Lithotomy - “Cutting for Stone”

No anesthesia!

October 16, 1846 MGH Boston
First demonstration of ether anesthesia

Lister’s introduction of surgical antisepsis: 1867

Early MIS
- Hugh Young - Johns Hopkins Hospital
- Developed instrument for transurethral prostate resection - 1906

Controversy about Robotic Surgery
Robotic Surgery: How We Got Here and Where We Are Going
Craig A. Peters, MD
Chief, Pediatric Urology
Children’s Medical Center
University of Texas Southwestern
Dallas, TX

Why Minimally Invasive Surgery in Children?
“Children recover quickly from any incision, and my incision is small”

Pediatric Laparoscopic Pyeloplasty - 1995

Simply reducing the number of stitches or the length of the incision is NOT the goal of minimally invasive surgery - surgical morbidity is a complex combination of tissue trauma, metabolic changes, inflammatory effects, and patient perception

If an operation is difficult, you are not doing it properly

Robert Gross, MD
“Father” of American Pediatric Surgery
• What nice operation are you making difficult today?

W. Hardy Hendren, MD
Robert Gross Professor of Surgery, Harvard Medical School

Conventional Laparoscopy:

Pirate Surgery

• Ergonomically challenging: like running with a peg-leg
• Operating with a hook at times
• Working with one eye covered

Idea stolen from John Meehan, MD

Conventional Laparoscopic vs. Robotic Pyeloplasty

Evolution of a Technology

• Development of single-site robotic systems may reduce surgical morbidity even more without affecting safety

Robotic Surgery - Challenge

• Is this simply an expensive technology that has reduced morbidity for a few?
• Another example of “Technology-push” innovation that will ultimately have limited real value?
• ...or, a truly valuable, paradigm-shifting technology that will re-define the surgical experience?
Pediatric Applications of the DaVinci System

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<td>Ureteral reimplantation</td>
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<td>Gastroscopy repair</td>
<td>Urothelial leiomyoma</td>
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<tr>
<td>Duodenal atresia</td>
<td>Open repair</td>
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Progressive Capability

- Mastery of simple procedures laid the foundation for more complex ones
- Nephrectomy facilitated pyeloplasty
- Pyeloplasty facilitated partial nephrectomy and ureteroureterostomy
- Reimplants facilitated excisional megaureter repair, continent catheterizable channels and cystoplasty...

Innovative Robotic Surgery

- HIDES technique pyeloplasty for kidney obstruction: all incisions below waist line
- Augmentation cystoplasty
- Continent catheterizable stomas for bladder abnormalities
- Bladder neck reconstruction for incontinence
- Radical cystectomy in children
- Retroperitoneal lymph node dissection for testis cancer

Laryngeal cleft repair

Robotic Surgery in the Pediatric Airway

- Robotic set-up
- Open repair
Pediatric Urology Robotic Surgery - State of the Art 2017

- Pyeloplasty (primary and reoperative)
- Ureteral reimplantation
- Partial Nephrectomy
- Pelvic Surgery
- Bladder augmentation, continent urinary diversion (emerging)

Growth of Robotics

Robotic Surgery Market Share

Robotic Surgery Growth

Robotic Surgery Development
Did Halsted need a robot?

- Visualization
The only way the defenseless patient can retaliate upon the incompetent surgeon is hemorrhage. W.S. Halsted.
Pathways to the Future

• Control and Automation
• Image integration
• Navigation
• Haptics: physical and biological
• Novel Robotic Systems

“No fly” zones

Semi-autonomous surgical robot
Augmented Reality ("Mixed reality")

Haptics: Technology

- Visual
- Auditory
- Force-feedback
- Biologic

Haptic Needs

- Tissue texture – differentiate types of tissues and structures to identify location/anatomy
- Tool resistance when moving into a structure you may not want to touch
- Tension on suture or tissue

Pneumatic force sensors

Procedure-specific Robotic Systems

- Procedure/Location-specific Systems
  - Mazor System: spine surgery
  - Mako Robotics: knee surgery
  - DaVinci: largely limited to abdominal and thoracic (chest) procedures
**Task-specific Robots**

- Manage individual surgical tasks
  - Cutting or sawing
  - Suturing
  - Anastomosis
  - Endoscope control
  - Needle biopsy

**Procedure-specific Robotics**

**Tele-proctoring**

- Use of real-time, remote access to DaVinci video stream to observe and guide the more advanced trainee.
- Secure link via Internet into the robotic OR

**Modular Robotics**

**Robotic Simulation**

- Novel virtual reality simulator for robotic surgery with the DaVinci system
  - MIMIC (Seattle, USA)
Da Vinci Virtual Reality Simulation

Robotic Simulation

- Development and Validation of an inexpensive procedure-specific simulation tool – Timberlake
- $2.50

Robotic Skills Assessment

- Credentialing
- Maintenance of Certification
- Liability

Virtual Robotic Systems

- SRI Robotics is licensing technology directly to VERB
- Goal: "...advanced imaging, data analysis, and machine learning to remove variation, enable greater efficiency and provide better outcomes across the spectrum of surgery." [WSJ 2016]
Paradigm Shift?

“Paradigm shih?”

The Patient Experience

• While difficult to measure or value, patient and family experience and perceptions are critically important
• What is “enough” reduction in morbidity?
• What is the value of a better cosmetic result?

Impact on the Patient and Family

• Reducing morbidity and improving outcomes requires being able to measure them
• It is not the patient alone who is impacted by surgery, but the entire family
• Developing ways to capture how the patient and family are affected by the surgical experience is essential for us to really improve that experience

Surgical Robotics 2017

• There is an inherent dilemma within new medical technologies:
  ✓ The need to ensure value and safety
  ✓ The need to allow innovation to survive
• Robotic pediatric surgery has several clear “wins” – pyeloplasty in older children, retrovesical surgery, complex renal reconstruction – these may be seen as heralds of potential future “wins”.

The Future?

The ultimate in outpatient surgery?

Better than human: why robots will — and must — take our jobs
Surgical Robotics 2017; and beyond

• Our job is to critically look at robotic procedures, their outcomes and impact on the patient and their family
• This requires a degree of equipoise – you have to be willing to be objective and self-critical
• If not, credibility goes out the door
• Anticipate and Shape the future