Background  With a limited supply of donor organs, mechanical circulatory support (MCS) has played a key role in advanced heart failure (1). While left ventricular assist devices (LVADs) can be used as a bridge to transplantation, recovery, or as destination therapy (refer to Fast Fact #205), a total artificial heart (TAH) is only approved as a bridge to transplantation. Approximately 100 TAHs are implanted annually in the U.S (2,3). This Fast Fact explores practical and ethical considerations with TAH therapy.

The Technology  The TAH is a pulsatile pneumatic pump that orthotopically replaces both native cardiac ventricles and all heart valves and is attached to the remnant native atria. It can deliver a cardiac output of 9.5 L/min and is used in patients when LVAD is contraindicated -- biventricular failure or refractory arrhythmias. While a 400-lb machine was previously required to operate a TAH, smaller “suitcase-sized” drivers are available in the hospital setting. In the U.S., patients with a TAH require hospital care unless part of a clinical trial.  A portable “backpack-sized” driver which can support patients outside of the hospital is under investigation in the U.S (approved for use in Europe).

Outcomes  Almost 80% of patients with a TAH go on to receive cardiac transplantation (4). For the remaining 20% who become transplant-ineligible or die awaiting a suitable organ, data are limited regarding best practices for the disease-directed and supportive care for when the TAH has become de facto destination therapy. Classic symptoms of heart failure -- dyspnea, anxiety, pain, and debility -- can remain problematic for patients with a TAH; a sense of confinement in the hospital setting, sleep disturbance and anxiety from the sound of the pneumatic pump can negatively impact quality of life.  The longest reported time a patient has been supported with a TAH prior to receiving a transplant is 3.5 years (2). Bleeding in the immediate postoperative period and infection are the most common complications. When infections occur, they are unlikely to cause death or delay transplantation. TAHs have a low risk of device malfunction or thromboembolic events (5). In a small cohort, mortality with TAH in situ was usually from multorgan failure followed by procedural or technical complications (6).

Ethical/Legal Issues  It is ethically permissible to discontinue life-sustaining treatments as patients maintain a right to refuse intervention. Legal rulings have asserted no difference between withholding or withdrawing such therapies (See Fast Fact #56,#111,#112,#159). Some raise concern as to whether the considerations are different with TAH compared with an LVAD since the native heart’s valves and ventricles are surgically removed (7). Regardless, many ethicists, cardiologists, and palliative care clinicians support TAH deactivation if it no longer meets a patient’s goals of care or if the burdens of the TAH outweighs its benefits (8). Considering that 20% who receive a TAH do not go on to transplantation, informing patients prior to TAH implantation that an iatrogenic condition is being created that can alter their end-of-life experience is prudent (8).

Palliative Care Specialist Services  Supportive care and symptom management of patients can be provided in parallel, similar to LVADs (See Fast Fact #269). Palliative care teams are often instrumental in assuring symptom management, and providing psychosocial support to patients and families when transplantation is no longer an option. Common palliative medications which can prolong the QT interval (i.e. haloperidol or ondansetron) are acceptable as the ventricles are surgically absent and hence ventricular arrhythmias are not an issue.

Discontinuing TAHs  Most TAH deactivations take place in the hospital setting, although deactivation elsewhere has been reported. Following informed consent from the patient or surrogate and discussion with key stakeholders—including cardiothoracic surgery, cardiology, MCS coordinators, and social work—deactivation can be planned. Unlike discontinuation of other cardiac therapies where survival can be variable, death after TAH deactivation occurs within minutes due to absence of cardiac output and is confirmed by apnea. Care should be taken to ensure that effective symptom management and that loved ones are fully supported during this time; see related Fast Facts that explore discontinuation of other life-sustaining therapies (See Fast Fact #33,#34,#35,#269). Patients may also progress to clinical death (i.e.
respiratory arrest or brain death) with the TAH functioning, necessitating post-mortem pump deactivation. Providers can be trained by perfusionists to deactivate the TAH in a manner with minimal alarms. TAHs, like LVADs, do not require explantation prior to cremation whereas pacemakers and defibrillators do as they have an internal battery (See Fast Fact #111,#112,#269).

References:


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Version History: This Fast Fact was originally edited by Sean Marks MD. First electronically published May 2015

Fast Facts and Concepts are edited by Sean Marks MD (Medical College of Wisconsin) and associate editor Drew A Rosielle MD (University of Minnesota Medical School), with the generous support of a volunteer peer-review editorial board, and are made available online by the Palliative Care Network of Wisconsin (PCNOW); the authors of each individual Fast Fact are solely responsible for that Fast Fact’s content. The full set of Fast Facts are available at Palliative Care Network of Wisconsin with contact information, and how to reference Fast Facts.

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