HEART RESEARCH

Openventio PUBLISHERS

ISSN 2377-164X Open Journal http://dx.doi.org/10.17140/HROJ-1-102

Review

*Corresponding author
Emilia Mikołajewska, PhD
Rehabilitation Clinic
Military Clinical Hospital No. 10 and Polyclinic, Powstańców Warszawy 5
85-681 Bydgoszcz, Poland
E-mail: e.mikolajewska@wp.pl

Volume 1 : Issue 1
Article Ref. #: 1000HROJ1102

Article History
Received: May 1st, 2014
Accepted: May 19th, 2014
Published: May 30th, 2014

Citation
Mikołajewska E, Mikołajewska D. Cardiac Telerehabilitation - Current State and Clinical Perspectives. *Heart Res Open J.* 2014; 1(1): 10-14. doi: 10.17140/HROJ-1-102

Cardiac Telerehabilitation - Current State and Clinical Perspectives

Emilia Mikołajewska[1,2*] and Dariusz Mikołajewski[2,3,4]

[1]Rehabilitation Clinic, Military Clinical Hospital No. 10 and Polyclinic, Bydgoszcz, Poland

[2]Disorders Consciousness Research and Neurorehabilitation Unit, Neurocognitive Laboratory, Centre for Modern Interdiscyplinary Technologies, Nicolaus Copernicus University, Toruń, Poland

[3]Institute of Mechanics and Applied Computer Science, Kazimierz Wielki University, Bydgoszcz, Poland

[4]Department of Informatics, Nicolaus Copernicus University, Toruń, Poland

ABSTRACT

Cardiovascular Diseases (CVD) are regarded as a leading cause of death globally, constituting important medical, social and economical problem. Systematic reviews and meta-analyses show the positive effect of exercise-based Cardiac Rehabilitation (CR). Despite well-established benefits of CR, many heart failure patients do not attend such programs for a variety of reasons. Cardiac telerehabilitation has the huge potential to deliver CR programs to aforementioned patients. The aim of this study was threefold: to establish the current state of the cardiac telerehabilitation, investigate the extent to which the available opportunities in cardiac telerehabilitation are being exploited, and discuss clinical perspectives and directions of further research.

KEYWORDS: Telemedicine; Cardiac rehabilitation; Telerehabilitation; Clinical applications.

INTRODUCTION

Cardiovascular Diseases (CVD) are regarded as a leading cause of death globally, constituting important medical, social and economical problem. Recent systematic reviews and meta-analyses show the positive effect of exercise-based cardiac rehabilitation (CR). It can significantly reduce the risk of hospital admissions and improve health-related quality of life, moreover exercise training may reduce mortality in the longer term.[1,2] According to the most secondary cardiovascular prevention guidelines, regular exercise training and rehabilitation obtained the class of recommendation I, level of evidence A (indications with type I A evidence) in heart failure patients.[3,4] It can play a critical role in restoring their quality of life, and maintaining (or improving-where available) functional capacity. We should take into consideration that hospital or home-based cardiac rehabilitation programs provide integral care and education concerning cardiovascular risk factors.[4] Components of multidisciplinary CR include: patient assessment, physical activity counselling, exercise training, weight control management, diet/nutritional counselling, lipid management, blood pressure monitoring, smoking cessation, and psychosocial management.[5] Thus such programs are important basic or supplementary way of the cardiovascular diseases prevention and important component of a comprehensive approach to CVD.[6]

Despite well established benefits of CR, many heart failure patients do not attend such programmes for a variety of reasons. Generally CR effects tend to decrease after the initial rehabilitation period.[7] Many patients are inactive, and existing forms of outpatient CR programs may be perceived inappropriate.[3] Additionally, access to CR services may be limited, especially in rural and remote areas.[2] CR seems to be underutilized both in high-, low- and middle-income countries.[8] Usually up to one-third of eligible patients attend a CR program.[9] Importance of CVD prevention seems be not matched by the resources and actions within health care sys-

ISSN 2377-164X Open Journal http://dx.doi.org/10.17140/HROJ-1-102

-tems.[10] CR support should be more important issue at least for policy makers, healthcare providers, insurers, patients and their families/caregivers. There is need for other approaches increasing access of such patients to the outpatient cardiac rehabilitation. One of them is perceived cardiac telerehabilitation.

Cardiac telerehabilitation has the huge potential to deliver CR programs to aforementioned communities. It is defined as providing CR services at a distance using communication technologies. It makes another breakthrough in providing equitable access to geographically remote, physically disadvantaged, and economically disadvantaged patients and to improve the quality of CR health care. Required optimization of the timing, intensity and duration of therapy can be the same as of the traditional face-to-face treatment. It may significantly improve the implementation of and adherence to CR.[6] Flexible follow-up strategy of cardiac-telerehabilitation and easier access to a specialized team[5] may significantly improve way of secondary prevention and long-term care of cardiac patients. Moreover home-based CR is safe and effective, especially in the area of short-term exercise capacity.[7] Home-based, well-known environment may effectively motivate patients, and simultaneously improve their independence compared with inpatient therapy and care.

The aim of this study was threefold: to establish the current state of the cardiac telerehabilitation, investigate the extent to which the available opportunities in cardiac telerehabilitation are being exploited, and discuss clinical perspectives and directions of further research.

CARDIAC TELEREHABILITATION

Telerehabilitation, new and developing field of telehealth, is defined as providing rehabilitation services at a distance using communication technologies.[11,12] The conceptual framework of telerehabilitation consists of the three areas influencing outcomes of the telerehabilitation: rehabilitative biosystems, human-technology interfaces, and behavioral compliance.[11] Each component of such framework can be used to conceptualize, understand, and optimize whole process and to analyze alternative approaches for optimizing outcomes.[11]

Preliminary evidence of potential cost savings for the healthcare facility thanks to telerehabilitation was provided by Kairy et al.[13] But, we should be aware that identification of clinical outcomes and processes, and possible healthcare utilization and costs associated with telerehabilitation need additional individual research, adapted to the diversity of people, communities, and systems.

Compartmental studies in the area of cardiac telerehabilitation can be very difficult due to huge variety of technical solutions. Systems can range from low-bandwidth low-cost videophones, to expensive, fully immersive virtual reality systems with haptic interfaces.[12] Their basic division can be as follows:

• image-based telerehabilitation - using video conferences and optical measurements within the process of remote counse ling or rehabilitation,

• sensor-based telerehabilitation - using various sensors to assess patient's health status or to supervise rehabilitation process,

• virtual reality-based telerehabilitation (including game-based telerehabilitation) - using semi-realistic interactions for assessment and rehabilitation.

Cardiac telerehabilitation systems usually should be adapted to a variety of Hospital Information Systems (HISs). This makes another challenge for engineers.

CURRENT EVIDENCES

Canadian research by Grace et al.[14] showed, that only 34% of eligible patients participated in CR programs, and member of underrepresented groups are women and ethnic minority groups. There is need for strategies to increase their access to CR programs, where available. There were identified barriers as follows: distance, personal travel, lack of referral and physician recommendation, and - subjectively perceived - low need.[14] Advantages of the universal health care system can be not clear in the case of CR programs. According to the compartmental study by de Melo Ghizi et al.,[8] despite lower availability of CR programs in Brazil, Canadians reported significantly greater (and usually modifiable) barriers than Brazilians (total number of barriers: 21):

• Canadians identified already exercising (at home or in the community), and personal travel,

• Brazilians identified distance and cost of the CR program.[8]

CR programs in Singapore are based on face-to-face treatment, thus recently interactive evidence-based Heart Recovery Education Booklet was introduced as supplementary tool to improve current situation in home-based CR without using telerehabilitation.[15]

Unfortunately there is little research on Home-based Cardiac Telerehabilitation (HTCR). All successful cardiac telerehabilitation programs can be helpful for scientists and clinicians initiating or modifying their own programs. One of them conducted by Piotrowicz et al.[6] showed that HTCR resulted in a significant improvement; moreover, neither deaths nor adverse events were observed. Generally patients accepted HTCR (percentage of non-adherent patients: 0.8). Thus, HTCR may be regarded as a feasible, safe and well-accepted form of rehabilitation by patients. Benefits of hybrid approach, joining ambulatory rehabilitation and home-based telerehabilitation, was recently described by Korzeniowska-Kubacka et al.[16]

ISSN 2377-164X Open Journal http://dx.doi.org/10.17140/HROJ-1-102

	Traditional face to face rehabilitation	Telerehabilitation
Benefits	Provides continuous direct assessment, monitoring timing, intensity and sequencing of the rehabiltiation, patient-therapist relationship.	Decreases influence of: – inadequate provision of resources, – lack of specialists in a geographic area, – physical distance from health facilities, – lack of transportation, – influence of physical imapairment, – costs. Provides: – continuity of the rehabilitation, – rehabilitation in patient's own environment.
Limitations	– provision of resources and number of specialists, – physical distance from health facilities and lack of transportation – influence of physical imapairment, – costs, – contunuity of procedur es.	– need for changes within strategy and organization of whole heal care system, – low social awareness, – hands-on approach of some treatments, – paucity of online assessment, treatment tools, and outcomes, – aging (of whole societies) and/or disability, – huge variety of technical equipment (possibly decreased thanks to coherent telehealth policy, where available), – huge costs of such system initiation (novel equipment, medical staff education providing their confidence in conducting a safe exercise program, etc.), ethical and legal issues (e.g. licensure laws, responsibility for errors in assessment).
Challenges	Accessibility and efficacy, especially in long term rehabilitation and secondary prevention. Need for common awareness and changes in life style, especially in aging societies.	Uncommon awareness concerning cardiac telerehabiltiation benefits and efficacy evidences. High quality long-term cardiac telerehabilitation programs, including hybrid approaches.

Table 1: Compartment of the traditional face to face rehabilitation and telerehabilitation in terms of their respective benefits, limitations and challenges.

Research of the Working Group on Out-Patient Cardiac Rehabilitation (AGAKAR) demonstrated beneficial short- and long-term effects of the Austrian model of out-patient cardiac rehabilitation.[17]

Dissemination of the knowledge seems to be the most important issue concerning CR (traditional and using telerehabilitation) - nowadays.[18] There is a lack of common awareness among the public about the benefits of CR programs and role of exercise in everyday secondary prevention.[4] Despite there are developed new attractive tools for CR programs (pedometers, continuous monitoring systems),[19,20] they need promotion among potential users.

DIRECTIONS OF FURTHER RESEARCH

Cardiac telerehabilitation becomes commonly accepted as part of the telehealth and everyday clinical prac tice in rehabilitation.[11] Early reports concerning various forms and systems of cardiac telerehabilitation in patients with heart failure are promising.[9] But, current weak scientific base of evidences verifying this group of services must be developed. Further Randomized Controlled Trials (RCTs) are needed to confirm short- and long-term efficacy of cardiac telerehabilitation.[1] Current research showed home-based cardiac telerehabilitation as safe and effective in improving short-term exercise capacity, but novel telemonitoring techniques should support also its long-term effects on physical fitness depending on age, gender, etc.[7] Large scale prospective randomized studies should show equal efficacy of the cardiac telerehabilitation compared to the traditional face-to-face rehabilitation programs. Detailed standards and guidelines, useful for compartmental studies purposes, should be developed.[9]

There is need for quality indicators which will enable further measurement and improvement of the quality of CR programs.[14] As limitations of further development of the cardiac telerehabilitation systems are perceived also factors shown in Table 1.

There is need for prospect trials and comprehensive analysis where and how structured programs of CR should be delivered.[10] Spectrum of the cardiac telerehabilitation services should be each time adapted to both patients and possibilities of the health care system. Current needs are huge, but rather cost/effect analysis will decide.

CONCLUSIONS

Our review demonstrated that remote cardiac rehabilitation may be regarded as feasible, even compared with conventional face-to-face rehabilitation. This provides support for the development of cardiac telerehabilitation programs, which could be used at patient's home. Further studies should address the feasibility and validity of cardiac telerehabilitation in a home environment. We hope this paper will motivate colleagues to provide more evidences in aforementioned area.

REFERENCES

1. Taylor RS, Sagar VA, Davies EJ, et al. Exercise-based rehabilitation for heart failure. *Cochrane Database Syst Rev*. 2014; 4: CD003331. doi: 10.1002/14651858.CD003331.pub3

2. Tang J, Mandrusiak A, Russell T. The feasibility and validity of a remote pulse oximetry system for pulmonary rehabilitation: a pilot study. *Int J Telemed Appl*. 2012; 2012: 798-791. doi: http://dx.doi.org/10.1155/2012/798791

3. Piotrowicz E. How to do: telerehabilitation in heart failure patients. *Cardiol J*. 2012; 19(3): 243-248.

4. Acevedo M, Krämer V, Bustamante MJ, et al. Exercise and cardiac rehabilitation in secondary cardiovascular prevention [article in Spanish]. *Rev Med Chil*. 2013; 141(10): 1307-1314. doi: 10.4067/S0034-98872013001000010

5. European Association of Cardiovascular Prevention and Rehabilitation Committee for Science Guidelines, EACPR, Corrà U, Piepoli MF, Carré F, et al. Secondary prevention through cardiac rehabilitation: physical activity counselling and exercise training: key components of the position paper from the Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation. *Eur Heart J*. 2010; 31(16): 1967-1974. doi: 10.1093/eurheartj/ehq236

6. Piotrowicz E, Korzeniowska-Kubacka I, Chrapowicka A, Wolszakiewicz J, Dobraszkiewicz-Wasilewska B, et al. Feasibility of home-based cardiac telerehabilitation: Results of TeleInterMed study. *Cardiol J*. 2014. doi: 10.5603/CJ.a2014.0005

7. Kraal JJ, Peek N, van den Akker-Van Marle ME, Kemps HM. Effects and costs of home-based training with telemoni toring guidance in low to moderate risk patients entering cardiac rehabilitation: The FIT@Home study. *BMC Cardiovasc Disord*. 2013; 13: 82. doi: 10.1177/2047487314552606

8. de Melo Ghisi GL, Oh P, Benetti M, Grace SL. Barriers to cardiac rehabilitation use in Canada versus Brazil. *J Cardiopulm Rehabil Prev*. 2013; 33(3): 173-179. doi: 10.1097/HCR.0b013e3182930c9f

9. Piotrowicz E, Piotrowicz R. Cardiac telerehabilitation: current situation and future challenges. *Eur J Prev Cardiol*. 2013; 20(2 Suppl): 12-16. doi: 10.1177/2047487313487483c

10. Piepoli MF, Corrà U, Benzer W, et al. Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation. Secondary prevention through cardiac rehabilitation: from knowledge to implementation. A position paper from the Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation. *Eur J Cardiovasc Prev Rehabil*. 2010; 17(1): 1-17. doi: 10.1097/HJR.0b013e3283313592

11. Winters JM, Winters JM. A telehomecare model for optimizing rehabilitation outcomes. *Telemed J E Health*. 2004; 10(2): 200-212. doi: 10.1089/tmj.2004.10.200

12. Theodoros D, Russell T. Telerehabilitation: current perspectives. *Stud Health Technol Inform*. 2008; 131: 191-209.

13. Kairy D, Lehoux P, Vincent C, Visintin M. A systematic review of clinical outcomes, clinical process, healthcare utilization and costs associated with telerehabilitation. *Disabil Rehabil*. 2009; 31(6): 427-447. doi: 10.1080/09638280802062553

14. Grace SL, Bennett S, Ardern CI, Clark AM. Cardiac rehabilitation series: Canada. *Prog Cardiovasc Dis*. 2014; 56(5): 530-535.doi: 10.1016/j.pcad.2013.09.010

15. Wang W, Thompson DR, Chow A, Kowitlawakul Y. An education booklet to aid cardiac patients' recovery at home. *Int Nurs Rev*. 2014. doi: 10.1111/inr.12091

16. Korzeniowska-Kubacka I, Dobraszkiewicz-Wasilewska B, Bilińska M. i wsp. Two model sof early cardiac rehabilitation in male patients after myocardial infarction with preserved left ventricular function: comparison of standard out-patient versus hybrid training programmes. *Kardiol Pol*. 2011; 69(3): 220-226.

17. Niebauer J, Mayr K, Harpf H, et al. Long-term effects of outpatient cardiac rehabilitation in Austria: a nationwide regis try. Wien Klin Wochenschr. 2014; 126(5-6): 148-155. doi: 10.1007/s00508-014-0527-3

ISSN 2377-164X Open Journal http://dx.doi.org/10.17140/HROJ-1-102

18. Griffo R, Temporelli PL, Fattirolli F, et al. ICAROS (Italian survey on CardiAc RehabilitatiOn and Secondary prevention after cardiac revascularization): temporary report of the first prospective, longitudinal registry of the cardiac rehabilitation network GICR/IACPR [article in Italian]. *Monaldi Arch Chest Dis*. 2012; 78(2): 73-78.

19. Frederix I, Dendale P, Berger J, Vandereyt F, Everts S, Hansen D. Comparison of two motion sensors for use in cardiac telerehabilitation. *J Telemed Telecare*. 2011; 17(5): 231-234. doi: 10.1258/jtt.2010.100914

20. Helmer A, Kretschmer F, Deparade R, et al. A system for the model based emergency detection and communication for the telerehabilitation training of cardiopulmonary patients. *Conf Proc IEEE Eng Med Biol Soc*. 2012; 2012: 702-706. doi: 10.1109/EMBC.2012.6346028