Use of Surgical Robots on Cardiology Surgery: Advantages and Barriers for its Implementation

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AABRI International Conference
January 2, 2015
Introduction

• Robots are machines that perform complex actions controlled by a computer to replace human effort.

• Surgical robots replicate human movements to more precise motions, giving more accurate and delicate operations.
Introduction cont.

• Robotic surgery is a recent, innovative addition to minimally invasive surgery.

• The use of robotic surgery is not to replace surgeons but to assist.

• The most common use for robotic assisted heart surgery is the da Vinci System.
Historical Perspectives

- Early 1980’s: U.S. Department of Defense and NASA introduced initial robotic technology
- 1985: First documented robotic surgery
- 1987: First robotic laparoscopic surgery
- 1990’s: FDA approved Zeus robotic surgical system for endoscopic surgery
- 2000: FDA approved da Vinci robotic surgical system for general laparoscopic surgery
Robotic Utilization

- **Surgical disciplines utilizing robotics:**
  neurology, orthopedics, gynecology, cardiothoracic, urology, and general surgery

- Most common: Robot Assisted Radical Prostatectomy (RARP)

- In 2006, da Vinci RARP represented 10% of all radical prostatectomies in U.S.

- 2008-2009, da Vinci RARP increased to 65% of all radical prostatectomies in U.S.
Purpose

• The purpose of this research was to study the evolution of technical features of surgical robots on cardiology to determine technical advantages and barriers of these technologies.
Methodology

• Literature review utilizing 29 articles
• Databases searched: PubMed, Science Direct, EbscoHost, and Google Scholar
• Key Search terms: ‘cardiac’ OR ‘heart AND ‘robotic’ AND ‘surgery’’
• Included articles from 2003-2013 in the English Language only.
Conceptual Framework

Inaccurate Problems in Surgery → Need for Robotic Surgery → Applications & Adoptions

Promote Adoption

Benefit

Impede Adoption

Barrier

Figure 1: Conceptual Framework: Robotic Cardiac Surgery Technical Features
Source: Yao (2011)
Da Vinci Robot System
Da Vinci Robotic System

• Most popular robotic system with more than 500 installed in the U.S.

• Components: surgeon console, patient side car, and vision system.

• Robotic Arm: three dimensional endoscope and EndoWrist instruments

• Advantages: Seven degrees of freedom, three dimensional vision, instinctive movement of instruments
Da Vinci Robot System
Results

• Ability to manipulate instruments and tissues easier with increased degrees of freedom (7)
• Instrument manipulation more intuitive by eliminating fulcrum effect.
• 3-D view with depth perception greatly enhances vision
• Improved patient outcomes
Results

- Robotic Surgical System: initial cost $1.2 million and yearly maintenance $138,000.
- Extended Operating Room Time:
  1. 18% longer Mitral valve repair robotic 239 minutes vs. conventional 209 minutes.
  2. Laparoscopy robotic 97.1 minutes vs. traditional 82.1 minutes
Discussion

Benefits:

• Cardiac surgery robots have a positive influence on how well surgeons perform
• These robots make the surgeons' job easier and produce better patient outcomes
• Cardiac surgery robots can improve and perform better as technology advances
Discussion

Barriers:

- Cost
- Takes longer time
- Fewer surgeries per day
- Longer to train and educate
Discussion

• Cost
  – da Vinci robot is an initial $1.2 million investment
  – Approximately $100,000 yearly maintenance fee
  – $1500 per patient fee for disposable robotic equipment
  – Institutions should perform individualized cost/benefit analysis to avoid “Gizmo Idolatry”
Limitations

- Research bias
- Select few databases used
- Search strategy
- Publication bias
Discussion

- Cost is the main component impeding the adoption of cardiac surgery robots
- Implementation would benefit hospitals, physicians, and patients
- Cardiac surgery robots should be the new standard of practice
Discussion

• Da Vinci cardiac procedure ranks superior in all functional outcomes reviewed.
  – Improved precision and accuracy

• Major drawbacks: Cost & Steep Learning Curve

• More experimental studies are needed to validate the positive benefits of the da Vinci cardiac surgery.
Implications

• Surgical robots have the potential to provide surgical care in underserved areas

• Robotic surgery can provide surgical care to patients that do not have direct access to a surgeon
Questions?
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