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Review
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CONSIDERATIONS FOR EXERCISE THERAPY WITH SHORT-TERM AND LONG-TERM MECHANICAL CIRCULATORY SUPPORT

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Summary

Once a mechanical circulatory support (MCS) system has been inserted the physiotherapists' role is crucial to prepare the patient either for transplantation, for upgrade to long-term MCS or for device explant. There are numerous considerations for rehabilitation that should be addressed in order to provide a safe and effective exercise programme. This paper highlights considerations for exercise in both short-term and long-term MCS devices.

Key words: physiotherapy; exercise; mechanical circulatory support; MSC; Ventricular assist device; VAD

Introduction

Currently there is a lack of evidence regarding exercise-training protocols for people who have mechanical circulatory support (MCS) devices implanted for end-stage heart failure. Of the papers that have described rehabilitation most are post-left ventricular assist device (LVAD) insertion; many are single case studies, have less than 10 subjects, or are retrospective analysis [1,2,3].

The use of short-term extracorporeal MCS has brought about new challenges to Physiotherapy once patients are haemodynamically stable in the intensive care unit (ICU). Short-term MCS devices are being inserted more frequently and in a wide variety of clinical situations. Usually these patients are confined to bed in the ICU. Prolonged immobility is known to dramatically affect functional capacity, which can adversely affect post-insertion outcomes and increase ICU length of stay.

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There are many versions of long-term LVADs available and the exercise capacity will depend on the ability of the device to deliver an output that matches the intensity of exercise required.

The following considerations are based on the limited available evidence and clinical experience gained at Harefield Hospital, UK.

Considerations for exercise with short-term MCS

The main objectives of mobilising patient's who have short-term MCS devices in-situ are to: improve respiratory function; re-educate balance mechanisms; improve peripheral vascular tone; facilitate normal movement patterns and prevent further deconditioning. Prior to mobilising patients who have short-term MCS devices in-situ a thorough risk assessment needs to be conducted. The patient must be haemodynamically stable on the MCS, must be awake, alert and able to follow commands.

An echocardiogram must be performed to assess for thrombus formation and the activated partial thromboplastin time must be within the range set by the surgical/medical team. Knowledge of the surgical procedure is imperative, as it must be known if the cannulae have been well secured prior to any attempt at mobilisation.

A method to secure the device cannulae to the patient needs to be in place to reduce the amount of movement produced when mobilising from the bed. The securing method should also help reduce the gravitational pull of the cannulae as the patient stands up. The patient must be able to tolerate sitting in the full chair position in the bed for an adequate amount of time with no drop in device flows or reduction in mean arterial pressure before progressing to mobilising out of bed with greater challenge on the cardiovascular system. Prior to more dynamic mobility the patient may need time to improve their peripheral vascular resistance to prevent venous pooling and reductions in device flows when they are in a position with greater gravitational effects.

A team of appropriately trained staff should be present for the mobility session. One member of the team to be responsible for all invasive lines/infusions and tracheostomy tube if necessary; two physiotherapists to facilitate normal movement/balance and to assist with the use of equipment; one perfusionist/ventricular assist device (VAD) team member per short-term device and one member of the surgical team if there are any concerns with the cannulae.

The exercise sessions should be progressed by improving normal movement patterns and exercise tolerance. A mixture of cardiovascular exercise and muscle resistance work should be incorporated into the rehabilitation programme. The device flows are not adjusted during the mobility session, as the peripheral vascular

resistance would not be able to be fully assessed and also to prevent any thromboemboli that may exist being dislodged by the change in flow dynamics.

The patient should not sit out of bed in case they suffer from venous pooling causing reduced device flow. If this does happen it may be unsafe to use a hoist to transfer the patient back into bed due to the position of the cannulae. The patients can sit in the full chair position in the bed, exercise from the bed and then return to the full chair position in the bed to avoid the necessity to sit out of bed. The cannulae need to be constantly assessed during the mobility session as they may exhibit an increased amount of movement ("chattering") caused by suction of the ventricles, which may lead to permanent damage.

Consideration for exercise with long-term MCS

The mechanism of non-pulsatile devices means that it is extremely difficult, if not impossible at times, to measure an accurate blood-pressure, oxygen saturation or heart rate using non-invasive means. It should not be assumed that the pump rate of the pulsatile devices is equal to the heart rate. Hypotension and low device flows are one of the most common problems. The patient must be well educated regarding the normal flow values so that they are able to take appropriate action when required.

Excessive movement of the driveline at the abdominal incision can cause micro-trauma, which can increase the chances of infection and cause pain. The driveline needs to be immobilised sufficiently to prevent shearing and torsion injury [4]. Driveline pain and infection can severely limit physical therapy, as it is not advisable to exercise when an active infection is present. The pain from the micro-trauma can also affect normal movement patterns. The position of the driveline through the abdominal wall causes the patient not to be able to perform any specific abdominal exercises. This driveline position also limits use of exercise machines that involve movement of the upper limbs and the lower limbs simultaneously or any movements that cause repeated twisting of the trunk.

The underlying condition requiring LVAD insertion and post-operative effects will affect the degree of exercise tolerance at any time. Each patient with an LVAD will require an individual assessment and exercise programme. The programme will be designed around physical limitations and the ability of the LVAD to affect exercise capacity.

Exercise prescription for long-term VADs

Treadmill exercise testing with a modified Bruce, Naughton or modified Naughton protocol has been used safely with this patient group [5,6]. The modified Wa-

ssermann ramp protocol for a cycle ergometer has also been used to assess maximal exercise capacity [6]. Treadmill exercise with a workload of 3-5 METS for 20-30minutes has been shown to be safe and effective [3].

Exercise should not be stopped suddenly and should include a "cool-down" period to prevent problems with venous pooling. Hypovolaemia will cause reduced device flows, which may result in feelings of light-headedness. When exercising for a prolonged period, patients should be encouraged to increase their fluid intake to avoid dehydration.

There is a lack of studies that have published any contraindications to exercise for patients with MCS. Only one study [7] has published any contraindications to exercise for LVAD patients and these are stated as contraindications at 4-6weeks post-surgery. These include: onset of angina; a drop in systolic blood pressure (BP) below resting BP; an increase in systolic BP exceeding 200mmHg; ECG changes; oxygen desaturation <85%; a drop in LVAD flow <3litres/minute and a rating of >13 on the Borg RPE scale at sub-maximal workloads. These contraindications are however extremely difficult to establish with non-pulsatile devices as it is difficult to gain accurate measurements by non-invasive means of BP, hear rate or oxygen saturations. On some non-pulsatile devices the device flows are not available to view if the patient is on portable batteries (Heartmate II). Together these limit the accurate assessment of the effect that the exercise is having on the patient.

Conclusion

Physiotherapy input is essential for patients requiring MCS to combat physical deconditioning that occurs with heart failure and with prolonged periods in bed on the ICU after device insertion. Separate considerations are implicated for exercising patients with short-term and long-term MCS. A thorough risk assessment should be conducted in order to establish a safe and effective exercise programme.

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Sažetak

Prijedlog programa vježbanja bolesnika s dugotrajnom i kratkotrajnom mehaničkom potporom

Nakon ugradnje mehaničke potpore srcu i cirkulaciji (MSC) važna je uloga fizioterapeuta u dobroj pripremi pacijenta za eksplantaciju uređaja, transplantaciju ili ugradnju dugoročnog MSC-a. Kako bi program vježbanja bio siguran i efektivan za pacijenta, potrebna je dobra priprema fizioterapeuta. Što je sve potrebno razmotriti kod fizioterapije pacijenata s ugrađenim kratkoročnim odnosno dugoročnim MCS uređajem prikazano je u ovom članku.

Ključne riječi: fizioterapija; vježbanje; mehanička potpora srcu i cirkulaciji; MSC; VAD