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Telecardiology and its outcome among patients with implantable cardiac devices during COVID-19 pandemic

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Original Article

Abstract

BACKGROUND: During ongoing coronavirus disease 2019 (COVID-19) pandemic, social isolation and lockdown measures were implemented to prevent spread of virus which created enormous challenges to patient healthcare. In order to overcome these challenges, teleconsultation (telecardiology) was initiated. Objective of this study was to assess outcome of telecardiology using audio/visual/audio-visual consultation among patients with implantable cardiac devices.

METHODS: Telecardiology was performed (either physician-initiated or patient-initiated) among 1200 patients over a five-month period (July 13 to December 13, 2020) to review health status of patients to decide further course of treatment and to access their satisfaction level with telecardiology.

RESULTS: Teleconsultation was cardiologist- and patient-initiated in 1042 (86.8%) and 158 (13.2%) cases, respectively. 1117 (93.2%) patients were stable, while scheduled admission, urgent hospitalization, and death were noted in 20 (1.8%), 45 (3.9%), and 18 (1.5%) patients, respectively. Next visit was rescheduled in 986 (82.2%), while 127 (10.6%) were called earlier because of battery depletion. Majority (n = 1077, 89.8%) were satisfied.

CONCLUSION: Telecardiolgy is an effective option during COVID-19 to minimize interpersonal contact, spread of disease, psychological stress, and burden on already stretched healthcare.

Keywords: COVID-19; Implantable Cardiac Devices; Heart Failure; Telecardiolgy

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Introduction

Severe acute respiratory syndrome caused by novel corona virus-2 (SARS-CoV-2), first reported from China in December 2019 as the cause of respiratory illness, has been designated as corona virus disease 2019 (COVID-19).[1,2] This pandemic has engulfed more than 213 countries globally and is responsible for millions of cases and as many deaths. India alone has witnessed nearly ten million cases with fresh cases still being reported. Social distancing and strict lockdown measures were implemented at the outset to prevent its spread, as it is very contagious disease which is mainly spread by respiratory droplets. It has mortality of 1%-2%, especially among those with cardiovascular comorbidities who carry maximum risk.[3-5] Even asymptomatic persons, because of high viral loads in their respiratory tract, may spread disease by shedding of virus.[6] With rapidly increasing burden of COVID-19 cases, all patients and their accompaniments visiting hospital are increasing the risk of exposure to disease, other fellow patients, and forefront healthcare providers. This pandemic has further strained already stretched healthcare causing a crisis, thereby putting adequate care into jeopardy.

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Reducing is integral in limiting its spread and resource use. Telemedicine incorporates telecommunications, integration of medical information and information technology to provide medical advice on basis of comprehensive information (audiovisual) transferred from patients. Many electrophysiology consultations may be completed without a physical visit of patients to hospital, by reviewing their reports and monitoring data which can minimize disease spread.[7,8] In telecardiology, further information is virtually exchanged between patients and cardiologist via various Internet platforms like video calling, WhatsApp, FaceTime, Skype, and Google Duo.[9] Aim of this study was to evaluate feasibility, safety, and impact of teleconsultations among patients with various implantable electronic devices [pacemakers, implantable cardioverter defibrillator (ICD), cardiac resynchronization therapy-defibrillator (CRT-D)].

Materials and Methods

This was a retrospective analysis performed at LPS Institute of Cardiology, G.S.V.M. Medical College, Kanpur, Uttar Pradesh, India, over five months (July 13 to December 15, 2020). Telecardiolgy service was provided by 9 consultants for 8 hours daily (10 am to 6 pm) on rotatory basis. Routine follow-up of patients with permanent pacemakers (PPMs) and those with ICDs and CRT-Ds is performed at 6- and 3-month intervals, respectively, at our institute. During this period, their medical records for comorbidities [coronary artery disease (CAD), hypertension (HTN), diabetes mellitus (DM), dyslipidemia, heart failure (HF), renal insufficiency], device parameters (sensitivity, threshold, amplitude, lead impedance, battery life), and any symptoms during previous visit were reviewed. Following this, patients were contacted through cellular phone using audio system and video when need was felt. If parameters were normal during previous visit and patients were asymptomatic, their scheduled visits were deferred for another 6 months and 3 months for those with pacemakers and those with ICDs and CRT-Ds, respectively. They were also educated about COVID-19, its risk, spread and prevention, their access to and availability of all of their medications, and also issued electronic prescriptions for their reimbursement if needed. When patient-initiated contact was made, they were enquired about their symptom and advised accordingly. Those complaining of worsening dyspnoea, palpitation, weight gain, dizziness, syncope, fever, effort intolerance, weakness, shock delivery, and sound alarm [ICD/cardiac resynchronization therapy (CRT)] were urgently called to hospital for evaluation and admitted when needed. All patients getting admission were first sent to holding area, their chest X-ray was done, and sample (nasal and throat swab) was sent for reverse transcription-polymerase chain reaction (RT-PCR) to detect COVID-19 antigen. If it was reported positive, they were transferred to dedicated COVID-19 centres, while those with negative result were transferred to green zone for further treatment.

Those patients in whom device was approaching end of life were called earlier than their scheduled visit. Those who had elective replacement indication (ERI) were followed up monthly and few of them were admitted before their scheduled date of replacement with minimal battery remaining. Patients having recent implantation of pacemaker (before lockdown) complaining of local swelling, pain, and redness over implantation site were examined using video and admitted urgently (for evaluation of endocarditis, bacteraemia, haematoma, diaphragmatic pacing, and pocket infection). Patients' satisfaction was assessed on a scale from 1 to 5, where 1 point meant not satisfied, 2- slightly satisfied, 3- neutral, 4- satisfied, and 5- very satisfied by taking their feedback.[10]

Statistical evaluation: All data were collected including their past medical records. Continuous variables with normal distribution were presented as mean ± standard deviation (SD), while categorical variables were presented as numbers and percentages.

Results

Telecardiolgy was carried out among 1200 patients. Their comorbidities and clinical presentation have been shown in table 1. Mean age of patients was 68.3 ± 11.6 years and majority of them were men (n = 872, 72.7%). There were 1036 (86.4%) patients with PPM, 121 (10.2%) with ICD, 32 (2.6%) with CRT-D, and 11 (0.8%) with CRT-pacemaker (CRT-P). The majority of pacemakers were single-chamber (n = 704, 58.7%). Mean time since implantation was 81.3 months (range: 2 weeks to 124 months). Various indications for PPM were sick sinus syndrome (SSS) (n = 304, 31.3%), atrioventricular (AV) block (n = 669, 68.8%), and bifascicular block (BFB) and trifascicular block (TFB) (n = 51, 4.2%), while ischemic cardiomyopathy (n = 89, 2.9%) and idiopathic dilated cardiomyopathy (IDC) (n = 78, 6.5%) accounted for ICD and CRT implantation.

Table 1. Baseline comorbidities and clinical presentation of patients (n = 1200)

Variables	Value
Age (year)	68.3 ± 11.6
Sex (men/women)	872 (72.7)/328 (27.3)
Comorbidities	
HTN	332 (27.7)
DM	289 (24.1)
Smoker	184 (18.4)
Dyslipidemia	278 (23.2)
Post CABG	51 (4.3)
CAD	198 (16.5)
Renal dysfunction	89 (7.4)
LVEF (%)	
> 55	979 (81.5)
35-55	69 (5.7)
< 35	162 (13.5)
Medications	
Aspirin	268 (22.3)
Statin	354 (29.5)
Beta-blocker	272 (22.6)
ACEI/ARB	245 (20.4)
Ivabradine	148 (12.3)
CCB	189 (15.8)
Aldosterone antagonist	202 (16.8)
Indications of device implantation	
SSS	304 (31.3)
AV block	669 (68.8)
Chronic BFB and TFB	51 (4.2)
Ischaemic cardiomyopathy	89 (8.2)
IDC	78 (6.5)
Types of device	
Pacemakers (single-chamber/dual-chamber)	783 (65.3)/253 (21.1)
ICD	121 (10.2)
CRT-P	11 (0.8)
CRT-D	32 (2.6)

Data are presented as mean ± standard deviation (SD) or number and percentage

IDC: Idiopathic dilated cardiomyopathy; HTN: Hypertension; DM: Diabetes mellitus; CABG: Coronary artery bypass graft; CAD: Coronary artery disease; LVEF: Left ventricular ejection fraction; ACEI: Angiotensin-converting-enzyme inhibitor; ARB: Angiotensin receptor blocker; CCB: Calcium channel blocker; SSS: Sick sinus syndrome; AV: Atrioventricular; BFB: Bifascicular block; TFB: Trifascicular block; ICD: Implantable cardioverter defibrillator; CRT-P: Cardiac resynchronization therapy-pacemaker; CRT-D: Cardiac resynchronization therapy-defibrillator

Sensitivity of atrial, right ventricular (RV), and coronary sinus lead was 3.97, 14.64, and 14.28 mV, respectively. Pacing threshold for atrial, RV, and coronary sinus lead were 0.72, 0.75, and 1.52 V, respectively, while impedance was 461.72, 506.21, and 791 ohm correspondingly for respective leads. All the three parameters were stable.

Physician- and patient-initiated teleconsultations were performed in 1003 (83.6%) and 158 (13.2%) patients, respectively, while 39 (3.2%) patients themselves visited hospital without prior consultation. 984 (82%) patients were stable at home, 127 (10.7%) were called earlier than their scheduled date, 29 (2.4%) and 41 (3.4%) patients with moderate and severe symptoms were hospitalized, respectively, while 19 (1.5%) patients succumbed to death. Various reasons for urgent hospitalization in 41 (3.4%) patients were decompensated HF (DHF) (n = 18, 1.5%), syncope (n = 5, 0.5%), recurrent shock (n = 4, 0.4%), fever (n = 11, 1%), and wound dehiscence (n = 3, 0.3%), while 21 (1.7%) patients were admitted on scheduled visit because of local site infection (n = 3, 0.3%), redness (n = 3, 0.3%), local site swelling at implantation site (n = 4, 0.3%), and device showing end of life (n = 11, 0.9%) (Figure 1). All these were detected when patients came to hospital for their stitch removal or when they complained of swelling or redness which was evaluated using audio-visual consultation.

Feedback on satisfaction level revealed that 57 (4.7%) patients were not satisfied (scale 1), 72 (6%) were slightly satisfied (scale 2), 39 (3.3%) were neutral (scale 3), 648 (54%) were satisfied (scale 4), while 381 (31.8%) were very satisfied (scale 5) with telecardiolgy (Figure 2). Majority of patients (n = 1029, 85.8%) were satisfied with teleconsultations. Overall satisfaction level was 4.1. Those who had scale 1/scale 2 were living in far remote areas. Their main concern was lack of physical consultation by cardiologist, but they were quite assured about benefit of telecardiology.

Discussion

Due to COVID-19 high transmission and overburdening on healthcare, hospital visits were minimized and social restrictions were imposed to curb its spread. As most of healthcare resources were allocated to fight with growing pandemic, it was soon realised that it may affect other aspects of health system, especially those with cardiovascular disorders.[11,12] Telecardiolgy was underutilized and its potential was not realised till COVID-19 pandemic. It led to increased patient participation which helped in prevention, diagnosis, therapy, and rehabilitation of patients with cardiac ailments which cut down financial burden and psychological apprehension of patients. Therefore, it directly complemented healthcare. Furthermore, patients feel more at home which gives them enough time and space to discuss their problem at length which is not possible in hospital because of huge rush and limited time.

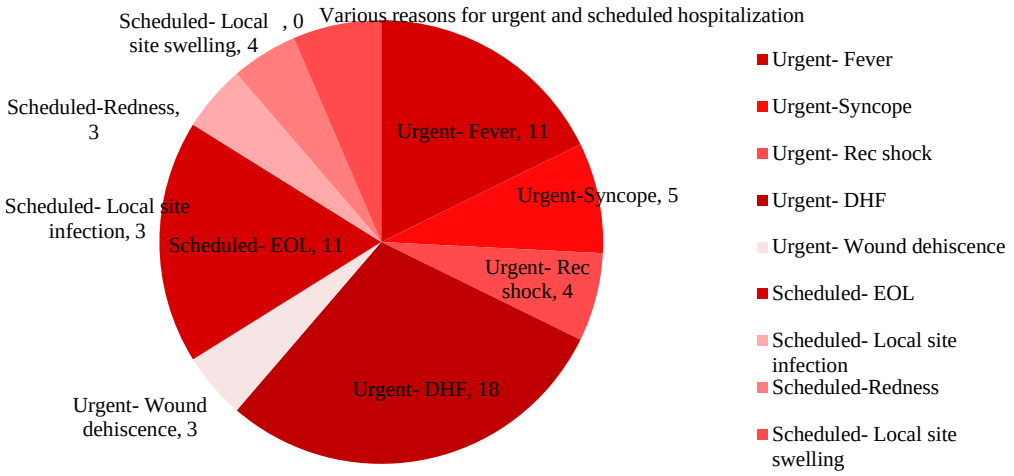

Figure 1. Reasons for urgent hospitalization and scheduled admission (DHF: Decompensated heart failure; EOL: End of life)

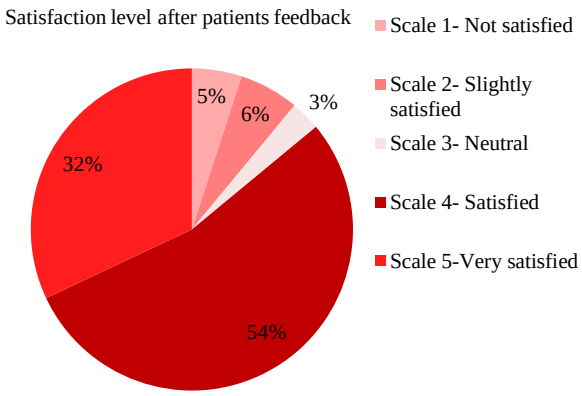

Figure 2. Satisfaction level after patient's feedback

Telecardiolgy certainly minimized patient's visit to the hospital and prevented their exposure to other potential COVID-19 patients which is very important, as majority of them had some comorbidities and were at maximum risk of exposure. As number of implantable cardiac devices has increased substantially over last two decades due to widening indications, patients' visits has increased at device clinics for follow-up and also hospital visit for any other problem attributed to their comorbidities.[13,14] In our study, majority of patients were not equipped with remote monitoring, but previous medical records helped to identify those at higher risk. Feedback of patients was mostly affirmative with average scale of 4.1. It was concordant with study reported by Paskudzka et al.[10] Indeed, 100% satisfaction is nearly impossible as it is a subjective finding although by incorporating the remote monitoring, this will be certainly higher and more acceptable among patients. Another technology introduced by Biotronik Company has superseded remote monitoring and is fully independent of patient or physician interaction although it is only seen in context of atrial fibrillation (AF). The device initiated transmissions daily, with additional pre-specified alerts (for abnormal parameters). These data were available for website review and reliability and early notification ability of this communication system were excellent.[15]

In another TRUST prospective multicentre clinical study, using home monitoring also demonstrated that telecardiology was very effective. It revealed that remote patient management reduced healthcare utilization by > 50% when one compulsory in-clinic check per year was incorporated.[16] These results were driven mainly because of reduction in scheduled visits which usually involve collection of routine measurements only (e.g., battery status, lead impedance, and sensing function). As no active clinical interventions like reprogramming and change of antiarrhythmic medications are performed, these can well be done by on-line data review.[16] It also showed greater follow-up adherence to 3 monthly calendar-based follow-ups. In this study, the overall reduction in face to face visits was accomplished safely, as there was no difference between two study arms in death, incidence of strokes, and events requiring surgical interventions (e.g., device explants or lead revision). This safety profile was maintained in patients with New York Heart Association (NYHA) class III/IV, i.e., lack of scheduled in-clinic device evaluation during remote monitoring did not predispose to risk in sicker patients. This study also indicated that aims of monitoring were fulfilled more effectively using telecardiology.[16]

Safety of telecardiology was also demonstrated in COMPAS trial although it considered only those patients who had received pacemaker.[17]As this care was introduced by Government of India which made electronic prescriptions valid for reimbursement, it ensured drug compliance as patients do not need to visit hospital personally. Moreover, it also helped in tailoring their further visits. It helps in real-time interaction, remote diagnosis, and treatment of HF and various arrhythmias. It also promotes their rehabilitation which improves cardiovascular health following device implantation. It removes barriers of transportation to and from hospital appointments and benefits patients, especially those who live in rural areas or those who do not have physical capacity or assistance.[18,19]

It has also demonstrated that it is not the same as a "face-to-face visit" and will certainly lack physical examination, but is very convenient to use provided that there is decent Internet connectivity and one has smart phone if he/she wishes real-time visual communication.[20] Despite lack of true physical examination, limited vital signs (blood pressure, pulse rare) can be monitored using ambulatory devices.[21] Additional tests [electrocardiography (ECG), echocardiography, blood test, chest X-ray, Holter monitor] can be advised to patients which can be reviewed on next visit and decision can be taken accordingly. One potential pitfall is learning to use this modern technology which patients either can learn by themselves or seek help of their family members.[22] It does not disrupt the healthcare but it augments it. Another misconception is that it cannot be effectively used by older patients who have a disproportionate demand for healthcare. Median age in our study was 68 years and 85% of patients were satisfied with telecardiology which was concordant with study by Paskudzka et al.[10] Elderly patients can adopt telehealth if they are properly educated and can be tailored as per their need, as Schwamm et al. reported in their study.[20]

Finally, introduction of smart watches like Apple Watch 4 and 5 is taking telecardiology to another level, as it can conduct and transmit real time ECG which can give information about device function to a large extent, but it is currently underutilized because of its high cost and limited availability.[21,22] Another novelty of telecardiology is that it cuts down stress level of both patients and cardiologists as both of them are in slow thinking mode; thus, it makes communication and comprehension better. It also breaks down typical cardiologist/patient hierarchy as both are standing on same audio-visual plane.

Conclusion

Telecardiology, by disseminating health-related services and information via electronic information and telecommunication technologies, helps to achieve the remote diagnosis and treatment of events among patients having implantable cardiac devices by remote specialist interpretation of ECG recordings. It allows long-distance patient and clinician contact, care, advice, reminders, education, intervention, monitoring, and remote admission which is very important during ongoing COVID-19 pandemic.

Telecardiolgy represents a viable alternate for management of patients with cardiac problems and guarantees continuity of care and creation of integrated networks between cardiologist and patients sitting remote. It may be particularly helpful where geographical barriers impinge on equity of access to health services. It allows early identification of symptoms related to implanted devices and reduces unnecessary visits although its safety needs further studies.

In India, nearly 70% of population living in rural areas do not have access to quality healthcare services, especially in era of COVID-19 pandemic. Healthcare is city centric and highly skewed in favor of urban population. Telecardiology, a branch of science, is based upon use of telecommunications in healthcare.

Telecardiology helps in bringing outpatient cardiology directly to patients in the communities by incorporating telehealth and digital health into our practices. It can augment traditional healthcare and cut down burden on healthcare during this ongoing pandemic by reducing unnecessary hospital visits. This also helps in limiting spread of high transmissible COVID-19 and is well accepted by large majority of patients.

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None.

Conflict of Interests

Authors have no conflict of interests.

Authors' Contribution

SKS, AKS, MMR, PS, MS, UP, CMV, RT, VK-conception and design, or analysis and interpretation of data; SKS, AKS, MMR, PS, MS,

UP, CMV, RT, VK-the drafting of the article or critical revision for important intellectual content; SKS, AKS, MMR, PS, MS, UP, CMV, RT, VK-final approval of the version to be published

References

1. Tabata S, Imai K, Kawano S, Ikeda M, Kodama T, Miyoshi K, et al. Clinical characteristics of COVID-19 in 104 people with SARS-CoV-2 infection on the Diamond Princess cruise ship: A retrospective analysis. Lancet Infect Dis 2020; 20(9): 1043-50.
2. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: A retrospective cohort study. Lancet 2020; 395(10229): 1054-62.
3. Li L, Zhang W, Hu Y, Tong X, Zheng S, Yang J, et al. Effect of convalescent plasma therapy on time to clinical improvement in patients with severe and life-threatening COVID-19: A randomized clinical trial. JAMA 2020; 324(5): 460-70.
4. Chen J, Qi T, Liu L, Ling Y, Qian Z, Li T, et al. Clinical progression of patients with COVID-19 in Shanghai, China. J Infect 2020; 80(5): e1-e6.
5. He X, Lau EHY, Wu P, Deng X, Wang J, Hao X, et al. Temporal dynamics in viral shedding and transmissibility of COVID-19. Nat Med 2020; 26(5): 672-5.
6. Zou L, Ruan F, Huang M, Liang L, Huang H, Hong Z, et al. SARS-CoV-2 viral load in upper respiratory specimens of infected patients. N Engl J Med 2020; 382(12): 1177-9.
7. Greenhalgh T, Wherton J, Shaw S, Morrison C. Video consultations for covid-19. BMJ 2020; 368: m998.
8. Smith AC, Thomas E, Snoswell CL, Haydon H, Mehrotra A, Clemensen J, et al. Telehealth for global emergencies: Implications for coronavirus disease 2019 (COVID-19). J Telemed Telecare 2020; 26(5): 309-13.
9. Piotrowicz R, Krzesinski P, Balsam P, Kempa M, Glowczynska R, Grabowski M, et al. Cardiology telemedicine solutions - opinion of the experts of the Committee of Informatics and Telemedicine of Polish Society of Cardiology, Section of Non-invasive Electrocardiology and Telemedicine of Polish Society of Cardiology and Clinical Sciences C. Kardiol Pol 2018; 76(3): 698-707. [In Polish].
10. Paskudzka D, Kolodzinska A, Cacko A, Stolarz P, Lyzwinski L, Opolski G, et al. Telephone follow-up of patients with cardiovascular implantable electronic devices during the coronavirus disease 2019 pandemic: Early results. Kardiol Pol 2020; 78(7-8): 725-31.
11. Chourasia G, Sycz WK, Wolniakowski I, Dudek K, Porebska B, Moczarska J, et al. Changes in the visits to emergency department of non-infectious hospital during the early COVID-19 state of epidemic. Emerg Med Serv 2020; 2: 99-102.
12. Pinkas J, Jankowski M, Szumowski L, Lusawa A, Zgliczynski WS, Raciborski F, et al. Public health interventions to mitigate early spread of SARS-CoV-2 in Poland. Med Sci Monit 2020; 26: e924730.
13. Wilkoff BL, Auricchio A, Brugada J, Cowie M, Ellenbogen KA, Gillis AM, et al. HRS/EHRA expert consensus on the monitoring of cardiovascular implantable electronic devices (CIEDs): Description of techniques, indications, personnel, frequency and ethical considerations. Heart Rhythm 2008; 5(6): 907-25.
14. Heidbuchel H, Lioen P, Foulon S, Huybrechts W, Ector J, Willems R, et al. Potential role of remote monitoring for scheduled and unscheduled evaluations of patients with an implantable defibrillator. Europace 2008; 10(3): 351-7.
15. Varma N, Stambler B, Chun S. Detection of atrial fibrillation by implanted devices with wireless data transmission capability. Pacing Clin Electrophysiol 2005; 28 Suppl 1: S133-S136.
16. Varma N. Rationale and design of a prospective study of the efficacy of a remote monitoring system used in implantable cardioverter defibrillator follow-up: The Lumos-T Reduces Routine Office Device Follow-Up Study (TRUST) study. Am Heart J 2007; 154(6): 1029-34.
17. Mabo P, Victor F, Bazin P, Ahres S, Babuty D, Da CA, et al. A randomized trial of long-term remote monitoring of pacemaker recipients (the COMPAS trial). Eur Heart J 2012; 33(9): 1105-11.
18. Slotwiner D, Varma N, Akar JG, Annas G, Beardsall M, Fogel RI, et al. HRS Expert Consensus Statement on remote interrogation and monitoring for cardiovascular implantable electronic devices. Heart Rhythm 2015; 12(7): e69-100.
19. Brahmbhatt DH, Cowie MR. Remote Management of Heart Failure: An overview of telemonitoring technologies. Card Fail Rev 2019; 5(2): 86-92.
20. Schwamm LH, Chumbler N, Brown E, Fonarow GC, Berube D, Nystrom K, et al. Recommendations for the implementation of telehealth in cardiovascular and stroke care: a policy statement from the American Heart Association. Circulation 2017; 135(7): e24-e44.
21. Perednia DA, Allen A. Telemedicine technology and clinical applications. JAMA 1995; 273(6): 483-8.
22. Driggin E, Madhavan MV, Bikdeli B, Chuich T, Laracy J, Biondi-Zoccai G, et al. Cardiovascular considerations for patients, health care workers, and health systems during the COVID-19 pandemic. J Am Coll Cardiol 2020; 75(18): 2352-71.