Labib Riachi, M.D.
Chief Division of Robotics and Urogynecology
Chairman Dept of Ob/Gyn at Trinitas Regional Medical Center
Robotic Surgery Market

- General Surgery, 475,000, 37%
- Gynecology, 500,000, 38%
- Urology, 150,000, 11%
- Head and Neck, 25,000, 2%
- Cardiac, 75,000, 6%
- Thoracic, 75,000, 6%
Gynecologic Conditions

- Pre-cancer
- Cancer
- Pelvic masses
- Abnormal bleeding
- Endometriosis
- Fibroids
- Pelvic floor disorders
- Infertility
Cancer of the Female Reproductive Organs

Malignant growth or tumor
✓ Uterus or endometrium
✓ Cervix
✓ Ovary
Surgical Staging for Endometrial Cancer

• The most common gynecologic cancer
• Usually detected in an early stage
• Almost always treated with surgery
Radical Hysterectomy for Cervical Cancer

- Can be detected by an abnormal PAP smear
- Early stages are usually treated with surgery
- Advanced stages are treated with radiation/chemotherapy
Surgical Approaches to Gynecologic Conditions

Open (abdominal) surgery

Minimally invasive surgery (MIS)
- Vaginal surgery
- Conventional laparoscopic surgery
- *da Vinci*® Hysterectomy (robotic-assisted surgery)
Routes of Hysterectomy


Total vs. Supracervical

Hysterectomy Indications U.S.

Hysterectomy by Route

Benefits of Minimally Invasive Surgery (MIS)

- Reduced blood loss
- Fewer complications
- Shorter LOS
- Faster recovery
- Less scarring
- Less risk of infection
- Significantly less pain
- Improved cosmesis

Circa. 1991
MIS – Laparoscopic Surgery

- Minimally invasive surgery (MIS)
- Ability to operate through small keyhole incisions
- The camera and instruments fit through the keyhole incisions
- Better visualization than open surgery
Drawbacks with Conventional Laparoscopic Surgery

Surgeon operates from a 2D image
Straight, rigid instruments (limited range of motion)
Instrument tips controlled at a distance
Reduced dexterity, precision and control
Unsteady camera controlled by assistant
Dependent on assistant for surgical support through an accessory port
Greater surgeon fatigue
Makes complex operations more difficult
How to overcome these drawbacks?

- Improve visualization
- Improve instrument control
- Enhance dexterity for technically challenging aspects of the procedure
- Decrease surgeon fatigue, and hand tremor
History

Robot derived from the Czech word robota

1917, 1921, the Capek brothers
1958 GM introduced the Unimate
1985 robotic arm performed a brain biopsy
1992 Robodoc for use in hip replacement surgery
1994 AESOP/Hermes telerobotic manipulators system
1997 Da Vinci system performed a Cholecystectomy
1999 Zeus system and the surgeon’s workstation
2005 approved for gynecological surgery
Robotic Hysterectomy for Early Stage Cancer
Robotic-assisted laparoscopic hysterectomy (RALH) versus total abdominal hysterectomy (TAH) with pelvic + aortic lymphadenectomy (LA) for staging endometrial cancer

<table>
<thead>
<tr>
<th></th>
<th>RALH + LA (n=56)</th>
<th>TAH + LA (n=106)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>58.9</td>
<td>62.5</td>
<td>0.05</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>28.5</td>
<td>34.0</td>
<td>0.0001</td>
</tr>
<tr>
<td>Severe medical co-morbidity (%)</td>
<td>5.4</td>
<td>8.5</td>
<td>NS</td>
</tr>
<tr>
<td>Estimated blood loss (ml)</td>
<td>105</td>
<td>241</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>OR time (mins)</td>
<td>177</td>
<td>79</td>
<td>0.0004</td>
</tr>
<tr>
<td>Total lymph nodes</td>
<td>18.6</td>
<td>18.0</td>
<td>NS</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>1.0</td>
<td>3.2</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Transfusion rate (%)</td>
<td>0%</td>
<td>8.5%</td>
<td>0.005</td>
</tr>
<tr>
<td>Major peri-operative comps (%)</td>
<td>3.6%</td>
<td>20.8%</td>
<td>0.007</td>
</tr>
</tbody>
</table>

Source: Poster presentation by Dr. Robert Holloway (Florida Hospital) at SGO in March 2008.
**Type III Radical Hysterectomy with Pelvic Lymph Node Dissection for Treatment of Early Stage Cervical Cancer: Robotic vs. Open**

<table>
<thead>
<tr>
<th></th>
<th>da Vinci (n=50)</th>
<th>Open (n=50)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>47.4</td>
<td>41.9</td>
<td>0.029</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>28.6</td>
<td>26.1</td>
<td>0.08</td>
</tr>
<tr>
<td>Estimated blood loss (ml)</td>
<td>95.4</td>
<td>416.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>OR time (mins)</td>
<td>210.8*</td>
<td>247.8</td>
<td>0.0002</td>
</tr>
<tr>
<td>Total lymph nodes</td>
<td>33.8**</td>
<td>23.3</td>
<td>0.0003</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>1.0</td>
<td>3.2</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Post-operative complications</td>
<td>8.0% (4)</td>
<td>16.0% (8)</td>
<td>0.35</td>
</tr>
</tbody>
</table>

*Operative times of last 12 cases was 193 mins.

**Improved lymph node yield due to improved dissection boundaries with da Vinci.

Source: Oral presentation by Dr. John Boggess (UNC) at SGO in March 2008.
Robotic assisted Hysterectomy

- Better access and visualization enable more precise dissection
- Precise, controlled dissection around arteries, veins and nerves
- Access to pelvic and aortic lymph nodes allows replication of open surgical techniques

Video courtesy of Labib Riachi, M.D.
Pelvic Node sampling
Vaginal cuff closure

Video courtesy of Labib Riachi, M.D.
Robotic adhesiolysis

- Dexterity for complex dissections (e.g. endometriosis)
- Great precision in dissecting bowel adhesions
- Improved visualization and access around structures
- Ability to address complex adhesions with greater safety

Video courtesy of Labib Riachi, M.D.
Adhesions

Video courtesy of Labib Riachi, M.D.
Endometriosis

Video courtesy of Labib Riachi, M.D.
Ovarian cystectomy
Vesico-vaginal Fistula
**Robotic Hysterectomy Minimizes TAH and Conversion Rates**

Data from Drs. Thomas Payne and Ralph Dauterive
Ochsner Clinic, Baton Rouge, LA

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**Retrospective Review of Hysterectomy: Pre-Robotic versus da Vinci**

<table>
<thead>
<tr>
<th></th>
<th>Pre-robotic (n=100)</th>
<th>da Vinci (n=100)</th>
<th>Last 25 da Vinci</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>43.5</td>
<td>43.2</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>28.8</td>
<td>28.8</td>
<td></td>
</tr>
<tr>
<td>Estimated blood loss (ml)</td>
<td>113</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>1.6</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>TAH rate</td>
<td>20%</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>Conversions (subset of TAH)</td>
<td>9%</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>Avg uterine weight of conversions</td>
<td>359.5</td>
<td>1387.5</td>
<td></td>
</tr>
<tr>
<td>TAH due to adhesions</td>
<td>8%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Operative times (skin-to-skin)</td>
<td>92.4</td>
<td>119</td>
<td>78.7</td>
</tr>
</tbody>
</table>
Benefits of *Robotic* Hysterectomy

- Enables GYNs to treat complex pathology endoscopically
  - Unsurpassed precision, dexterity and control offer potential for:
    - More precise and efficient dissections
      - Ureters, vesico-uterine reflection, colpotomy
    - Quicker, easier vaginal cuff closure
    - Greater ability to perform MIS on more patient types
      - Compromised anatomy and tissue planes, e.g., due to endometriosis and adhesive disease from prior pelvic surgeries
      - Larger pathology
      - Obese patients
Robotic Myomectomy
da Vinci Myomectomy

- High-definition 3D visualization of tissue planes for a more precise dissection and enucleation
- Enhanced dexterity facilitates enucleation of larger myomas
- Precise, 3-layer suture reconstruction of uterus

Video courtesy of Labib Riachi, M.D.
Myomectomy

Video courtesy of Labib Riachi, M.D.
Benefits of *Robotic Myomectomy*

Enables an MIS approach for myomectomy
- Open is standard; laparoscopy is very difficult to learn/perform
  - An effective 3-layer suture reconstruction is difficult
  - Concern over conversions and uterine rupture
- Most GYNs perform open or opt for hysterectomy instead

Advantages over laparoscopy
- Better suture reconstruction and faster more precise dissection

Advantages over laparotomy
- Potential patient benefits associated with MIS
- Longer procedure times outweighed by improved outcomes
  - Short LOS, minimum EBL, minimum comp or conversions, quick recovery, better cosmesis
da Vinci Sacrocolpopexy
RASC

- Easier, quicker and more precise suturing
- Complete control of the camera and all three operative arms
- A reproducible approach
- RASC is safe and effective for POP
**Benefits of da Vinci Sacrocolpopexy**

*da Vinci* Sacrocolpopexy is considered the gold standard for vaginal vault prolapse

- <5% are performed with laparoscopy
- This procedure typically requires difficult dissections and extensive suturing

*Robotics* enables an endoscopic approach for sacrocolpopexy

The unsurpassed visualization, depth perception, dexterity and control offered by the Robotic System provide:

- Improved access to the pelvis compared to open and conventional laparoscopic approaches
- Easier, more precise rectovaginal and presacral dissections
- Improved handling of suture and mesh for more accurate graft placement and attachment
Symptomatic and Anatomic 1-year Outcomes after Robotic and Abdominal Sacrocolpopexy


<table>
<thead>
<tr>
<th></th>
<th>Robotic Sacrocolpopexy (N = 125)</th>
<th>Abdominal Sacrocolpopexy (N = 322)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptomatic Failures</td>
<td>8%</td>
<td>4%</td>
<td>0.16</td>
</tr>
<tr>
<td>C Point</td>
<td>-8.5</td>
<td>-8</td>
<td>0.78</td>
</tr>
<tr>
<td>Anatomic Failures</td>
<td>6%</td>
<td>6%</td>
<td>0.57</td>
</tr>
<tr>
<td>Estimated Blood Loss (mL)</td>
<td>$90.0 \pm 89.3$</td>
<td>$227.9 \pm 195.0$</td>
<td>&lt; .01</td>
</tr>
</tbody>
</table>

One year after sacrocolpopexy, women who underwent robotic sacrocolpopexy have similar **symptomatic** and **anatomic** success compared with those women who underwent abdominal sacrocolpopexy.
dVH vs. TLH: Five Meta-analyses


<table>
<thead>
<tr>
<th></th>
<th># of Studies</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBL</td>
<td>14</td>
<td>-0.61</td>
<td>(-47.42; 46.20)</td>
<td>NS</td>
</tr>
<tr>
<td>Operative Time</td>
<td>20</td>
<td>0.66</td>
<td>(-15.72; 17.04)</td>
<td>NS</td>
</tr>
<tr>
<td>LOS</td>
<td>17</td>
<td>-0.43</td>
<td>(-0.68; -0.17)</td>
<td>0.05</td>
</tr>
<tr>
<td>Conversion to laparotomy</td>
<td>15</td>
<td>0.49</td>
<td>(0.31; 0.77)</td>
<td>0.05</td>
</tr>
<tr>
<td>Postoperative complications</td>
<td>14</td>
<td>0.68</td>
<td>(0.49; 0.94)</td>
<td>0.05</td>
</tr>
</tbody>
</table>

A total of 1,280 robotic and 1,386 laparoscopic hysterectomies included in the analyses, covering both malignant and benign conditions. No statistically significant differences were found when comparing malignant and benign cases with respect to the measured indices except operative time and postoperative complications.
Thus, we conclude that, compared with traditional laparoscopic hysterectomy, robotic-assisted hysterectomy might have an overall smaller effect on hospital, societal, and psycho-physiologic stress factors, with a shorter hospital LOS, a smaller number of conversions to open surgery, and fewer postoperative complications.
Progress to Single Incision Surgery

- Open Surgery
- Multi-port Surgery
- Single Incision Surgery
Titan’s SPORTTM Surgical System

Size of Current Robots

Small footprint provides easy setup and maneuverability

Cost

Capital cost ~ $600k

Limited Market Penetration

Improved instrument dexterity and reach expands market penetration

Training

Simulation allows quicker and more efficient procedure training

Titan believes that SPORTTM’s smaller footprint, lower cost and improved dexterity will drive utilization and enhance return on investment for hospitals
Is it Safe?
Robotic Surgery Brings Higher Costs, More Complications, Study Shows
Columbia Researchers Compared Robotic Surgery to Regular Laparoscopic Surgery for Removing Ovaries, Ovarian Cysts
The Future

"I'm closing up now. Can you go to the theatre and wake the patient up in ten minutes?"

FUTURE REMOTE ROBOTIC SURGERY.
Questions ???????????