Complete Explantation of Left Ventricular Assist Device Due to Myocardial Recovery

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KEY WORDS: heart failure, recovery, left ventricular assist device (LVAD) explantation

IMAJ 2014; 16: 127–128

Left ventricular assist devices are effective supporters of heart function as a bridge to cardiac transplantation in patients with end-stage heart failure. Technological advances have led to a burst of newer generation devices that are smaller, lighter, easier to implant, and more reliable than those applied thus far [1]. Introduction of these advanced devices has evoked a marked improvement in risk-benefit ratios, with increased device durability and reduced patient morbidity [2]. Substantial recovery of ventricular function has been reported in some patients on LVAD bridge to transplant or recovery support. In these cases, cardiac function improved within several months of device implantation, which allowed for LVAD explantation [2,3]. It is now clear that when provided with sufficient mechanical unloading, as is the case with LVAD support, reverse myocardial remodelling occurs at a structural, whole-heart, cellular, molecular, metabolic, electrophysiological, cell survival and functional level. Together, these elements of reverse remodelling render myocardial recovery feasible [4,5]. In real life however, due to the lack of clinical experience and valid criteria, along with patients' individual variations, recovery allowing LVAD explantation occurs sporadically.

We describe here a 29 year old patient with severe heart failure disease that mandated LVAD implantation as a lifesaving procedure. After 22 months, the patient underwent a complete LVAD explantation due to substantial myocardial recovery. To the best of our knowledge, this is the first complete explantation of an LVAD ever undertaken in Israel as a result of myocardial recovery.

PATIENT DESCRIPTION

A 29 year old patient was admitted due to severe heart failure and deterioration over several months following a febrile illness. An echocardiogram demonstrated left ventricular end-diastolic dimension of 71 mm and left ventricular ejection fraction of 20%. A HeartMate II LVAD™ (Thoratec Corporation, USA) was implanted as a "long bridge." Although the apical core biopsy performed several months after the febrile illness demonstrated fibrotic changes with no active inflammation, a presumed clinical diagnosis of myocarditis was made and the remote possibility of future recovery was considered and discussed with the patient. The patient was discharged from the hospital and was able to resume an almost normal life. Over the next 18 months of follow-up, we constantly evaluated the possibilities of myocardial recovery. Since no proven consensual protocol exists, we created our own series of "functional recovery assessment tests" showing the development of a gradual but steady myocardial recovery:

- Serial echocardiograms were performed while the patient was supported by his daily LVAD speed of 8800 rounds per minute, demonstrating a gradual reduction of left ventricular EDD from 71 mm to 5.4 and improvement of left ventricular ejection fraction from 20% to 55% during 18 months post-implantation.
- After receiving intravenous heparin, he had repeated echocardiograms at the minimal speed allowed in HM-II (6000 RPM) to prevent regurgitation, maintaining both EDD and LVEF values with no worsening of right ventricular systolic function, mitral regurgitation or pulmonary hypertension.
- After the patient was given intravenous heparin, at a speed of 6000 RPM, maximal oxygen consumption was measured via a cardiopulmonary exercise test, measuring the MVO_2 of 25 ml/kg/min (63% of the predicted), VE/VCO_2 of 27.9, 70% of the predicted O_2 pulse values, reaching an respiratory exchange ratio of 1.4 and maximal load of 132 watts.
- Stress echocardiogram was performed at the end of the cardiopulmonary exercise test, while the patient remained on 6000 RPM with an aortic valve opening of 1:1, demonstrating normal sized left ventricular dimension and normal function with no significant mitral regurgitation, right ventricular systolic dysfunction or pulmonary hypertension.

After analyzing the tests and discussing with the patient the options and the

***The first two authors contributed equally to this study**

LVAD = left ventricular assist device

EDD = left ventricular end-diastolic dimension
LVEF = left ventricular ejection fraction
MVO_2 = maximal oxygen consumption

possible risks of recurrence of heart failure symptoms post-explantation, a decision was made to explant the LVAD. We explanted the device completely via a recurrent mid-sternotomy approach, along with the inflow cannula, and closed the apex with a pericardial patch. The patient was discharged from the hospital and instructed to continue heart failure medical therapy. Two years later, the patient is in New York Heart Association functional class I, has a normal lifestyle, and is working full time as a computer technician. His follow-up echocardiogram is stable with near-normal ejection fraction, and a high level of exercise reached on his stress test (> 10 METS).

COMMENT

LVAD explantation following recovery is an unusual event but still feasible in selected patients. We believe that in young patients with non-ischemic etiology who undergo LVAD implantation, future explantation should be considered and evidence for myocardial recovery should be sought repeatedly. In our opinion and as demonstrated in this case, emphasis should focus on functional assessment tests but further studies are needed to better clarify which are the best predictors for long-lasting recovery after LVAD explantation.

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Capsule

Sun exposure can lower blood pressure

Liu and collaborators investigated the effects of UVA exposure – equivalent to 30 minutes of sun exposure at noon on a clear day in Southern Europe – on 24 healthy volunteers, controlling for both temperature and dietary nitrate. The researchers found plasma nitrate and nitrite changes as well as reductions in blood pressure, that were consistent with the release of NO from skin storage. These observations support a mechanism for the modulation of systemic NO bioactivity and a possible role of the skin in cardiovascular homeostasis. Clinically speaking, tests to evaluate blood pressure response to repeated UVA exposure with respect to age, gender, and disease states (such as hypertension) are needed. But if the blood pressure-reducing effects of UVA light hold up in larger trials, the authors suggested that a reevaluation of the risks and benefits associated with sun exposure might be in order. Still, this work is in the early stage. For now, people should not take these findings as any mitigation against the well-founded recommendation by dermatologists to avoid excessive sun exposure.

J Invest Dermatol 2014; doi: 10.1038/jid.2014.27

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Capsule

Transmissible dog cancer genome reveals the origin and history of an ancient cell lineage

Canine transmissible venereal tumor (CTVT) is the oldest known somatic cell lineage. It is a transmissible cancer that propagates naturally in dogs. CTVT is an unusual form of cancer because the infectious agent is not a virus or bacterium but the tumor cells themselves, which are passed from one dog to another during coitus. Murchison et al. sequenced the genomes of two CTVT tumors and found that CTVT has acquired 1.9 million somatic substitution mutations and bears evidence of exposure to ultraviolet light. CTVT is remarkably stable and lacks subclonal heterogeneity despite thousands of rearrangements, copy-number changes, and retrotransposon insertions. More than 10,000 genes carry non-synonymous variants, and 646 genes have been lost. CTVT first arose in a dog with low genomic heterozygosity that may have lived about 11,000 years ago. The cancer spawned by this individual dispersed across continents about 500 years ago. These results provide a genetic identikit of an ancient dog and demonstrate the robustness of mammalian somatic cells to survive for millennia despite a massive mutation burden.

Science 2014; 343: 437

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