

Gastrointestinal Bleeding in Recipients of Left Ventricular Assist Devices

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Senior Talk

October 29, 2007

Outline

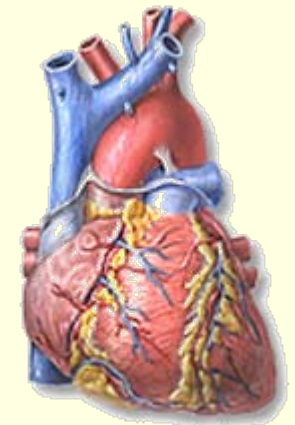
- Case report
- Background
 - Heart failure
 - Left ventricular assist devices
 - Arteriovenous malformations
- Study
 - Methods
 - Results
 - Discussion

Case Report

- 60y male w/ ICM s/p CABG and AICD
 - No prior h/o GIB
 - Presented with heart failure
- Admitted to the CCU
 - Failed medical management
 - A nonpulsatile LVAD was implanted
- Refractory GIB developed
 - POD 6, 17, 18, 44, 58, 62, 90
- GIB resolved after cardiac transplantation [4]

Heart Failure

- A condition in which the heart can't pump enough blood to keep up with demand [1]
- Affects roughly 5 million people in the U.S.
- Approximately 1 million hospital admissions per year
- Roughly 300,000 deaths per year

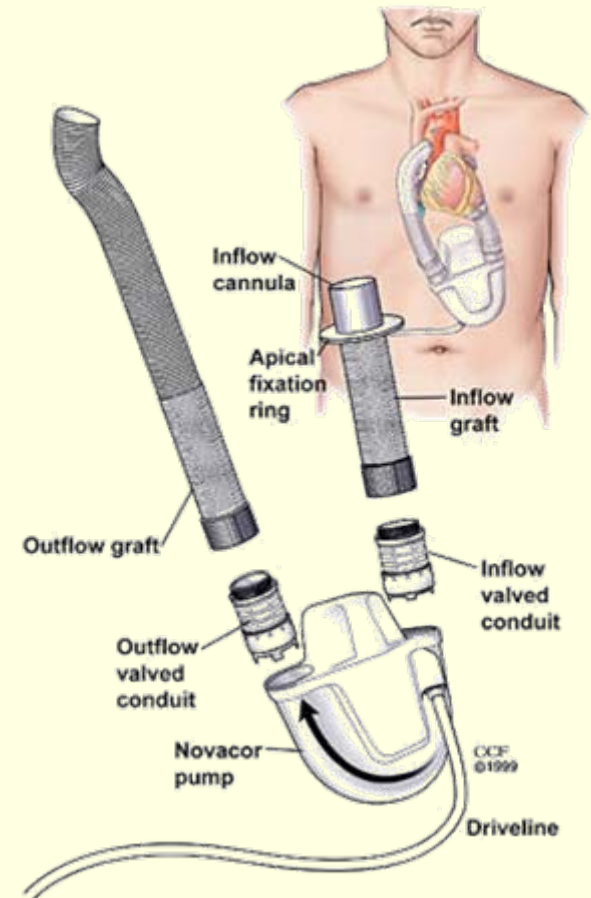


Etiology & Medical Treatment

- Coronary artery disease accounts for 2/3's of the cases of heart failure
 - Other causes include hypertension, diabetes, valvular disease, arrhythmias, infection, thyroid disease, infiltrative disease
- Traditional therapy
 - Stage A: ACE-I, Statin
 - Stage B: Add Beta blockers
 - Stage C: Add Diuretics, Digoxin, Hydralazine/Imdur
 - Stage D: Add IV Inotrops

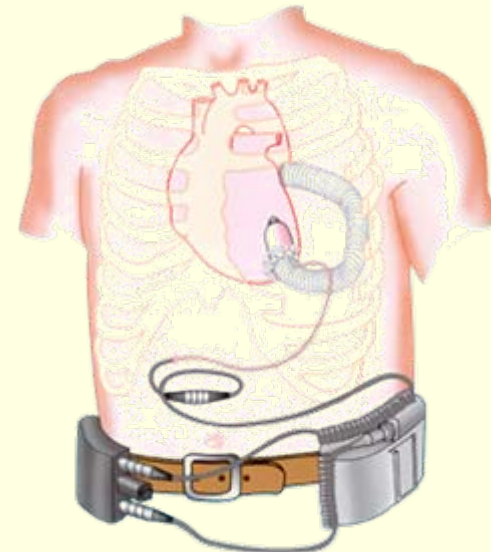
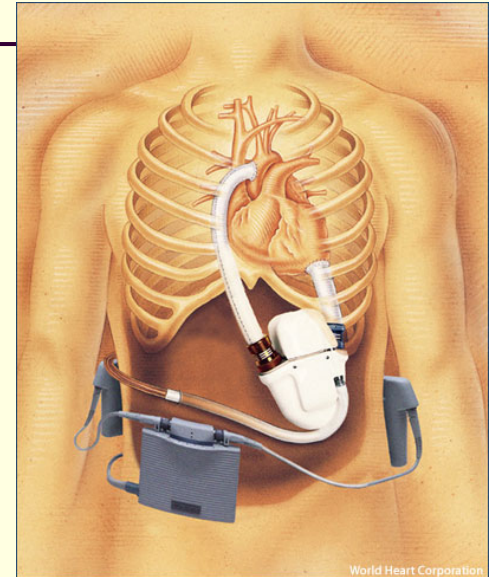
Ventricular Assist Devices (VAD)

- For end-stage heart failure refractory to medical management
- Mechanical pumps
 - Provide circulatory support
 - Take over the function of the damaged ventricle
- Indications
 - Bridge to cardiac transplant
 - Bridge to myocardial recovery
 - Destination therapy



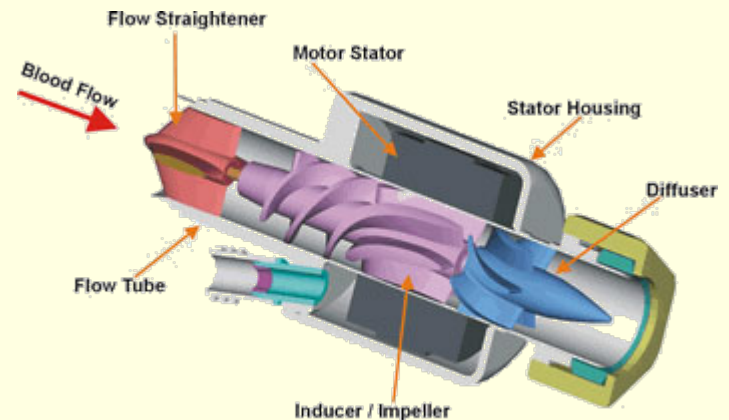
VAD Technical Variations

- Location
 - Paracorporeal
 - Intracorporeal
- Support
 - Left ventricle (LVAD)
 - Right ventricle (RVAD)
 - Both ventricles (BiVAD)
- Flow mechanism
 - Pulsatile
 - Nonpulsatile



VAD Mechanisms of Flow

- Pulsatile
 - Displacement mechanism
 - Pump a discrete volume at regular intervals
- Nonpulsatile
 - Rotor or axial mechanism
 - Continuous flow



Nonpulsatile VAD Characteristics

- Advantages [2]
 - Compact design
 - Mechanical simplicity
- Concerns about pulseless circulation
 - Adequate perfusion
 - Gastrointestinal bleeding (case study)



Arteriovenous Malformations (AVMs)

- Also known as angiodysplasias and vascular ectasias
- Frequently found in the gastrointestinal tract
 - Most common gastrointestinal vascular malformation
 - 1% estimated prevalence
 - May also appear elsewhere
- Most lesions clinically silent
 - Minority cause bleeding



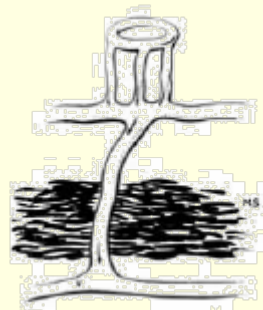
AVM Characteristics

- Vascular Malformations
 - Dilated, tortuous, thin-walled vessels
 - Located in the mucosa and submucosa
 - Lined by endothelium
 - Little or no smooth muscle
- Appearance during endoscopy
 - Cherry red, 5 to 10 mm, fern-like pattern
 - Associated with synchronous lesions 20% of the time
 - The colon is the most common site



AVM Pathogenesis

- Mechanism not well understood [3]
 - Venous obstruction or hypoperfusion
 - Venous dilation
 - Propagates proximally to capillary bed
 - Precapillary sphincter becomes incompetent
 - Results in an arteriovenous communication



GI AVM Associations

- Age
- Chronic kidney disease
 - Platelet dysfunction, vascular overload
- Von Willebrand disease
 - Platelet dysfunction
- Aortic stenosis (\pm von Willebrand)
 - Low pulse pressure (Heyde syndrome) [5]
 - Damage to VWF factors passing through AV
- Scleroderma, portal HTN, & Turner syndrome

Summary

- Case Study
 - Refractory GIB in nonpulsatile LVAD recipients
- Background
 - Heart failure, VADs, and AVMs
- Hypothesis suggest by Letsou et al. [4]
 - Empiric observation in 3 of 21 patients
 - Nonpulsatile ventricular assist devices may contribute to GI bleeding from AVMs
 - Nonpulsatile → low pulse pressure → AVM formation
 - Similar to the Heyde syndrome [5]

Study Methods

- Retrospective analysis of 53 consecutive intracorporeal LVAD recipients
 - Nonpulsatile: VentrAssist, HeartMate II, & Jarvik 2000
 - Pulsatile: Novacor and HeartMate XVE
 - Excluded 1 patient who died within 4 hours of implantation
- The primary endpoint was clinically evident GI bleeding, confirmed by endoscopy
- Analyzed data by odds ratio, Fischer's exact test, logistic regression, and the t test

Results: Baseline Characteristics

| | Nonpulsatile (n=25) | Pulsatile (n=27) | p |
|---|--------------------------------|-----------------------------|----------|
| Implant age in years | 52 ±15 | 54 ±16 | 0.495 |
| Male | 16 (64%) | 19 (70%) | 0.633 |
| Caucasian | 16 (64%) | 17 (63%) | 0.843 |
| Pre-implant screening colonoscopy | 6 (24%) | 4 (15%) | 0.411 |
| Days on device | 112 ±119 | 254 ±251 | 0.013 |
| Ischemic cardiomyopathy | 9 (36%) | 13 (48%) | 0.386 |
| Aortic stenosis (AV ≤ 1.5 cm ²) | 1 (4%) | 1 (4%) | 0.957 |
| Chronic kidney disease (Cr ≥ 1.5 mg/dl) | 9 (36%) | 6 (22%) | 0.248 |

Results: Post-LVAD GI Bleeding

| | Nonpulsatile (n=25) | Pulsatile (n=27) | p |
|----------------------|--------------------------------|-----------------------------|----------|
| GI bleeding from AVM | 1 (4%) | 2 (7%) | 0.607 |
| All GI bleeding | 2 (8%) | 6 (22%) | 0.162 |

Results: Pre-Implant Colonoscopy

- The 10 subjects received pre-implant colonoscopies
 - Cancer screening for patients over 50
 - 7 had pathologic findings
 - 4 polyps
 - 2 diverticulosis
 - 1 colitis
 - 3 went on to develop post-implant GI bleeding
 - No association ($p = 1.000$)

Discussion

- Letsou et al. suggested an association between nonpulsatile LVADs and GI AVMs [4]
 - We found no statistical association between nonpulsatile LVADs and AVMs [7]
 - Ironically found more bleeding in the pulsatile group, but this was not statistically significant
- Only age was found to be an independent predictor of GI bleeding ($p = 0.001$)

Study Limitations (Both Studies)

- Did not consider residual ejection fractions
 - Device recipients may still have pulsatile aortic pressures if their ventricles remain ejecting
- Only considered clinically evident AVMs
 - Hematemesis, hematochezia, melena, guaiac positive stools, iron deficiency anemia
- Did not control for confounding factors
 - CKD, VWD, AS, portal HTN, etc.
- Small, retrospective

Discussion, Continued

- Colorectal disease in transplant recipients [6]
 - Anticoagulation and immunosuppression
 - Increased rate of gastrointestinal malignancy, infection, and bleeding
- Screening colonoscopies did not help predict those who would develop GI AVMs
 - May want to expand screening to patients with...
 - Prior bleeding events Unexplained anemia
 - Coagulopathy Aortic stenosis
 - Chronic kidney disease Gastrointestinal disease
 - Liver disease Connective disease

Conclusions

- Nonpulsatile LVADs were not associated with an increase in GI AVMs or GI bleeding
- The limited number of pre-implant colonoscopies was not predictive of post-implant GI bleeding
- Take-home points
 - Nonpulsatile LVADs are safe to use (w/ respect to risk of GI bleeding)
 - May want to expand endoscopic screening criteria for transplant candidates

Acknowledgements

- Erika D. Feller, MD
- Erik N. Sorensen, PhD
- Jonathan M. Fenkel, MD
- Eric M. Goldberg, MD

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