Figure 2. Work rate (Watts) $V_{O_2}$ relationship in normal subjects and patients with heart failure. A: Normal slope is $\sim 10 \text{ ml } V_{O_2}$ per Watt. B: At high work rates, the $V_{O_2}$/Watts slope may plateau in HF patients. C: In severe LV dysfunction, $V_{O_2}$ may decline as blood pressure and cardiac output are reduced.

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Figure 3. Identification of the ventilatory threshold (VT) by the V-Slope method. Patients with heart failure demonstrate a change in the V-Slope at a lower $V_O_2$.

Below VT: $CO_2$ from Kreb’s cycle stimulates ventilation

Above VT: $CO_2$ from Kreb’s and lactate buffering further stimulates ventilation, increasing $CO_2$ output

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Figure 4. Ventilatory response ($V_\text{E}$) as a function of $V\text{CO}_2$ ($V_\text{E}/V\text{CO}_2$ slope) during incremental exercise in normal and patients with mild or moderate heart failure.