Ventricular Assist Devices

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Harefield Hospital
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Background
What is a VAD?

- Ventricular Assist Device

- Augments or replaces native ventricular function

- Powered by external sources that connect to the implanted pump via a percutaneous lead (driveline) that exits the body via the abdomen

- LVAD: Attached to the left ventricle and aorta
HeartWare

Outflow Graft
Pump
Driveline
Battery
System Controller

Heartmate II
Why do we need VADS?
Why do we need VADS?
Indications for VAD insertion

- **Bridge to transplant (BTT):**
  - Most common indication

- **Bridge to candidacy (BTC):**
  - When ineligible at implant due to cardiogenic cause
  - Likelihood of reversal e.g. pulmonary hypertension/renal dysfunction

- **Bridge to recovery (BTR):**
  - Allows us to offload the heart and promotes reverse remodelling

- **Destination therapy (DT):**
  - Permanent device in transplant ineligible patients
  - Not in UK
Clinical Scenario
Case presentation

- 31YO male
- Pakistani origin
- Severe LVSD (LVIDd 7.0cm/ LVEF 15%)
- Right heart non-dilated with good function on echo
- Primary prevention ICD in situ
- Gallstones with previous cholecystitis
- Non smoker & no regular alcohol
- No significant family history

Referred SNAHFS by base cardiology team for transplant assessment
Medication:
- Furosemide 80mg TDS
- Ramipril 2.5mg BD
- Carvedilol 3.125mg BD
- Eplerenone 25mg daily
- Omeprazole 40mg daily

On examination:
- NYHA III
- BP 90/60mmHg
- HR 60bpm, SR, Narrow QRS
- Third heart sound

- Referred by base cardiology team for transplant assessment
Investigations

BMI 22
Blood group A
Mildly deranged LFTs
NT proBNP 10,225
ECG: SR QRS 94ms
CMR: Non-ischae mic, non-infiltrative DCM with LVEF 10%
Carotid Dopplers: Normal flow & calibre
DEXA Scan: Normal bone density
PFTs: Normal lung function
### Right Heart Catheter

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Result</th>
<th>Normal range/ units</th>
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<td>0-5mmHg</td>
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<tr>
<td>RV</td>
<td>63/5/34</td>
<td>10-25mmHg</td>
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<tr>
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<td>31</td>
<td>&lt;12mmHg</td>
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- Clinical improvement with increased off-loading
- MDT discussion and plan for optimal medical therapy and OP review
2 months later........

- Readmitted & clinically NYHA IV
- OMT
- Ongoing high pulmonary pressures on RHC

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Progress

- MDT discussion
- Heartware LVAD implantation June 2015 as bridge to candidacy
  - Therapeutic anticoagulation plus aspirin 150mg BD
  - Other HF medication as before
- Education- Patient, GP, Family, A&E, ambulance
RHC 6 months post LVAD insertion

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Progress…..

- Active routine cardiac transplant waiting list December 2015
- Orthotopic cardiac transplant October 2016
- Minimal post operative support
- Established on immunosuppression
- Currently doing well
Clinical Issues
VAD Issues

- **Bleeding**
  - Initial anticoagulation with IV heparin ~4hrs post surgery
  - Combination antiplatelet and anticoagulation
    - Aspirin 150mg OD, Warfarin INR 2-3
  - Von Williebrand factor reduced/Angiodysplasia

- **Thrombosis**
  - Careful control of anticoagulation imperative
  - Home monitoring of INR with VAD nurse prescribers dosing warfarin
  - LMWH (Typically enoxaparin) if INR sub-therapeutic – given on D/C
VAD issues

- **Infection:**
  - Driveline infection is very common and can be catastrophic
  - Good aseptic technique is very important
  - VAD specialist nurses only to do driveline dressings in hospital.
  - Family/carer trained by VAD specialist nurse to do once discharged
  - Prevent infection
    - Good management of driveline essential
    - Dress according to protocol
    - Surgical consult as soon as any infection is suspected
    - Often recurrent and difficult to treat
Driveline Site Infections
Low Flow Alarms

Reduction of preload

1. **Hypovolaemia**: Inadequate filling of LV
   - Low flow
   - Suction events

Dry skin, small vessels, pale colour

?Bleeding/ ?Dehydrated

?Infusion/transfusion
Low Flow Alarms

Reduction in preload

2. RV Failure
   – Signs of right heart failure
   – Elevated CVP, wedge/PCWP/PAP
   – Echo: reduced RVEF, TAPSE

- Catecholamines, sildenafil, fluid restriction
  ? Urgent Heart CTx list
Low Flow Alarms

Reduction of preload

3. Arrhythmia
   – Haemodynamic stable/unstable (right heart function)
   – Chemical cardioversion: ESC guidelines
   – Anti-tachycardia Pacing (ATP) via ICD
   – TOE and electrical cardioversion
High Power alarms

Highly suspicious of pump thrombus

- Heart Failure symptoms
- High watts alarm
- Flows >10 l/min
- Haemolysis (haematuria/coca cola coloured urine)
- Pump parameters (increased power and flow)
- Lab parameters (LDH and plasma Hb)
VAD Emergencies
VAD emergencies

1) AUSCULTATE FOR PUMP HUM
NO HUM

- Check cables and connections
- Check batteries
2) CHECK MAP, ASSESS PERFUSION
3) JUDICIOUS FLUID CHALLENGE

- Check pump flows and response.
4) MONITOR +/- DEFIBRILLATE

- Check electrolytes, correct potassium
- Avoid chest compressions
5) URGENT ECHO

- **RV small**- hypovolaemia, bleeding, sepsis
- **RV bigger than LV, D-shaped septum, TR**- RV dysfunction
- **Large LV (+MR)**-
  - High power- pump thrombosis (haemolysis, altered hum)
  - Low power- inflow or outflow obstruction
  - Ischaemic events
- **Aortic Incompetence**
Emergency call received from patient with Left Ventricular Assist Device (LVAD) as treatment for heart failure.

On arrival

Attempt to make contact with implanting VAD Centre prior to arrival but do not delay emergency treatment

Note: Normally LVADs produce a continuous blood flow and pulse may be difficult to palpate, pulse oximetry and non-invasive arterial blood pressure measurement may be impossible

Unresponsive or ‘peri-arrest’ patient?

Airway, Breathing

Circulation

Check both LVAD and ECG

LVAD

Usually LVADs consist of a high speed impeller which propels the blood from the left ventricle to the aorta. A working LVAD emits a ‘humb’ which can be heard using a stethoscope over the heart.

Assess external components of VAD

Remove from bag if in use.

Batteries (or mains power)

Check they are charged by pressing button on battery. If not, replace with spares.

Check batteries are properly connected to controller.

Controller

Check it is properly connected to the...

Driveline

If none of these measures result in LVAD working, connect spare controller to driveline and batteries.

Does patient have VT or VF?

ECG

Is the patient conscious?

NO

Yes

Is the patient conscious?

NO

Yes

DC Cardioversion (repeat as required)

Arrange prompt transfer to A&E for elective DC Cardioversion

Clinical signs that circulation is stabilised?

START CPR

Consider other causes, e.g. stroke and sepsis

Attempt to stabilise

Contact VAD Centre via number on controller to arrange transfer to A&E (or VAD Centre)
Resuscitation Guidelines

- Defibrillation without disconnection of the VAD
- Chest compressions as a last resort
Algorithms to guide ambulance clinicians in the management of emergencies in patients with implanted rotary left ventricular assist devices


VAD issues

Call VAD centre

We’re here to help!

Call us now for more information

Call us Today
Thank you