Robotic Cardiac Surgery: An Overview

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Financial Disclosures

• Scientific Advisor for the following companies: Edwards, Intuitive Surgical, Atricure, ATS & Medtronic.
Two Major Areas of Technological Development Allow Endoscopic Cardiac Surgery

2D Videoscopes and Shafted Instruments

Robotic Surgical System

Femoral Access for CPB, Aortic Occlusion and Cardioplegia Delivery
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## Robotic Cardiac Surgery 2000-2010

### PRO’s
- Enabling Technology for MICS.
- 3D Vision, Improved Dexterity.
- Development of “Dynamic Retractor” Instruments.
- Multi-Specialty adoption.
- Learning Curve shortened with standardized procedure guides.
- Outcomes Data as good as “Industry Standard”

### CON’s
- Initial Limitation of “3 arm system”.
- More cumbersome set up than standard 2D Video.
- Reliance on static retractors.
- Still need for some “adjunctive technology”.
- Up front investment $$$$$
- Learning Curve!!!!
- No Large Scale studies.
Robotic Cardiac Surgery

Right Chest Procedures

Intra-Cardiac Surgery

• Mitral Valve Procedures.
• Tricuspid Valve Procedures.
• ASD’s/VSD’s.
• Masses and Tumors in all 4 cardiac chambers.
• HOCM.
• Bi-Atrial MAZE Procedure.
• CABG (Access to Both IMA’s, LAD, Diag, and RCA).
Heartport Platform

1. Allows a Lateral Approach
2. Can be used in Redo’s
3. No instrumenting of the Aorta
4. May be faster than clamping.
5. “System” allows for insertion of a CS catheter and PA vent.

1. Requires a consistent Team.
2. Has a separate “learning curve”.
3. Catheters are expensive and disposable.

Aortic Root Pressure
1. Familiar Technique
2. Cost effective.
3. Poses danger to PA, LAA.
4. Not a safe option in Redo’s.
5. Requires Antegrade "Access"
**Beating Heart**

**Fibrillation**

1. Simplistic.
2. Inexpensive.
3. Visualization can be difficult.
4. Concerns for Air Emboli.
5. Headache with AI! (which can be precipitated by retraction)
3D Reconstruction
CT Aortogram with Iliac Runoff
Femoral Perfusion Issues
Endoclamp Balloon Issues
Endoscopic Chest Issues
Localized Dissection
Aberrant Right Subclavian Artery
Breast Implants
Robotic Cardiac Surgery

Left Chest Procedures

- LIMA/RIMA Harvest.
- MIDCAB.
- TECAB
- Access to LAD, Diag, and OM.
- LV Lead Placement
Instrument installed but not ready for surgeon control. Move instrument past cannula tip for surgeon control.
Totally Endoscopic Mitral Valve Repair Using a Robotic-Controlled Atrial Retractor

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Purpose. Our aim was to assess the feasibility of totally endoscopic robotic mitral valve surgery using a novel atrial retractor manipulated by a fourth arm da Vinci surgical system (Intuitive Surgical Inc, Sunnyvale, CA).

Description. Eighteen patients with mitral valve disease underwent totally endoscopic mitral valve surgery using the retractor. It was inserted in the second or third intercostal space just lateral to the sternum, and it was manipulated at the robotic console for dynamic exposure of the valve structures.

Evaluation. Mitral valve repair procedures were feasible in all patients with the robotic-controlled atrial retractor providing superior exposure of the mitral valve anatomy. The time until satisfactory exposure of the mitral valve was noticeably decreased with the robotic retractor. All patients were discharged home in sinus rhythm and transesophageal echocardiography revealed competent mitral valves.

Conclusions. The EndoWrist atrial retractor (Intuitive Surgical Inc) facilitated complex totally endoscopic mitral valve surgery, including concomitant procedures, regardless of pathology with excellent clinical outcomes.

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Total Operative Time

Minutes

p=0.004

267.16
230.26
210
220
230
240
250
260
270

Group 1
Group 2

Operation Time

Mean

Total Operative Time

Minutes
Aortic Occlusion Time

p<0.001
Aortic Occlusion and Cardioplegia

Peripheral CPB Experience

TEE Experience

Anesthesia Skills

Patient Referrals

Cardiac Surgery Techniques

da Vinci Robot

Robotic Console Skills

Patient Side Assistant Skills

O R Equipment and Set Up

Robot Troubleshooter

Committed OR Staffing
Future Enabling (Potential) Technology

- Improved Visualization for target vessel identification and graft patency assessment.
- Simulation for training and decreasing “learning curve” time.
- Web bases “mini-fellowships” International College of Robotics, ICR St Joseph Hospital Atlanta.
- Single port platforms to decrease surgical incision size and trauma.
L.A.D. Artery
Simulation
Task Based Simulation

- Further assess the ability to perform tasks
- Task performance measurement
- Surgical certification
Mentoring / Proctoring Console

- Senior Surgeon to Junior Surgeon
- Same 3-D field of view
- Ability to seize control in order to teach or prevent patient harm
Image Guidance
New Robots
Advanced Instrumentation
dV Network
Training

Surgical Cockpit

"90th Annual Meeting"
"Toronto, ON, Canada"
"May 1-5, 2010"
Robotic Cardiac Surgery

- Robotics has evolved over the past decade and can now be applied to a wide range of procedures.
- Progress has been slower in Cardiac surgery than other specialties (i.e., Urology).
- Outcomes Data have consistently shown “non-inferiority” vs. conventional surgery.
- Despite standardization in procedure guides, learning curve still exist.
- Opportunities exist for Web Based Training (International College of Robotics Website www.icrstraining.org)
- Continued Innovations may increase adoption but incorporation likely will still be dependant on patient demand and clinician acceptance.
Questions?