Surgical Treatment of Advanced Heart Failure : New Approaches

Rajneesh Malhotra
Chief Cardiac Surgeon, Max Delhi and Delhi NCR, Max Super speciality Hospital, Saket, Newdelhi
New and Emerging Epidemics

- Heart failure
- Atrial fibrillation
- "Degenerative" VHD (AS, MR)
- Metabolic syndrome
Demographics of Heart Failure in United States & Europe

United States

- Prevalance: 5 million
- Incidence of New Cases: 400,000/year
- Annual Mortality: 250,000/year

Europe

- Prevalance: 6.5 million
- Incidence of New Cases: 580,000/year
- Annual Mortality: 300,000/year
HEART FAILURE

- Defined as the deteriorating functions of the heart with end organ hypoperfusion despite maximum pharmacological and/or intra aortic balloon pump support

(A) Diastolic Dysfunction

(B) Systolic Dysfunction
PROGRESSION OF HEART FAILURE
Normal Heart

Dilated Cardiomyopathy
THE ALPHA AND OMEGA
“In designing a heart failure management program, it's vitally important to embrace continuity of care, ideally beginning well before the first symptoms appear, to ensure consistent, appropriate treatment throughout the natural course of the disease.”
Surgery for Heart Failure

- Repair
- Remodeling
- Replacement
Surgical Options

- Coronary artery bypass grafting (CABG)
- Mitral valve repair
- Surgical ventricular restoration (SVR)
- Restraint devices
- ECMO
- Ventricular assist devices (VADs)
- Cardiac transplantation
CABG: Must Assess Viability

- Thallium – Perfusion
- Dobutamine stress echo – function
- PET/ SPECT

UNANSWERED QUESTIONS

- At what level of viability do you operate?
- Off Pump or On Pump?
Coronary Artery Bypass Grafting (CABG) : OPCAB

- The use of off-pump techniques and beating heart surgery have lessened the morbidity and mortality associated with coronary revascularization in patients with severe left ventricular dysfunction and in marginal patients.
Anastomosis on Anterior Wall
The appearance of MR is an adverse event in Ischemic cardiomyopathy, heralding rapid death at 1 to 2 years.

Small amounts of leak are important in those with poor EF.

Vicious cycle of dilatation → MR → dilatation.
Resynchronization Therapy : RCT
Wide QRS complex = 120-160msec.
- LBBB
- ?RBBB
- ?IVCD
Bi-ventricular Pacing

1) Right atrium: AV synchrony
2) Right ventricle: Inter-ventricular synchrony
3) Left ventricle: Intra-ventricular synchrony

Doug Smith: Right Atrial Lead

Left Ventricular Lead

Right Ventricular Lead
Extra Corporeal Membrane Oxygenation

ECMO

“A technique of extra-corporeal life support which uses heart(and /or) -lung bypass techniques for days or weeks to support heart, lung or both functions in the Intensive Care Unit”
There should be routine application of ECMO at all advanced ICUs where Cardiac or Respiratory Failure patients are treated.
Can devices be used as a long-term “destination therapy” for patients with ESHD?
Ventricular Assist Devices (VADs)

- VADs are used as:
  - Bridge To Recovery (BTR)
  - Bridge To Transplantation (BTT)
  - Destination Therapy (DT) in patients who are non-transplant candidates either because of age or comorbidity.
SO WHEN DO WE OFFER THESE OPTIONS TO OUR PATIENTS?

- Before it is too late
- When it is too late
Peripherals
Short-term MCS Devices

Degree of Circulatory Support

IABP

CI* ↑15%

PARTIAL SUPPORT

TandemHeart pVAD
Abiomed Impella 2.5 LP

CI ↑30-60%

FULL SUPPORT

CI ↑100%

*CI – cardiac index
HEART WARE

- Weigh 145 gms
- Pumps 4-5 liter/min
- No pocket required
Per operative View

Intracorporeal Ventricular assist device (Heart Ware)
HeartMate II® Left Ventricular Assist System
CASE 1

- Mr. SDC a 38 yr old man
- KN case of Dilated CMP with AICD x 2yrs
- Admitted to another hospital, He was put on ventilator due to pul.edema and was in multior gan failure.
- He was told he would die in next few hrs.
- I received call if emegernt extracorporeal LVAD can be considered
- Transferred the patient to our hospital
- IV infusions(inotropes/Swan/IABP was inserted to optimise him as he had fever(39.5))
CASE 1

- Lab at admission were
- TLC 24000, Cr.7.8  Urea 272,  SGOT/PT 8700/5660
- Neurological status was unknown.
- CRRT started for high Cr. – Remained for 4 days and Cr. Came down to 2.2
- After 2 days he woke up
- On esmolol infusion for VT
- Started recovering and 2 options were discussed with family
- Heart Transplant and LVAD
- Becoz of Puacity of organ donation  LVAD looked more appropriate
CASE 1

- Inotopes weaned to minimal/ Esmolol stopped/
- With the anticipation of putting LVAD IABP was removed to avoid intravascular lines.
- 3 hrs after removal of IABP – Crashed - Reintubated—IABP reinserted
- LVAD was implanted after few days on Feb 16.
- IABP was removed - All inotropes weaned off – Moved to Room
- Had post op AF –settled with pharmacotherapy
- Discharged home after 3 wks of surgery.
Pump Flow: 5.6 lpm
Pump Speed: 8780 rpm
Pulse Index: 6.9
Fixed Mode - Speed Setpoint: 8800 rpm
Pump Power: 5.2
Case 2

- 36 yrs old young man Kn cae of dilated cardiomyopathy since Aug 2013.
- CRT was not offered becoz of narrow QRS complex
- Had 2 episodes of acute heart failure with abnormal labs.
- Airlifted few days ago to another hospital for pulm.edema
- Labs showed raised LFT and RFT and low perfusion state.
Case 2

- Advised LVAD – shifted to our hospital
- IV inotropes /Swan /diuretics – Medical optimization Cardiac index at time of insertion was 0.75
- Got better – LVAD implanted on March 12, 2015
- Extubated next morning – Recovered uneventfully.
- Off inotropes/ Swan removed in 4 days
- Discharged home on POD 11
Indications: When it is too late

REMATCH

- NYHA IV
- EF < 25%
- O2 consumption < 10 ml/kg
- Needs I V inotropes
- Anticipated mortality of 50% at 1 year
Heart transplantation
HEART TRANSPLANT SURVIVAL

10 Yrs. Survival - 69.2%
5 Yrs. Survival - 80%
1 Yr. Survival - 95%
Conventional Heart Transplantation is limited by:

- Donor availability
- Problems of immunosuppression
- Accelerated coronary atheroma
- Rejection
- Increasing cost
- Infections, lymphomas etc.
CURRENT STATUS

- Results of Heart Transplantation are excellent and will further improve with time
- High level of Finances and proper routine follow up is required
- Recurrent CAD is a major problem
- Non availability of donor hearts and a long waiting list of recipients is adding to options for alternative procedures
- Mechanical assist devices only is the real alternative to heart transplantation
- Percutanious assist devices may be an option in the future
- Artificial Heart has a considerable future
Surgical treatment for congestive heart failure with autologous adult stem cell transplantation: A prospective randomized study

Amit N. Patel, MD, MS, a,b,c Luis Geffner, MD, b Roberto F. Vina, MD, b Jorge Saslavsky, MD, b Harold C. Urschel, Jr, MD, c Robert Kormos, MD, a and Federico Benetti, MD b

**Background:** Autologous adult stem cell transplantation has been touted as the latest tool in regenerative medical therapy. Its potential for use in cardiovascular disease has only recently been recognized. A randomized study was conducted with a novel epicardial technique to deploy stem cells as an adjuvant to conventional revascularization therapy in patients with congestive heart failure.

**Methods:** After institutional review board and government approval, adult autologous stem cell transplantation (CD34+) was performed in patients with ischemic cardiomyopathy and an ejection fraction of less than 35% who were scheduled for primary off-pump coronary artery bypass grafting. Preoperatively, the patients underwent echocardiography, stress thallium imaging single photon emission computed tomography, and cardiac catheterization to identify ischemic regions of the heart and to guide in the selection of stem cell injection sites. The patients were
Mending a Broken Heart

Scientists have taken adult stem cells from patients with chronic heart failure and injected them into their hearts, restoring lost function. One day scientists may isolate and grow stem cells that can be given by any donor to any patient.

1. Stem cells are filtered from bone marrow removed from a patient's hip.

2. The cells are injected into the heart's damaged area.

3. The cells embed themselves and produce proteins that may signal the growth of new blood vessels and heart muscle.

Data: University of Pittsburgh, McGowan Institute for Regenerative Medicine
Diffuse Coronary Artery Disease

New Hope
Stem Cell Harvest & Separation

15 minutes
The biologic is delivered to the border zone around multiple transmural laser channels created on the free wall of the ventricle during sole therapy or adjunctive TMR.
The artificial heart is an orthotopic, biventricular, pneumatic, pulsatile blood pump, *it replaces the native ventricles*. It is attached to the left and right atrial cuffs with individual "quick connectors" (elastic polyurethane couplers over rigid ventricular valve mounts) that couple to their respective ventricles.

Blood passes through this almost imperceptible junction from the atrium, across a 27-mm Medtronic-Hall valve, to the ventricular chamber.

The spherical chamber is lined with segmented polyurethane. The outer chamber is a semirigid polyurethane-lined housing that does not move. The inner chamber contains a four-layer polyurethane diaphragm driven by air pressure. The diaphragm moves toward a rigid plastic wall as the ventricle fills with blood in diastole and toward a 25-mm Medtronic-Hall outflow valve in systole, ejecting about 55 to 60 cc per beat. Blood flows through the outflow valves into woven Dacron conduits to the respective great vessels. Dacron-covered drivelines exit through tunnels in the left epigastrium and connect to a driver console. This console contains a backup driver, 304 Surgical Management of Congestive Heart Failure. Drawing to scale of the CardioWest TAH and console. Multiple alarms, an internal compressed air supply, and a laptop monitor. The monitor provides beat-to-beat monitoring of ventricular filling, ejection pressure, heart rate, cardiac output on both the left and right sides, and trend monitoring of cardiac output. The console is mobile within the hospital, allowing patients to attend daily cardiac rehabilitation classes and to ambulate outside. There are at least two portable consoles under development that are compatible with out-of-hospital life. The company plans to use these consoles once commercial approval for the device and large console have been obtained in the United States.
Total Artificial Hearts
BRIDGE TO TRANSPLANT

Liotta TAH
Akutsu III TAH
Jarvik 7 TAH
Research into new methods of treatment
The HeartSensor® is similar in size to a pacemaker and measures critical clinical factors such as intracardiac pressure.

Daily pressure readings are conducted via home monitoring devices and the data is transferred over a phone line to the physician.

The HeartSensor® may help physicians to better manage patients with heart failure.

Medications can be adjusted as necessary, and the device serves as an early warning before physical symptoms are manifested.
Thank You