Out-of-hospital experience in patients with implantable mechanical circulatory support: present and future trends

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Abstract

From March 1993 to August 1995, 33 patients received implantable VAD systems at our center. Nineteen patients received the wearable Novacor LVAS and 14 patients the TCI HeartMate device. Both systems enable the patients to be mobilized very quickly and some of them even do not require critical care after a few days. In our series 17 patients (eight Novacor, nine TCI) could be transferred to the normal floor. The wearable electrically driven Novacor system opens the opportunity of sending patients out of hospital. Since July 1994 we have referred five patients to a rehabilitation center, and six patients were sent home, three of them for more than 70 days. A number of factors are necessary to prepare the patient for being discharged. One of the most important things is to guarantee ambulatory patient care and to find an easy way for effective home monitoring. Our experience has shown that discharging these patients means giving them a maximum in quality of life and decreasing the costs by more than 50% in comparison to a stay in hospital for the whole time. Our results are encouraging to improve this strategy in the future. © 1997 Elsevier Science B.V.

Keywords: Mechanical circulatory support; Patient mobilisation; Rehabilitation; Wearable Novacor LVAS; TCI HeartMate

1. Introduction

From March 1987 to August 1995, 691 heart transplantations were performed at our hospital. Within these years the number of organ recipients increased rapidly and the success of cardiac transplantation is limited by the gap between supply and demand of donor hearts. This limitation increases the risk of patient morbidity and mortality during the long waiting period. Many patients here and elsewhere die awaiting a heart transplant or suffer irreversible injury to vital organs which makes them no longer eligible for transplantation [6]. Fortunately, modern types of ventricular assist devices offer a good possibility of a 'bridge' to cardiac transplantation. In addition, VAD systems are increasingly applied in patients with post-cardiotomy heart failure and miscellaneous other cardiac indications.

Between March 1987 and August 1995, 236 implantations of different types of mechanical circulatory support systems (MCSS) in 220 patients aged between 10 and 82 years (mean 50.7) were performed. The Biomedicus centrifugal pump has been applied since September 1987 in 67 patients, the Abiomed system since October 1990 in 60 patients, the Thoratec system since March 1992 in 76 patients, the wearable Novacor LVAS since March 1993 in 19 patients and the TCI HeartMate system (pneumatic) since March 1994 in 14 patients. Duration of support was between 1 h and 342 days (mean 21.1 ± 31.6 days) [1,2].

The electrically driven wearable Novacor LVAS 100 and the pneumatically driven TCI HeartMate are implantable devices for left ventricular assistance only. Both systems enable the patients to be mobilized very
quickly and most patients do no longer require critical care after a few days [7]. Under certain conditions patients supported with the Novacor device may even be discharged until a suitable donor organ has been found. The electrically driven TCI HeartMate system, which will soon be available at our center, also offers the possibility of temporarily discharging the patients [4].

In the following we describe our current strategy, which has been applied in 19 Novacor patients.

1.1. Patient management

After a quick mobilisation we transfer the patient to the normal ward. The next step is to transfer the patient to a rehabilitation center 1 km away from our hospital. Following rehabilitation patients supported with the Novacor system can be sent home under certain circumstances (Table 1). Some patients could even be discharged home directly following the hospital stay without rehabilitation treatment. Other patients, however, could not be discharged because they did not meet criteria mentioned in the following.

Several criteria have to be considered before discharging the patients. The first point is to make sure that the patients have no hemodynamic and technical problems. Improved mobilized patients are in advantage. A good general and psychological condition, a cooperative attitude and optimal help by the family are equally important. Patients and family members have to be (intellectually) able to be introduced to the system. The patients’ home should be adequately furnished so that equipment installation is possible without major problems. Another point of discussion is the distance to our hospital. In case of emergency or transplant it should be possible to take the patient to our center within a maximum of 4 h by car or 1 h by helicopter. Our first patient lives about 500 km away from our hospital.

The first step in our patient’s out-of-hospital life is a rehabilitation center 1 km away from our hospital, which has specialized in cardiac rehabilitation and is experienced in pre- and post-transplant treatment. This institution offers an optimal possibility of preparing the patient for being sent home. All patients are accommodated in nicely furnished rooms providing a private atmosphere. Extended physiotherapeutical measures and more activities on their own in a non-hospital surrounding increase the patients’ general well-being. In addition, teaching of patient and family members as well as social re-integration are of major importance during the rehabilitation period.

1.2. Training of staff

Before we transferred the first patient to the rehabilitation center the nursing staff was very anxious and reserved about this step. For this reason, we initiated a special VAD teaching program for nurses, doctors and other medical staff. They were trained in the specific anatomical and physiological situation and the specific operation of the VAD system. We also introduced the staff in our wound care protocol to guarantee continuous wound infection prophylaxis.

An important point is to make anybody of the involved staff familiar in dealing with the common alarm situations, changing Compact Controllers, how to manage emergency situations and who and when to call for help.

1.3. Out-of-hospital strategy

Within the last two years eight patients supported with the Novacor device were discharged home for a

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Table 1
Transferring activities in patients with implantable LVAD

<table>
<thead>
<tr>
<th></th>
<th>NOVACOR</th>
<th>TCI HeartMate</th>
</tr>
</thead>
<tbody>
<tr>
<td>All patients</td>
<td>19</td>
<td>14</td>
</tr>
<tr>
<td>Transferred to normal ward</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Transferred to rehab. center</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Home for weekend</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Permanently at home</td>
<td>3</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 2
Out-of-hospital experience with patients on the Novacor LVAS

<table>
<thead>
<tr>
<th>Patient</th>
<th>Sex</th>
<th>Age</th>
<th>Rehab center</th>
<th>Home for weekend</th>
<th>Home &gt; 60 days</th>
<th>HTX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Female</td>
<td>63</td>
<td>41 days</td>
<td>Yes</td>
<td>203 days</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>Male</td>
<td>49</td>
<td>80 days</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>62</td>
<td>No</td>
<td>No</td>
<td>100 days</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>65</td>
<td>15 days</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>60</td>
<td>28 days</td>
<td>No</td>
<td>99 days</td>
<td>Waiting</td>
</tr>
<tr>
<td>6</td>
<td>Female</td>
<td>30</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>Male</td>
<td>16</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>Male</td>
<td>50</td>
<td>28 days</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
period between one weekend and 203 days (Table 2). Significant problems could not be observed.

Sending patients home means bringing them back to their familiar atmosphere, to the family and to friends. Some patients can spend their time enjoying hobbies and two patients in our group have even returned to work. All these points can distract the patient from his illness and makes it easier for him to tolerate the long waiting time for a suitable donor heart and bring the patient back to normal life.

In addition, our experience has shown that costs of treatment for these patients can be decreased by about 50%.

However, a number of factors are necessary to prepare the patient and his family for living at home with a VAD device [3]. One of the most important things is to guarantee the ambulatory patient care and to find an easy way for effective home monitoring. For this reason patient, family members and family doctor were introduced in the function and power management of the system, patient wound care, dealing with alarm situations, how to behave in an emergency situation, and who and when to call for help. The training included changing of important technical parts such as the Compact Controller.

Another question in the development of our out-of-hospital strategy was our management of ambulatory care. It was our primary goal to leave the patient as independent as possible from people outside the family and from medical staff. The daily monitoring of blood pressure, temperature, and body weight as well as pump rate, pump output, and stroke volume was done and documented by the patient himself by means of common monitoring devices. In addition, they perform a Quick’s self test once a week. Pump parameters can easily be measured by the Novacor home monitor. In case of any significant deviation the patient can contact the patient care unit for help, where a competent person is available 24 h a day for patient information. Usually, we recommend a visit by the family doctor once a week for physical examination within the first month. Wound dressings should be changed every second day by a family member or family doctor.

At present, the patient is visited by an LVAS operator every 10 days within the first month, and than every 30 days. This visit includes a short clinical, neurological and psychological examination, wound inspection, complete VAD function check. Furthermore, an intensive discussion of any problems with the patient, family members and family doctor is important.

Every 6 weeks the patient presents himself at our out-patient department. The examination includes echocardiography, X-ray, ECG, clinical examination, neurological/psychological examination, wound inspection, laboratory tests, and detailed conversation between the VAD team and the patient.

2. Conclusion

Due to the encouraging results during the last years the application of ventricular assist devices has continuously increased. In addition the waiting time for suitable donor hearts is increasing as well so that we will have more VAD patients for long-term support in the future. For patients requiring left ventricular support exclusively, modern types of implantable devices such as the Novacor LVAS 100 W and the TCI HeartMate VE system are available. This systems offers the patient the possibility of being mobilized very quickly and of regaining an almost normal quality of life within a short time [3]. This is the reason for sending these patients home so that they can live a normal life together with their relatives.

In the future these VAD systems can become an alternative to a cardiac transplantation observing strict criteria. Further development is still to be done to make them smaller and completely implantable [1,5].

References


