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**

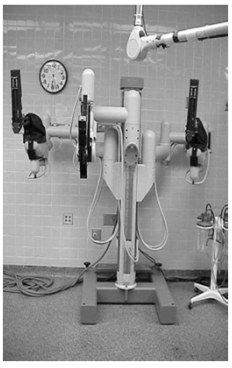
History

- **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)**
- **First reports of robotic Heller myotomy (2001), Pancreatic resection (2001), and Four arm surgery (2004).**

ROBODOC

Lanfranco AR[1], Castellanos AE, Desai JP, Meyers WC. Robotic Surgery: A Current Perspective. Ann Surg. 2004 Jan;239(1):14-21.

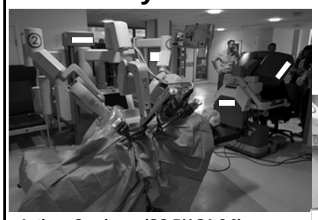
1999



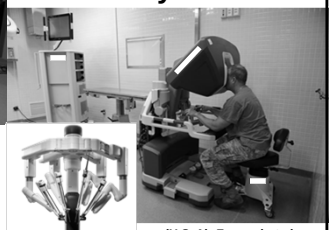
Si System

2017

Xi System



Author: Cmglee (CC BY-SA 3.0)

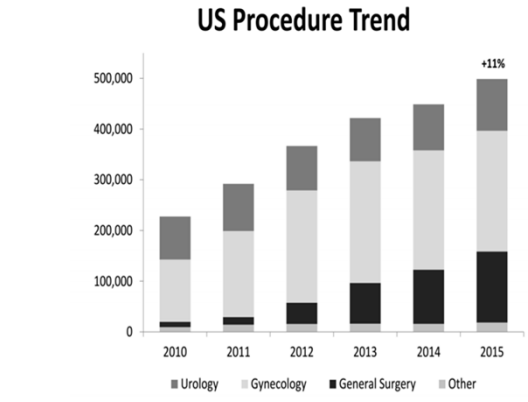


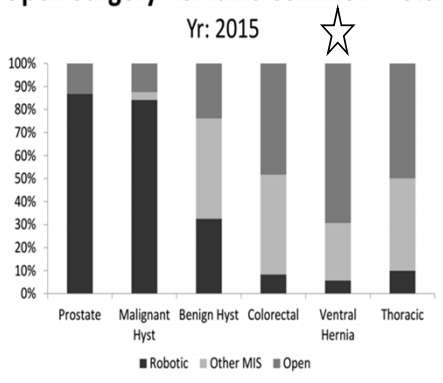
(U.S. Air Force photo by Kemberly Groue/Released)

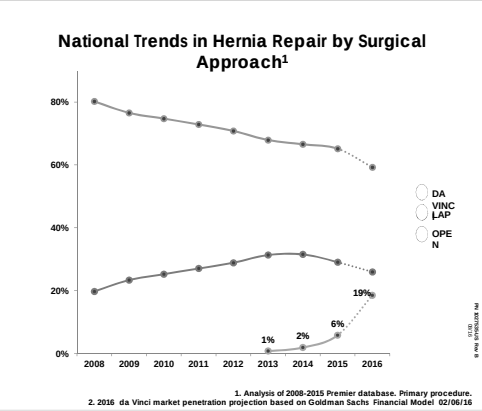
Author: Intuitive Surgical (CC BY-SA 3.0)

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

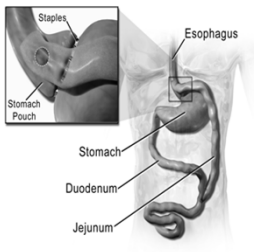
Estimate of Bariatric Surgery Numbers, 2011-2015

	2011	2012	2013	2014	2015
Total	**158,000**	**173,000**	**179,000**	**193,000**	**196,000**
RNY	36.7%	37.5%	34.2%	26.8%	23.1%
Band	35.4%	20.2%	14%	9.5%	5.7%
Sleeve	17.8%	33%	42.1%	51.7%	53.8%
BPD/DS	0.9%	1%	1%	0.4%	0.6%
Revisions	6%	6%	6%	11.5%	13.6%
Other	3.2%	2.3%	2.7%	0.1%	3.2%
Balloons					~700 cases
V-Bloc					18 cases

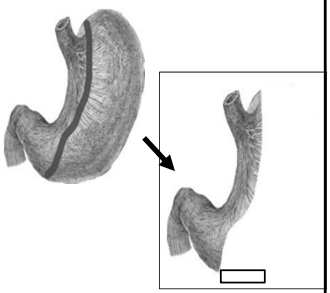
ASMBS total bariatric procedures numbers from 2011, 2012, 2013, 2014 and 2015 are based on the best estimation from available data (BOLD, ASC/MBSAQIP, National Inpatient Sample data and outpatient estimations).

asmbs.org

Robotic Bariatric Surgery



Roux-en-Y Gastric Bypass



Sleeve Gastrectomy

Images from https://en.wikipedia.org/wiki/Gastric_bypass_surgery

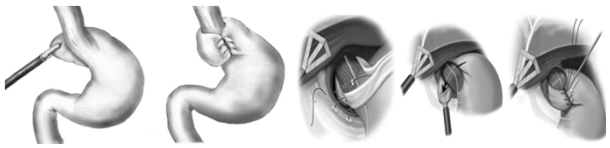
Robotic Bariatric Surgery

- **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

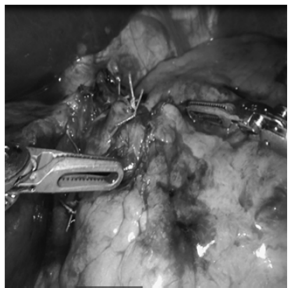
- **Hiatal hernia repair with Nissen (360^0) or Toupet (270^0) fundoplication**



- **Paraesophageal hernia repair**

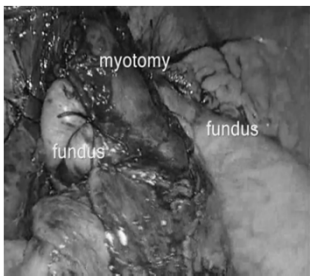
https://medlineplus.gov/ency/presentations/100181_5.htm

Robotic Foregut Surgery



Robotic Foregut Surgery

- Heller myotomy for achalasia



Robotic Foregut Surgery

- 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

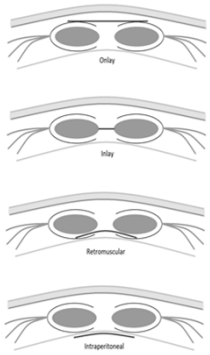
Advantages: Minimally Invasive Approach

- **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**

Gonzalez, A., Escobar, E., Romero, R. et al. Surg Endosc (2016).

Advantages: Minimally Invasive Approach

- **Retrorectus hernia repair: brings fascial edges to the midline to create a more functional abdominal wall**

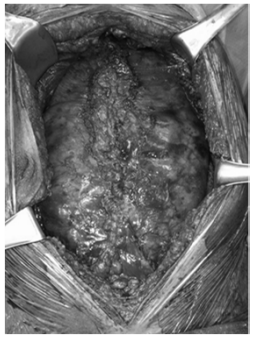


Advantages: Minimally Invasive Approach

- **Recent study compared length of stay of robotic retrorectus ventral hernia repair (r-RVHR) to open retrorectus ventral hernia repair (o-RVHR)**
- **Evaluating value added to patients and the health system by assessing one component, length of stay**

Carbonell AM, et. al. Ann Surg. 2017 Mar 27

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.

Carbonell AM, et. al. Ann Surg. 2017 Mar 27

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

Gonzalez, A., Escobar, E., Romero, R. et al.
Surg Endosc (2016).

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References

1. Lanfranco AR[1], Castellanos AE, Desai JP, Meyers WC. Robotic Surgery: A Current Perspective. Ann Surg. 2004 Jan;239(1):14-21.

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5. Carbonell AM1, Warren JA, Prabhu AS, Ballecer CD, Janczyk RJ, Herrera J, Huang LC, Phillips S, Rosen MJ, Poulose BK. Reducing Length of Stay Using a Robotic-assisted Approach for Retromuscular Ventral Hernia Repair: A Comparative Analysis From the Americas Hernia Society Quality Collaborative. Ann Surg. 2017 Mar 27. doi: 10.1097

6. Gonzalez, A., Escobar, E., Romero, R. et al. Robotic-assisted ventral hernia repair: a multicenter evaluation of clinical outcomes. Surg Endosc (2016). doi:10.1007/s00464-016-511.8-0

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

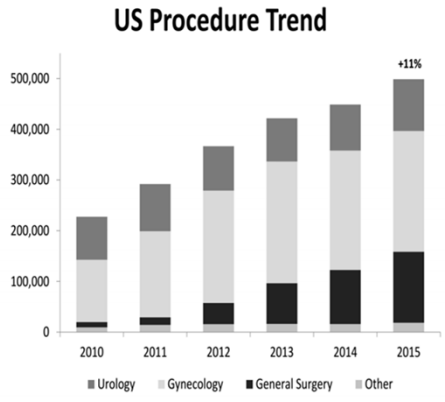
- **First performed in September of 1985.**
- **Popularized as Standard of Care**
- **Gave birth to the Laparoscopic Revolution of Surgery**
- **Continues to be one of the most common procedures performed in the United States**

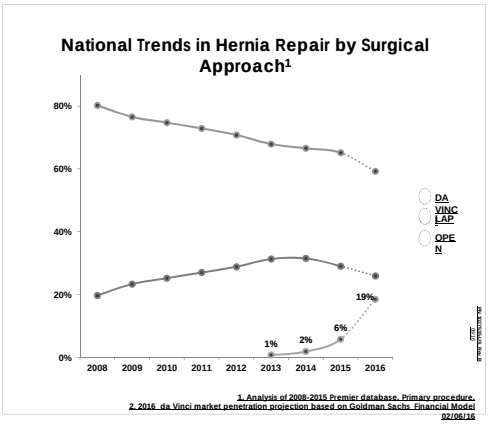
Minimally Invasive Advances in Biliary Surgery

- Fluorescence imaging popularize 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

Robotic Cholecystectomy with Fluorescence Imaging

Robotics in Resident and Fellowship Training





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

Robotics in General Surgery