

## Cardiac Rehabilitation and Peripheral Artery Disease Supervised Exercise Therapy Protocol for Patient with Left Ventricular Assist Device (LVAD)

Chest Pain or Angina
<p>1. Patient complains of chest pain or angina, <b>or</b> exhibits at least 1 sign or symptom of angina: pain, pressure, or squeezing discomfort in chest, back, neck, jaw, or upper extremity; indigestion-like discomfort; nausea or vomiting; diaphoresis at rest.</p>
<p>2. Assess symptoms, electrocardiogram (ECG), Doppler blood pressure (BP), respiratory rate (RR), oxygen saturation (O2 sat) <i>if obtainable</i>, LVAD parameters.</p>
<p>a. If any vital sign is <b>unstable</b> (HR &lt;45 or at rest &gt;120 bpm, BP &lt;80 or at rest &gt;105 mmHg, RR &lt;8 or at rest &gt;30 bpm, O2 sat &lt;90%), <b>or</b> ECG is changed from baseline, <b>or</b> LVAD parameters are changed from baseline:</p> <ol style="list-style-type: none"> <li>i. For Raleigh Campus, activate <i>Code LVAD</i>. For off-campus outpatient rehab sites, notify supervising provider and activate emergency response.</li> <li>ii. Contact the patient's VAD Coordinator.</li> <li>iii. Monitor ECG, RR, O2 sat continuously. Reassess symptoms, BP, LVAD parameters at least every 5 minutes, or with changes in patient condition.</li> <li>iv. Do NOT administer <b>Nitroglycerin</b>.</li> <li>v. Follow VAD Coordinator instructions. Hand off care to emergency response team upon arrival.</li> </ol>
<p>b. If vital signs are <b>stable</b> (HR ≥45 or at rest ≤120 bpm, BP ≥80 mmHg or at rest ≤105 mmHg, RR ≥8 or at rest ≤30 bpm, O2 sat ≥90%), <b>and</b> ECG <b>and</b> LVAD parameters are unchanged from baseline:</p> <ol style="list-style-type: none"> <li>i. Contact the patient's VAD Coordinator.</li> <li>ii. Monitor ECG, RR, O2 sat continuously. Reassess symptoms, BP, LVAD parameters at least every 5 minutes, or with changes in patient condition.</li> <li>iii. Do NOT administer <b>Nitroglycerin</b>.</li> <li>iv. Follow VAD Coordinator instructions.</li> </ol>
<p>c. At end of initial assessment, if angina self-resolves, patient may exercise at low intensity.</p> <ol style="list-style-type: none"> <li>i. Reassess symptoms, ECG, BP, O2 sat, LVAD parameters at least once during exercise; at completion of exercise; and with changes in patient condition.</li> <li>ii. Notify patient's VAD Coordinator.</li> </ol>
Decreased Oxygen Saturation, Shortness of Breath, or Respiratory Distress
<p>1. O2 sat &lt;90%, <b>or</b> patient complains of shortness of breath <b>or</b> exhibits at least 1 sign or symptom of respiratory distress: increased respiratory effort (e.g., tachypnea, nasal flaring, retractions, use of accessory muscles to assist in breathing); inadequate respiratory effort (e.g., bradypnea or hypoventilation); abnormal airway sounds (e.g., stridor, wheezing, grunting); pale, cool skin tone or in some cases warm, red, and diaphoretic; changes in level of consciousness or agitation</p>
<p>2. Assess symptoms, electrocardiogram (ECG), Doppler blood pressure (BP), respiratory rate (RR), oxygen saturation (O2 sat) <i>if obtainable</i>, LVAD parameters.</p>
<p>a. If any vital sign is <b>unstable</b> (HR &lt;45 or at rest &gt;120 bpm, BP &lt;80 or at rest &gt;105 mmHg, RR &lt;8 or at rest &gt;30 bpm, O2 sat &lt;90%), <b>or</b> ECG is changed from baseline, <b>or</b> LVAD parameters are changed from baseline:</p> <ol style="list-style-type: none"> <li>i. For Raleigh Campus, activate <i>Code LVAD</i>. For off-campus outpatient rehab sites, notify supervising provider and activate emergency response.</li> <li>ii. Contact the patient's VAD Coordinator.</li> <li>iii. Administer <b>oxygen starting at 4 L/min via nasal cannula</b>, increasing by 1 L/min up to 6 L/min to maintain O2 sat ≥90% <i>if obtainable</i>.</li> <li>iv. If O2 sat is obtainable and ≥90%, encourage deep breaths.</li> <li>v. Monitor ECG, RR, O2 sat continuously. Reassess symptoms, BP, LVAD parameters at least every 5 minutes, or with changes in patient condition.</li> <li>vi. Follow VAD Coordinator instructions. Hand off care to emergency response team upon arrival.</li> </ol>
<p>b. If O2 sat &lt;90% <b>and</b> other vital signs are <b>stable</b> (HR ≥45 or at rest ≤120 bpm, BP ≥80 mmHg or at rest ≤105 mmHg, RR ≥8 or at rest ≤30 bpm), <b>and</b> patient does <b>not</b> complain of shortness of breath <b>or</b> exhibit any signs or symptoms of respiratory distress, <b>and</b> ECG <b>and</b> LVAD parameters are unchanged from baseline;</p> <p><b>OR</b></p> <p>If patient complains of shortness of breath or exhibits 1 sign or symptom of respiratory distress, <b>and</b> vital signs are <b>stable</b>, <b>and</b> ECG <b>and</b> LVAD parameters are unchanged from baseline:</p> <ol style="list-style-type: none"> <li>i. Contact the patient's VAD Coordinator.</li> <li>ii. Administer <b>oxygen starting at 4 L/min via nasal cannula</b>, increasing by 1 L/min up to 6 L/min to maintain O2 sat ≥90% <i>if obtainable</i>.</li> <li>iii. If O2 sat is obtainable and ≥90%, encourage deep breaths.</li> <li>iv. Monitor ECG, RR, O2 sat continuously. Reassess symptoms, BP, LVAD parameters at least every 5 minutes, or with changes in patient condition.</li> <li>v. Follow VAD Coordinator instructions.</li> </ol>

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<p>c. At end of initial assessment, if O<sub>2</sub> sat is obtainable and <math>\geq 90\%</math> <b>and</b> shortness of breath or signs and symptoms of respiratory distress self-resolve, patient may exercise at low intensity.</p> <ol style="list-style-type: none"> <li>i. Reassess symptoms, ECG, BP, O<sub>2</sub> sat, LVAD parameters at least once during exercise; at completion of exercise; and with changes in patient condition.</li> <li>ii. Notify patient's VAD Coordinator.</li> </ol>
<p><b>Hypoglycemia or Hyperglycemia</b></p>
<p>1. Patient complains of or exhibits 1 or more signs or symptoms of:</p> <ol style="list-style-type: none"> <li>a. <b>Hypoglycemia</b> (altered mental status; shakiness; nervousness, irritability, or anxiety; lightheadedness or dizziness; headache; tingling or numbness of tongue or lips; tachycardia; diaphoresis, chills, and clamminess; hunger)</li> <li>b. <b>Hyperglycemia</b> (fatigue, shortness of breath, tachycardia, increased thirst, very dry mouth, fruity breath odor, nausea or vomiting, stomach pain, frequent urination)</li> </ol>
<p>2. Perform point of care (POC) glucose test.</p> <ol style="list-style-type: none"> <li>a. <b>Blood glucose (BG) &lt;50 mg/dL or <math>\geq 500</math> mg/dL is a critical result.</b> For Raleigh Campus, activate <i>Code LVAD</i>. For off-campus outpatient rehab sites, notify supervising provider and activate emergency response. Contact the patient's VAD Coordinator.</li> </ol>
<ol style="list-style-type: none"> <li>b. If <b>BG &lt;70 mg/dL</b> and patient is <b>unable</b> to consume carbohydrates orally             <ol style="list-style-type: none"> <li>i. For Raleigh Campus, activate <i>Code LVAD</i>. For off-campus outpatient rehab sites, notify supervising provider and activate emergency response. Contact the patient's VAD Coordinator.</li> <li>ii. Administer <b>Glucagon 1mg IM STAT</b>. If patient has insulin infusing via insulin pump, disconnect pump until BG <math>\geq 120</math> mg/dL. Perform POC glucose test every 15 minutes.</li> <li>iii. Assess symptoms, electrocardiogram (ECG), Doppler blood pressure (BP), respiratory rate (RR), oxygen saturation (O<sub>2</sub> sat) <i>if obtainable</i>, LVAD parameters.</li> <li>iv. Monitor ECG, RR, O<sub>2</sub> sat continuously. Reassess symptoms, BP, LVAD parameters at least every 5 minutes, or with changes in patient condition.</li> <li>v. Follow VAD Coordinator instructions. Hand off care to emergency response team upon arrival.</li> </ol> </li> </ol>
<ol style="list-style-type: none"> <li>c. If <b>BG &lt;70 mg/dL</b> and patient is <b>able</b> to consume carbohydrates             <ol style="list-style-type: none"> <li>i. Treat with <b>15-30 grams fast-acting oral carbohydrate</b> (4-8 oz. juice). Perform POC glucose test in 15 minutes.</li> <li>ii. If repeat BG &lt;70 mg/dL, treat with <b>15 grams fast-acting oral carbohydrate</b> (4 oz. juice). Perform POC glucose test in 15 minutes.</li> <li>iii. If BG remains &lt;70 mg/dL <b>or</b> signs and symptoms of hypoglycemia persist after 2 treatments                 <ol style="list-style-type: none"> <li>1. For Raleigh Campus, activate <i>Code LVAD</i>. For off-campus outpatient rehab sites, notify supervising provider and activate emergency response. Contact the patient's VAD Coordinator.</li> <li>2. Treat with <b>15 grams fast-acting oral carbohydrate</b> (4 oz. juice). Perform POC glucose test every 15 minutes.</li> <li>3. Assess symptoms, electrocardiogram (ECG), Doppler blood pressure (BP), respiratory rate (RR), oxygen saturation (O<sub>2</sub> sat) <i>if obtainable</i>, LVAD parameters.</li> <li>4. Monitor ECG, RR, O<sub>2</sub> sat continuously. Reassess symptoms, BP, LVAD parameters at least every 5 minutes, or with changes in patient condition.</li> <li>5. Follow VAD Coordinator instructions. Hand off care to emergency response team upon arrival.</li> </ol> </li> <li>ii. Once BG <math>\geq 70</math> mg/dL, patient should consume a meal or snack (e.g., 2 graham cracker squares and 1 oz. peanut butter and/or snack bar). If signs and symptoms of hypoglycemia have resolved <b>and</b> emergency response was not activated, patient may exercise at low intensity.</li> </ol> </li> </ol>
<ol style="list-style-type: none"> <li>d. If <b>BG <math>\geq 250</math> mg/dL</b> for patients with Type 1 Diabetes (DM) <b>or</b> <b><math>\geq 350</math> mg/dL</b> for patients with Type 2 DM             <ol style="list-style-type: none"> <li>i. Implement orders to correct hyperglycemia per home medication orders. Provide 8 oz. water within prescribed fluid restrictions.</li> <li>ii. Perform POC glucose test in 15 minutes.</li> <li>iii. If BG &lt;250 mg/dL for patients with Type 1 DM or &lt;350 mg/dL for patients with Type 2 DM, <b>and</b> signs and symptoms of hyperglycemia have resolved, <b>and</b> emergency response was not activated; patient may exercise at low intensity.</li> <li>iv. If BG remains <math>\geq 250</math> mg/dL for patients with Type 1 DM or <math>\geq 350</math> mg/dL for patients with Type 2 DM, patient may <b>not</b> exercise. Notify patient's VAD coordinator.</li> </ol> </li> </ol>
<p><b>Exercise Blood Glucose Testing</b></p>
<p>1. For patients with a history of pre-diabetes or diabetes (DM) currently taking any form of medication that may affect blood glucose (BG) levels (e.g., DM medications, corticosteroids, fluoroquinolone antibiotics, cyclosporine, tacrolimus, sirolimus); <b>or</b> patients who have had a change in medication that may affect BG levels; <b>or</b> patients with HgA1C &gt;8%</p>
<p>2. Perform point of care (POC) glucose test, or check BG value using continuous glucose monitor (CGM), <b>pre-exercise</b>.</p> <ol style="list-style-type: none"> <li>a. To begin exercise, BG must be <math>\geq 100</math> mg/dL or 70-99 mg/dL with ordered treatment below, <b>and</b> &lt;250 mg/dL for patients with Type 1 DM or &lt;350 mg/dL for patients with Type 2 DM.</li> </ol>

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<p>b. If <b>BG &lt;70</b> mg/dL and patient is <b>unable</b> to consume carbohydrates orally</p> <ol style="list-style-type: none"> <li>i. For Raleigh Campus, activate <i>Code LVAD</i>. For off-campus outpatient rehab sites, notify supervising provider and activate emergency response. Contact the patient's VAD Coordinator.</li> <li>ii. If BG was obtained from CGM, perform POC glucose test to confirm BG value.</li> <li>iii. Administer <b>Glucagon 1mg IM STAT</b>. If patient has insulin infusing via insulin pump, disconnect pump until BG <math>\geq</math> 120 mg/dL. Perform POC glucose test every 15 minutes.</li> <li>iv. Assess symptoms, electrocardiogram (ECG), Doppler blood pressure (BP), respiratory rate (RR), oxygen saturation (O2 sat) <i>if obtainable</i>, LVAD parameters.</li> <li>v. Monitor ECG, RR, O2 sat continuously. Reassess symptoms, BP, LVAD parameters at least every 5 minutes, or with changes in patient condition.</li> <li>vi. Follow VAD Coordinator instructions. Hand off care to emergency response team upon arrival.</li> </ol>
<p>c. If <b>BG &lt;70</b> mg/dL and patient is <b>able</b> to consume carbohydrates</p> <ol style="list-style-type: none"> <li>i. If BG was obtained from CGM, perform POC glucose test to confirm BG value.</li> <li>ii. Treat with <b>15-30 grams fast-acting oral carbohydrate</b> (4-8 oz. juice). Perform POC glucose test in 15 minutes.</li> <li>iii. If repeat BG &lt;70 mg/dL, treat with <b>15 grams fast-acting oral carbohydrate</b> (4 oz. juice). Perform POC glucose test in 15 minutes.</li> <li>iv. If BG remains &lt;70 mg/dL <b>or</b> signs and symptoms of hypoglycemia persist after 2 treatments <ol style="list-style-type: none"> <li>1. For Raleigh Campus, activate <i>Code LVAD</i>. For off-campus outpatient rehab sites, notify supervising provider and activate emergency response. Contact the patient's VAD Coordinator.</li> <li>2. Treat with <b>15 grams fast-acting oral carbohydrate</b> (4 oz. juice). Perform POC glucose test every 15 minutes.</li> <li>3. Assess symptoms, electrocardiogram (ECG), Doppler blood pressure (BP), respiratory rate (RR), oxygen saturation (O2 sat) <i>if obtainable</i>, LVAD parameters.</li> <li>4. Monitor ECG, RR, O2 sat continuously. Reassess symptoms, BP, LVAD parameters at least every 5 minutes, or with changes in patient condition.</li> <li>5. Follow VAD Coordinator instructions. Hand off care to emergency response team upon arrival.</li> </ol> </li> <li>v. Once BG <math>\geq</math>70 mg/dL, patient should consume a meal or snack (e.g., 2 graham cracker squares and 1 oz. peanut butter and/or snack bar). If signs and symptoms of hypoglycemia have resolved <b>and</b> emergency response was not activated, patient may exercise at low intensity.</li> </ol>
<p>d. If <b>BG = 70-99</b> mg/dL,</p> <ol style="list-style-type: none"> <li>i. If BG was obtained from CGM, perform POC glucose test to confirm BG value.</li> <li>ii. Provide <b>15-30 grams oral carbohydrate</b> (4-8 oz. juice and/or 2 graham cracker squares and 1 oz. peanut butter and/or snack bar).</li> <li>iii. Patient may proceed with exercise.</li> </ol>
<p>e. If <b>BG = 100-150</b> mg/dL prior to exercise and patient took full dose of rapid or short-acting insulin <b>or</b> hypoglycemic oral agent with most recent meal (e.g. Insulin Lispro, Aspart, Glulisine, Regular; Glyburide, Glipizide, Glimepiride, Chlorpropamide, Tolazamide, Tolbutamide, Nateglinide, Repaglinide, Pramlintide, Exenatide), perform POC glucose test after 15-25 minutes of exercise. Depending on BG value, provide treatment as indicated in sections 2b-d.</p>
<p>f. If <b>BG <math>\geq</math>250</b> mg/dL for patients with Type 1 DM <b>or</b> <b><math>\geq</math>350</b> mg/dL for patients with Type 2 DM</p> <ol style="list-style-type: none"> <li>i. If BG was obtained from CGM, perform POC glucose test to confirm BG value.</li> <li>ii. Implement orders to correct hyperglycemia per home medication orders. Provide 8 oz. water within prescribed fluid restrictions.</li> <li>iii. Perform POC glucose test in 15 minutes.</li> <li>iv. If BG &lt;250 mg/dL for patients with Type 1 DM or &lt;350 mg/dl for patients with Type 2 DM, <b>and</b> signs and symptoms of hyperglycemia have resolved, <b>and</b> emergency response was not activated; patient may exercise at low intensity.</li> <li>v. If BG remains <math>\geq</math>250 mg/dL for patients with Type 1 DM or <math>\geq</math>350 mg/dL for patients with Type 2 DM, patient may <b>not</b> exercise. Notify patient's VAD coordinator.</li> </ol>
<p><b>3. Perform POC glucose test post-exercise.</b></p>
<p>a. If <b>BG &lt;70</b> mg/dL and patient is <b>unable</b> to consume carbohydrates orally</p> <ol style="list-style-type: none"> <li>i. For Raleigh Campus, activate <i>Code LVAD</i>. For off-campus outpatient rehab sites, notify supervising provider and activate emergency response. Contact the patient's VAD Coordinator.</li> <li>ii. Administer <b>Glucagon 1mg IM STAT</b>. If patient has insulin infusing via insulin pump, disconnect pump until BG <math>\geq</math> 120 mg/dL. Perform POC glucose test every 15 minutes.</li> <li>iii. Assess symptoms, electrocardiogram (ECG), Doppler blood pressure (BP), respiratory rate (RR), oxygen saturation (O2 sat) <i>if obtainable</i>, LVAD parameters.</li> <li>iv. Monitor ECG, RR, O2 sat continuously. Reassess symptoms, BP, LVAD parameters at least every 5 minutes, or with changes in patient condition.</li> <li>v. Follow VAD Coordinator instructions. Hand off care to emergency response team upon arrival.</li> </ol>

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- b. If **BG <70** mg/dL and patient is **able** to consume carbohydrates
- Treat with **15-30 grams fast-acting oral carbohydrate** (4-8 oz. juice). Perform POC glucose test in 15 minutes.
  - If repeat BG <70 mg/dL, treat with **15 grams fast-acting oral carbohydrate** (4 oz. juice). Perform POC glucose test in 15 minutes.
  - If BG remains <70 mg/dL **or** signs and symptoms of hypoglycemia persist after 2 treatments
    - For Raleigh Campus, activate *Code LVAD*. For off-campus outpatient rehab sites, notify supervising provider and activate emergency response. Contact the patient's VAD Coordinator.
    - Treat with **15 grams fast-acting oral carbohydrate** (4 oz. juice). Perform POC glucose test every 15 minutes.
    - Assess symptoms, pulse, ECG blood pressure (BP), respiratory rate (RR), O2 sat. If patient has LVAD, assess LVAD parameters.
    - Monitor ECG, RR, O2 sat continuously. Reassess symptoms, BP, LVAD parameters at least every 5 minutes, or with changes in patient condition.
    - Follow VAD Coordinator instructions. Hand off care to emergency response team upon arrival.
  - Once BG  $\geq$ 70 mg/dL, patient should consume a meal or snack (e.g., 2 graham cracker squares and 1 oz. peanut butter and/or snack bar).
- c. If **BG = 70-89** mg/dL, provide **15-30 grams oral carbohydrate** (4-8 oz. juice and/or 2 graham cracker squares and 1 oz. peanut butter and/or snack bar) and encourage patient to eat a snack or meal within the hour.
- d. If **BG  $\geq$ 90** mg/dL, no treatment required.
- 4. Discontinue pre and post-exercise BG monitoring when the following conditions are met for 4 consecutive sessions:**
- Pre-exercise** BG  $\geq$ 100 mg/dL, **and** <250 mg/dL for patients with Type 1 DM or <350 mg/dL for patients with Type 2 DM
  - Post-exercise** BG  $\geq$ 90 mg/dL.
  - Exceptions**
    - If patient taking Metformin only, discontinue pre and post-exercise BG monitoring when pre-exercise BG  $\geq$ 90 mg/dL and post-exercise BG  $\geq$  80 mg/dL for 4 consecutive sessions.
    - Patients with Type 1 DM should continue to monitor their **pre and post-exercise** BG each session, or be monitored by staff, even after these conditions have been met.