How to do: Telerehabilitation in heart failure patients

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Abstract

According to the present guidelines for heart failure patients, regular exercise training has obtained the class of recommendation I, level of evidence A. Despite the benefits of cardiac rehabilitation, many heart failure patients are inactive. Common patient’s rejection of existing forms of rehabilitation and limitations resulting from the disease itself hinder the outpatient cardiac rehabilitation. That is why home telerehabilitation seems to be the optimal form of physical activity for heart failure patients. (Cardiol J 2012; 19, 3: 243–248)

Key words: telerehabilitation, heart failure

Introduction

Thanks to the progress in various scientific fields, medicine is capable of saving more and more lives. Yet, paradoxically, this situation generates an increasing number of patients with heart failure (HF). Heart failure is a crucial problem in modern cardiology. Statistics show that more than 10 and 4 million people suffer from HF in Europe and in the USA, respectively. According to the present guidelines for HF patients, regular exercise training has obtained the class of recommendation I, level of evidence A [1]. The problem medicine needs to deal with is the provision of cardiac rehabilitation (CR) to all HF patients and thus complying with these recommendations.

Despite the benefits of CR, many HF patients are inactive [2, 3]. Common patient’s rejection of existing forms of rehabilitation and limitations resulting from the disease itself hinder the outpatient CR. That is why home telemonitored CR seems to be the optimal form of physical activity. Telemedicine can be most useful in performing exercise training for two reasons: it can control the stability of clinical status and help supervise training sessions [4–9]. In order to fulfill these two tasks, symptoms (fatigue, dyspnea, chest pain) and parameters (electrocardiogram [ECG], heart rate, arrhythmias, ischemia, blood pressure, body mass, saturation, medication taken, etc.) need to be monitored. These procedures should render home telerehabilitation (TR) safe and secure.

Despite the fact that telemedicine is highly applicable and effective, there are very few papers dedicated to the study of TR in HF patients [9–16]. Until recently only a couple of home rehabilitation monitoring models have been presented. From the simplest (1) heart rate monitoring [10] and (2) transtelephonic electrocardiografic monitoring [11], through more advanced (3) tele-ECG-monitoring via a remote device [12] and (4) real-time ECG and voice transtelephonic monitoring [13]. It seems the last two are the most useful and reliable.

Model of telerehabilitation

There are no guidelines about TR in HF patients. On the basis of research data and our experience the following model of TR for HF patients can be proposed.
Telerehabilitation is carried out by a medical team and advanced monitoring systems are used. A TR medical team should be composed of: a physician, a physiotherapist, a nurse, an ECG technician, and a psychologist. The responsibilities of TR staff members are shown in Table 1.

Currently available monitoring systems include:

1. A special remote device for tele-ECG-monitored and supervised exercise training-TR set (Pro Plus Company, Poland), which consists of: EHO mini device, blood pressure measuring and weighing machine (Fig. 1).
2. A data transmission set via a mobile phone.
3. A monitoring centre capable of receiving and storing patients’ medical data (specialized hardware and software are necessary). Thus obtained data are subsequently analyzed by the medical team and a medical report follows.

**Telerehabilitation set**

An EHO mini device adjusted to register 16-seconds–5-minutes fragments of ECG recording from three precordial leads and to transmit the data via mobile phone network to the monitoring center (Fig. 2). An EHO mini device has training sessions preprogrammed individually for each patient (defined exercise duration, breaks, timing of ECG recording). The moments of automatic ECG registration are preset and coordinated with the exercise training. The planned training sessions are executed with the device indicating what should be done with sound and light signals. There are sound signals in the form of bleeps and light signals from color emitting diodes. Bleeps and green diode blinking mean the patient should do exercise, another set of bleeps and red diode blinking mean stop exercise. The timing of automatic ECG recordings corresponded to peak exercise.

An EHO mini device has a tele-event-Holter ECG feature as well. Tele-event-Holter ECG is a feature that enables a patient, whenever a worrying symptom occurs, to register and immediately send the ECG recording via mobile phone network to the telemonitoring centre. The system works in a loop scheme, owing to which it is possible to analyze the part of ECG recording which directly preceded an event which made a patient press the signal button.

Patients are also able to make additional registrations and send them at any time, for example, when they felt unwell, if they experienced symptoms like palpitations, chest pain, etc.

Apart from the EHO mini device, the TR set also includes a weighing machine and a manome-
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Table 2. The initial telerehabilitation phase — baseline clinical examination

<table>
<thead>
<tr>
<th>Tests</th>
<th>Potential abnormality</th>
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<tbody>
<tr>
<td>Laboratory tests</td>
<td></td>
</tr>
<tr>
<td>Blood count</td>
<td>Anemia (&lt; 13 g/dL in men, &lt; 12 g/dL in women)</td>
</tr>
<tr>
<td>Glycaemia</td>
<td>Hyperglycemia (&gt; 6.5 mmol/L), diabetes control</td>
</tr>
<tr>
<td>Serum creatinine, electrolytes concentrations (natrium, potas-</td>
<td>Renal dysfunction</td>
</tr>
<tr>
<td>sium, magnesium), urinalysis</td>
<td></td>
</tr>
<tr>
<td>Thyroid tests</td>
<td></td>
</tr>
<tr>
<td>BNP/NT-proBNP</td>
<td></td>
</tr>
<tr>
<td>ECG</td>
<td>Hyper/hypothyroidism, amiodarone</td>
</tr>
<tr>
<td>Chest X-ray</td>
<td></td>
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<tr>
<td>Echocardiography</td>
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<td>Ambulatory ECG monitoring (Holter ECG)</td>
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<tr>
<td>Six-minute-walk test [25]</td>
<td></td>
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<tr>
<td>Cardiopulmonary exercise test [26, 27]</td>
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<tr>
<td>BNP — B-type natriuretic peptide; NT-proBNP — N-terminal pro-BNP; CRT — cardiac resynchronization therapy</td>
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Performing telerehabilitation

Performing TR consists of two stages: an initial stage — conducted either at hospital sites or within outpatient programmes, and a basic stage — conducted at home.

The initial telerehabilitation stage

The goals of the initial stage are: a baseline clinical examination for reliable evaluation of clinical status and functional capacity (Table 2), education (Table 3), individual planning of exercise training depending on patient’s exercise efficiency

Table 3. Education programme designed and run by the telerehabilitation staff.

- Patients and their partners ought to be taught:
  - how to measure heart rate, blood pressure, body mass
  - how to self-evaluate worrying signs and symptoms
  - how to perform the exercise training
  - how to self-evaluate the level of perceived exertion according to the Borg scale during training session
  - how to operate a telerehabilitation set
  - how to give first aid in case of an emergency
Table 4. Borg’s rating of perceived exertion scale.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Score</th>
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<tbody>
<tr>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>7 very, very light</td>
<td>15</td>
</tr>
<tr>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>9 very light</td>
<td>17 very hard</td>
</tr>
<tr>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>11 fairly light</td>
<td>19 very, very hard</td>
</tr>
<tr>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>13 somewhat hard</td>
<td></td>
</tr>
</tbody>
</table>

achieved in tests, performing a few (3–6) monitored educational training sessions.

Planning the exercise training. The chosen workload should reflect individual effort tolerance with regard to: perceived exertion according to the Borg scale (Table 4) and the training heart rate range established individually for each patient depending on patient’s parameters (heart rate and physical effort) achieved in cardiopulmonary exercise tests.

Having accomplished the initial stage, patients should be given a TR set.

The basic telerehabilitation stage

The basic TR stage ought to consist of two parts performed prior to each training session:
— first part — the training consent procedure required to access each training session;
— second part — the training session.

The first part — the training consent procedure. Each patient, before a training session, should answer a series of questions regarding his or her present condition (factors should include fatigue, dyspnoea, oedema, and medicament(s) taken). Subsequently patients should transmit resting ECG, blood pressure and body mass data to the monitoring centre. If no contraindications to training are identified, patients can receive consent to start the training session.

The second part — the training session. Exercise training should be performed in accordance with the published standards for HF patients [17–23]. Three different training modalities have been proposed to improve exercise capacity in HF patients: aerobic endurance (continuous or interval), respiratory muscle and strength/resistance training. Within the TR programme, patients can perform a varied range of endurance training e.g. walking, nordic walking and cycle ergometer trainings. The intensity of exercise depends on workload achievements in tests. A training heart rate range of 40–70% HRR (HRR = difference between the basal and peak heart rate during exercise test) and 10/20–14/20 of the Borg perceived exertion are recommended [17, 24].

Telemonitoring during training sessions

TR set is used to monitor and control training in anywhere the patient has elected to exercise. If the training session is completed uneventfully, the patient transmits ECG recording via a mobile phone to the monitoring centre immediately after the end of every training session. The data are stored in a computer and are analyzed by TR team at the monitoring centre, and the safety, efficacy, and accuracy of a particular patient rehabilitation programme are assessed.

Using the data on heart rate during exercise and the patient’s subjective evaluation of the perceived exertion, consultants are able to adjust the training workload appropriately or, if necessary, to discontinue the session (physicians are those who take the final decisions).

Patients can also transmit an ECG recording at any moment, e.g. due to symptoms like palpitation, chest pain etc. (thanks to tele-event-Holter ECG feature). The telephone contact is also used for psychological support.

Summary

There have been numerous papers published recently indicating that cardiac disease patients, especially those with HF, benefit from home-based CR. A mandatory element which makes this type of CR possible is its supervision by using telemedicine. If this procedure is to be implemented, it is necessary to know how to do it. That is why I believe that this paper will be my humble contribution to making the slogan ‘H2H — Hospital-to-Home’ more popular [28].

Conflict of interest: none declared

References


