in interventional procedures: they manage the pre-operation care and technical setup; help the physician in the surgical room; check the correct functioning of the device and, if complications are detected, alert the physician and look for a quick solution to them. In order to perform these tasks, nurses should know how the device acts and which complications might occur after intervention, so they can be able to deal with them without any anxiety. In 2014 in order to assess critical care nurses' knowledge and practice regarding implantable cardiac devices in Egypt, was published a paper by which authors showed that Critical care nurses have inadequate knowledge and practice regarding implantable cardiac devices [8]. Unfortunately, things have not changed over the years. In 2017, in order to assess cardiology nurses' knowledge and confidence in providing education and support to ICD recipients, Steffes et al. published a paper. The result was surprising: authors proved that the ICD knowledge of US nurses in 2015 was similar to that reported in the United Kingdom in 2004 [9-10], with limited knowledge about the complexities of modern ICD devices. Such deficits in knowledge may affect the quality of education provided to ICD recipients in preparing them to live safely with an ICD. A survey published in 2021 by Fitzimons et al, showed that many nurses felt not being living up to their job and emphasize the importance of in continuing cardiovascular nursing education and of their professional updating[11]. Nowadays, the nurses should be a complete professional and should have the technical and care skills required to obtain the best result in interventional procedures, as regard the new generation devices as well. Consequently, the interventional cardiology/electrostimulation nurses are required to have not only care skills, but also the knowledge of devices. In CCM therapy, electrical stimulation is delivered to the cardiac muscle during the absolute refractory period. In this phase, the electrical signals activate the mobilization of calcium ions in the cardiomyocytes. The

mechanism of action of the CCM can be summarizing as follows: CCM signals applied during the absolute refractory period cause an increase of cytosolic calcium during the systole, resulting in improving the cardiac contraction [12]. The mechanism of action explains the typical ECG of a patient with CCM and the nurses must be able to recognize it in order not urgently alert the doctor. This is the reason why nurses as well should know it. Furthermore, nurses have to be aware about the effects of such therapy. A few seconds after the delivery of the therapy, normalization of the activity of the proteins that are involved in regulation of intracellular calcium, occurs. After a few hours, there is a progressive normalization of the abnormal expression of fetal gene program, which is a characteristic of heart failure. Reverse remodeling has been demonstrated within 3 months, with reduction of mechanical and neuro-hormonal stress and increase of left ventricular ejection fraction. CCM restores the structure and function of damaged cells to their normal state [13]. Due to this action, CCM improves clinical outcomes in terms of exercise tolerance and QOL at 6 months [14], and this is the reason why guidelines published in 2016 and the Consensus HFA ESC 2019, state that CCM can be considering in selected patients with HF [15]. In 2020, Giallauria et al. evaluated the three currently available randomized controlled trials of CCM therapy for treatment for patients with heart failure. This comprehensive meta-analysis made the authors conclude that CCM provides statistically significant and clinically meaningful benefits in measures of functional capacity and HF-related quality of life [16]. The latest ESC guidelines on heart failure (2021) suspend the judgment on CCM (*'under evaluation'*), since its effect on the long-term mortality rates of patients with heart failure has not evaluated yet in a randomized controlled multicenter trial [17]. However, it is noteworthy that some preliminary studies showed that CCM improves clinical outcome in terms of exercise tolerance and QOL. Besides, it improves long-term survival, compared with the mortality predicted by the Sattle Heart Failure Model Score and reduces hospitalizations by 75%. [18]. Due to these considerations, we highlighted that the cardiology nurses have not an adequate preparation. Because of this, patient care inevitably suffers. This is the reason why we believe that it

is mandatory for the nurse to be updated both about procedures and about devices. They should have adequate knowledge about the indications and the mechanism of action of devices. Furthermore, as regard the CCM, it is mandatory for the cardiology nurses, the knowledge of the typical ECG of a patient implanted with such device.

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Competing interest statement

There are no competing interests for this study.

Authors' contribution

Dr. C. Uran: Investigation, conceptualization, resources, preparation and translation of the paper.

Dr. M Falco; P. Piscitelli; Dr. G. Bombace; Dr. P. Eterno: Preparation

References

1. <https://www.fda.gov/media/123038/download;>
2. Abraham WT, Smith SA. Devices in the management of advanced, chronic heart failure. *Nat Rev Cardiol.* 2013;10(2):98-110.
3. Abraham W.T et al. A Randomized Controlled Trial to Evaluate the Safety and Efficacy of Cardiac Contractility Modulation. *J Am Coll Cardiol HF* 2018;
4. Kim Rajappan, Cardiac Department, John Radcliffe Hospital, Headley Way, Headington, Oxford OX3 9DU, UK; *Education in Heart Arrhythmias. Permanent pacemaker implantation technique: part I*; <http://dx.doi.org/10.1136/hrt.2007.132753>
5. Rajappan K. Permanent pacemaker implantation technique: part II. *Heart.* 2009;95(4):334-342. doi:10.1136/hrt.2008.156372
6. Porfili A. Protocollo infermieristico per procedure di elettrostimolazione: impianto o sostituzione di Pacemaker, Defibrillatori, Dispositivi per la terapia di re sincronizzazione cardiaca (CTR) *Linee guida AIAC 10.2018*
7. Glikson M, Nielsen JC, Kronborg MB, et al. 2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy. *Eur Heart J.* 2021;42(35):3427-3520. doi:10.1093/eurheartj/ehab364
8. Nahla Shaaban Ali; Warda Youssef; Abdo Mohamed; Ali Hussein Nurses' knowledge and practice regarding implantable cardiac devices in Egypt. *British Journal of Cardiac Nursing* Vol. 10, No. 1. Published Online:26 Dec 2014<https://doi.org/10.12968/bjca.2015.10.1.34>
9. Steffes SS, Thompson EA, Bridges EM, Dougherty CM. Knowledge of Implantable Cardioverter Defibrillator Purpose and Function Among Nurses in the United States. *J Cardiovasc Nurs.* 2017;32(3):304-310. doi:10.1097/JCN.0000000000000339
10. Tagney J. Can nurses in cardiology areas prepare patients for implantable cardioverter defibrillator implant and life at home? *Nurs Crit Care.* 2004;9(3):104Y114
11. Donna Fitzsimons, Matthew A Carson, Tina B Hansen, Lis Neubeck, Mu'ath I Tanash, Loreena Hill, The varied role, scope of practice, and education of cardiovascular nurses in ESC-affiliated

- countries: an ACNAP survey, *European Journal of Cardiovascular Nursing*, Volume 20, Issue 6, August 2021, Pages 572–579, <https://doi.org/10.1093/eurjcn/zvab027>
12. Borggreffe, M.; D. Burkhoff (Jul 2012). “Clinical effects of cardiac contractility modulation (CCM) as a treatment for chronic heart failure”. *Eur J Heart Fail.* **14** (7): 703–712.
13. Butter, C.; et al. (May 2008). “Cardiac Contractility Modulation Electrical Signals Improve Myocardial Gene Expression in Patients With Heart Failure” (PDF). *J Am Coll Cardiol.* **51** (18):1784–1789.
14. Kuschyk et al. Cardiac Contractility Modulation treatment in patients with symptomatic heart failure despite optimal medical therapy and cardiac resynchronization therapy (CRT) *International Journal of Cardiology* 277 (2019) 173-177 .
15. Petar M. Seferovic et al ”Clinical practice update on heart failure 2019: pharmacotherapy, procedures, devices and patient management. An expert consensus meeting report of The Heart Failure Association of the European Society of Cardiology.
16. Giallauria F, Cuomo G, Parlato A, Raval NY, Kuschyk J, Stewart Coats AJ. A comprehensive individual patient data meta-analysis of the effects of cardiac contractility modulation on functional capacity and heart failure-related quality of life. *ESC Heart Fail.* 2020;7(5):2922-2932.
17. McDonagh TA, Metra M, Adamo M, et al. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure [published correction appears in *Eur Heart J.* 2021 Oct 14;:]. *Eur Heart J.* 2021;42(36):3599-3726.
18. “MAGGIC” Heart Failure Risk Calculator according to Pocock et al. Predicting survival in heart failure: a risk score based on 39372 patients from 30 studies, *Eur Heart J* (2013) 34(19) 1404-1413.

MINNESOTA LIVING WITH HEART FAILURE® QUESTIONNAIRE

The following questions ask how much your heart failure (heart condition) affected your life during the past month (4 weeks). After each question, circle the 0, 1, 2, 3, 4 or 5 to show how much your life was affected. If a question does not apply to you, circle the 0 after that question.

Did your heart failure prevent you from living as you wanted during the past month (4 weeks) by -	No	Very Little				Very Much
1. causing swelling in your ankles or legs?	0	1	2	3	4	5
2. making you sit or lie down to rest during the day?	0	1	2	3	4	5
3. making your walking about or climbing stairs difficult?	0	1	2	3	4	5
4. making your working around the house or yard difficult?	0	1	2	3	4	5
5. making your going places away from home difficult?	0	1	2	3	4	5
6. making your sleeping well at night difficult?	0	1	2	3	4	5
7. making your relating to or doing things with your friends or family difficult?	0	1	2	3	4	5
8. making your working to earn a living difficult?	0	1	2	3	4	5
9. making your recreational pastimes, sports or hobbies difficult?	0	1	2	3	4	5
10. making your sexual activities difficult?	0	1	2	3	4	5
11. making you eat less of the foods you like?	0	1	2	3	4	5
12. making you short of breath?	0	1	2	3	4	5
13. making you tired, fatigued, or low on energy?	0	1	2	3	4	5
14. making you stay in a hospital?	0	1	2	3	4	5
15. costing you money for medical care?	0	1	2	3	4	5
16. giving you side effects from treatments?	0	1	2	3	4	5
17. making you feel you are a burden to your family or friends?	0	1	2	3	4	5
18. making you feel a loss of self-control in your life?	0	1	2	3	4	5
19. making you worry?	0	1	2	3	4	5
20. making it difficult for you to concentrate or remember things?	0	1	2	3	4	5
21. making you feel depressed?	0	1	2	3	4	5

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Figure 1. The Minnesota questionnaire 21 items

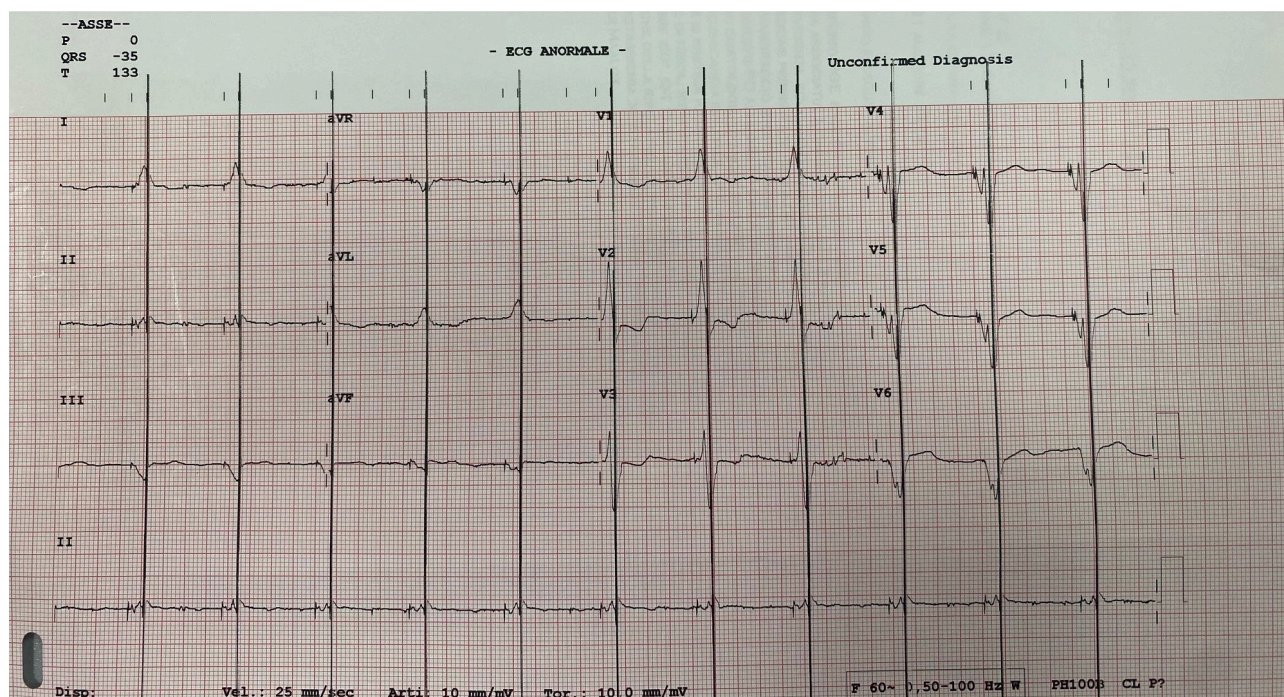


Figure 2. ECG of a patient with a CRT-D system, implanted with the CCM device

ECG	Electrocardiogram
ESC	European Heart Association
HF	Heart failure
HFA	Heart Failure Association
ICD	Implantable Cardioverter Defibrillator
IVS	Interventricular Septum
MLWHFQ	Minnesota Living with Heart Failure Questionnaire
NYHA	New York Heart Association
PNx	Pneumothorax
PSA	Pacing System Analyzer
QoL	Quality of life

Table of abbreviations