Robotics in General Surgery

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Objectives

• Brief History of Robotics in General Surgery
• Robotic General Surgery Procedures
• Advantages/Disadvantages of Robotic General Surgery
• Role of Robotic Surgery in Bariatric Surgery
• Role of Robotic Surgery in Foregut Surgery
• Role of Robotic Surgery in Ventral Hernia Surgery
History

- Multiple previous robotic devices created including Puma 560 (1985) for neurosurgical biopsies, AESOP (1993) for robotic assisted endoscopic surgeries, and ROBODOC for hip replacement surgery

- In 2000, the da Vinci Surgical System received FDA approval for minimally invasive surgery.

- Ohio State was one of the first robotic center worldwide (2000)

da Vinci Robot

- Initially developed for Cardiac Surgery use
- Ultimately expanded to other specialties with specific traction in Urology and Gynecology
- Over 3,100 systems worldwide
Advantages

- 3 dimensional viewing
- Wrist articulation
- Increased ability to perform fine dissection
- Minimally invasive approach to previous open procedures
- Better ergonomics for surgeons
### Disadvantages

- **Cost**
  - Capital investment
  - Instruments – 10 use
- **Longer Surgery Duration**
- **Learning Curve**
- **Patient advantage?**

### Robotic General Surgery Procedures

**FDA Approved procedures:**

- Bariatric procedures (sleeve, gastric bypass)
- Foregut Surgery: Nissen fundoplication, Heller Myotomy
- Gastrectomy (benign, malignant)
- Hernia repair
- Cholecystectomy
- Pancreatectomy (benign, malignant)
- Colectomy
- Rectal resection
Bariatric Surgery

The Obesity Epidemic

- 78.6 million (34.9%) Americans are considered obese
  - More than doubled from 13.3% in 1960

- Obesity-related conditions affect nearly every organ system and are some of the leading causes of preventable deaths

- www.cdc.gov

<table>
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[asmbs.org](https://asmbs.org)

## Robotic Bariatric Surgery

Roux-en-Y Gastric Bypass

Sleeve Gastrectomy

Images from [https://en.wikipedia.org/wiki/Gastric_bypass_surgery](https://en.wikipedia.org/wiki/Gastric_bypass_surgery)
Robotic Bariatric Surgery

- Advantages:
  - Studies have shown at least equal outcomes to laparoscopic surgery
  - May decrease gastrojejunostomy leak rate, stricture rate, length of stay
- Disadvantages:
  - Procedure length of time
  - Cost?
  - More studies needed to determine if there is a true patient benefit

Foregut Surgery
Robotic Foregut Surgery

- Hiatal hernia repair with Nissen (360°) or Toupet (270°) fundoplication

- Paraesophageal hernia repair

https://medlineplus.gov/ency/presentations/100181_5.htm
Robotic Foregut Surgery

• Heller myotomy for achalasia

Advantages of Robotic Foregut Surgery:

• 3D Visualization
• Magnification of Surgical Field
• Very useful for redo operations where more precise movement are needed
• Very useful for Heller myotomy for achalasia where precise division of muscle fibers is critical to prevent esophageal perforation
Ventral Hernia Repair

Advantages: Minimally Invasive Approach

- Minimally invasive hernia repairs are associated with shorter length of stay, fewer wound-related complications, improved postoperative pain profiles

- Limitations of Laparoscopic ventral hernia repair:
  - intraperitoneal mesh placement
  - difficult to re-approximate the midline
  - high cost of mesh and fixation devices
  - Bulging/Eventration of the mesh with larger defects
  - Technique not always equal to open
Robotic Pre-Peritoneal Ventral Hernia Repair – video

Advantages: Minimally Invasive Approach

- Robotic ventral hernia repair may bridge the gap between open and laparoscopic repairs

- Robotic ventral hernia repair allows for larger defects to be repaired minimally invasively including myofascial releases:
  - Transversus abdominus release (TAR)
  - External oblique release
  - Bilateral postrectus sheath incision with retrorectus hernia repair

<table>
<thead>
<tr>
<th>Advantages: Minimally Invasive Approach</th>
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<tr>
<td>• Retrorectus hernia repair: brings fascial edges to the midline to create a more functional abdominal wall</td>
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<tr>
<th>Advantages: Minimally Invasive Approach</th>
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<td>• Recent study compared length of stay of robotic retrorectus ventral hernia repair (r-RVHR) to open retrorectus ventral hernia repair (o-RVHR)</td>
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<tr>
<td>• Evaluating value added to patients and the health system by assessing one component, length of stay</td>
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Advantages: Minimally Invasive Approach

Robotic Retrorectus Ventral Hernia Repair – Video
Advantages: Minimally Invasive Approach

- Utilizing data from the Americas Hernia Society Quality Collaborative (AHSQC), evaluated the largest collection of r-RVHR to date.
- Length of Stay (statistically significant):
  - r-RVHR – 2 days
  - o-RVHR – 3 days
- Despite the increased cost of robotic platform, cost savings was noted from decreased length of stay, mesh choice.


Current Status of Robotics in Hernia

- Growing experience and increasing number of studies, however still very little data available
  - Literature primarily single surgeon experience
  - Largest study: Multicenter retrospective study
    - 368 patients underwent robotic primary or incisional hernia repair by 5 surgeons
    - Reproducibly safe
    - Short term outcomes comparable to laparoscopic results
- Scrutiny over cost vs. benefit

Robotics in General Surgery

References


2. asmbs.org

3. https://medlineplus.gov/ency/presentations/100181_5.htm


Robotics in General Surgery

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Objectives

• Role of Robotic Surgery in Inguinal Hernia Surgery
• Role of Robotic Surgery in Biliary Surgery
• Role of Robotic Surgery in Surgical Resident Education
Inguinal Hernia Repair

Inguinal Hernia Repairs

- Wide Variety of Repairs
  - Open Tissue Repairs
  - Open Mesh Repairs
  - Laparoscopic Mesh Repairs
    - Totally Extraperitoneal
    - Trans Abdominal Repairs
  - Robotic Mesh Repairs
### Advantages: MIS Inguinal Approaches

- Both open and minimally invasive inguinal hernia repairs continue to be largely outpatient procedures.
- Minimally invasive inguinal hernia repairs are associated with:
  - Smaller incisions
  - Fewer wound-related complications and mesh infections
  - Improved postoperative pain profiles
  - Fewer complications related to chronic nerve issues
  - Bowel evaluation in emergent cases

### Limitations: MIS Inguinal Approaches

- Limitations of Laparoscopic Inguinal hernia repair:
  - Steep learning curve
  - High cost of fixation devices
  - Difficulty managing larger defects
  - Technique not always equal to open
  - Previous Repairs may necessitate different approaches
Robotic Bilateral Inguinal Hernia Repair

Advantages: Robotic Minimally Invasive Approach

- Robotic inguinal hernia repair avoid costly fixation devices
- Robotic inguinal hernia repair may provide improved ergonomics to the surgeon during placement.
Biliary Surgery

Laparoscopic Cholecystectomy

• First performed in September of 1985.
• Popularized as Standard of Care
• Gave birth to the Laparoscopic Revolution of Surgery
• Continues to be one of the most common procedures performed in the United States
## Minimally Invasive Advances in Biliary Surgery

- Fluorescence imaging popularized for improved anatomic identification and prevention of complications
- Continues to push the boundaries of MIS surgeries including complex cancer resections and reconstructions
- Provides a stable platform for resident and fellow training

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## Robotic Cholecystectomy with Fluorescence Imaging
Robotics in Resident and Fellowship Training

US Procedure Trend

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2. 2016 da Vinci market penetration projection based on Goldman Sachs Financial Model

National Trends in Hernia Repair by Surgical Approach

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Robotic Training Requirements

- Online surgical system course work
- Simulation modules with passing metrics
- Beside assisting cases
- Primary cases as the Console Surgeon
- Simulation modules with passing metrics
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