Update on Robotic Surgery
Seattle Robotics Society

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Surgical Therapy: Essentials

• Medical care that requires removal, repair, revision, or reconstruction of tissue and/or organs under sterile conditions where the patient does not feel pain...
• War, police action, professional sports and SURGERY - the “sanctioned” forms of assault...
Current Drivers of Surgical Therapy

- **Efficacy** – often but not always the most effective and durable means of correcting structural problems and extirpating regionally confined disease (infection, inflammation, tumor)
- **Safety** – the right treatment for the right patient at the right time – for optimal results
- **Cost** – OR time $10 – 30$ per minute
- **Efficiency** – essential but limited resource – capital expense and FTE costs

Electrosurgery

- To stop bleeding during surgery and reduce tissue damage, to improve the efficiency of the operation, electrosurgery – use of electrical current to cauterize and dissect tissue – was introduced in 1924 by Drs. Harvey Cushing and William Bovie, also at Harvard.
Videoendoscopic Surgery

• Minimally invasive surgery
  – Sterilized camera, scope, halogen light source
  – Specialized equipment
  – Specialized skills!

Videoendoscopic Surgery: Definition

• surgical procedures done partially or completely under videoendoscopic image guidance.
• a form of minimally invasive surgery
• examples:
  – laparoscopy or laparoscopic surgery
  – thoracoscopy or thoracoscopic surgery
  – arthroscopy
  – endoscopic sinus surgery
Videoendoscopic Surgery: Benefits

• Less pain
• Smaller scars
• Shorter inpatient stay, recovery
• Improved physiology – moisture, temperature, motility, surgical stress reduction
• Equivalent clinical outcome
Videoendoscopic Operative Field

Camera Navigation
Grasping
Cutting
Suturing
Bleeding!
Surgical Robotics

- Interposing a computer and electromechanical linkage between the surgeon and the instrument
- Increased precision, scaling, and correction of the normal reversal due to the fulcrum or pivot of videoendoscopic surgery
- A specialized form of minimally invasive surgery

Da Vinci Robotic Actuator

Surgical Robotics

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Da Vinci Robotic Actuator
ZEUS – Surgical Robot
Robotic Nissen Fundoplication

• Multi-armed robot (3 to 4)
• Surgeon at console
• Assistant at bedside
• Movements are transferred via computer to robotic arms
• True 3-D view
daVinci Surgical System
Da Vinci Footpedals
Laparoscopic Prostatectomy

- Replicates hand
- 6 degrees of freedom
  - Up-down
  - Left-right
  - In-out
  - Rotation
  - Pitch
  - Yaw
- “Intuitive”

Endowrist
Precise Movement

- Motion scaling
- No tremor

3-D Vision

- True stereoscopic view
- No Glasses
- Restores depth
- Allows for precise dissection
Surgical Robots

+ Laparoscopic Prostatectomy

= Robotic Prostatectomy

• Most common procedure performed with daVinci*
• More than Cardiac, Gen Surg, GYN combined
• Fastest growing robotic procedure
• >80% prostatectomies in 2010 in the US are robotic

*Intuitive Surgical Marketing Data
Radical Prostatectomy

Prostate cancer - #1 cancer in males
Radical Prostatectomy

Division of Urethra

Wide Excision of Left Neurovascular Bundle
Radical Prostatectomy

daVinci Prostatectomy Steps
- Patient Positioning and Ports
- Docking Robot
- Removal of Prostate
- Vesico-urethral anastomosis
- Undock and Close
daVinci Prostatectomy
daVinci Prostatectomy
“Shoes off, kick back and...”

1. Incising endopelvic fascia
2. Dividing dorsal vein complex
3. Dividing bladder neck
4. Releasing rectum
5. Controlling vascular pedicles
6. Dividing urethra
7. Vesico-urethral anastomosis
Incision medial umbilical ligament

Division of urachus
Division of endopelvic fascia

Division of bladder neck
Dissection of seminal vesicles

Clipping of prostatic pedicle
Division of urethra

Urethral anastomosis - 1
Urethral anastomosis - 2

LRP-Post op
### Laparoscopic Prostatectomy

#### Operative Outcomes

<table>
<thead>
<tr>
<th>Series</th>
<th>Number of Patients</th>
<th>Mean Operative Time (min)</th>
<th>Mean Hospital Stay (days)</th>
<th>Mean Catheterization Time (days)</th>
<th>Mean Blood Loss (mL)</th>
<th>Transfusion Requirements %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Türk et al (2001)</td>
<td>125</td>
<td>240</td>
<td>8</td>
<td>12</td>
<td>185</td>
<td>2</td>
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<tr>
<td>Hoznek et al (2001)</td>
<td>134</td>
<td>240</td>
<td>6.1</td>
<td>4.8</td>
<td>Not reported</td>
<td>3</td>
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<tr>
<td>Guillonneau et al (2002)</td>
<td>550</td>
<td>200</td>
<td>Not reported</td>
<td>4.2</td>
<td>380</td>
<td>5.3</td>
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<tr>
<td>Abbou et al (2003)</td>
<td>230</td>
<td>271</td>
<td>Not reported</td>
<td>5.8</td>
<td>Not reported</td>
<td>2.8</td>
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<tr>
<td>Rassweiler et al (2003)</td>
<td>438</td>
<td>263</td>
<td>11.5</td>
<td>7</td>
<td>950</td>
<td>9.6</td>
</tr>
</tbody>
</table>

### Laparoscopic Prostatectomy

#### Functional Outcomes

<table>
<thead>
<tr>
<th>Series</th>
<th>Number of Patients</th>
<th>Positive Margin</th>
<th>Definition of Potency</th>
<th>Patients Achieving Potency</th>
<th>Definition of Continence</th>
<th>Patients Achieving Continence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rassweiler et al (2006)</td>
<td>5924</td>
<td>10.6% (pT2) 32.7% (pT3a) 56.2% (pT3b)</td>
<td>Intercourse</td>
<td>52% at 12 mo</td>
<td>No pads</td>
<td>84.9% at 12 mo</td>
</tr>
<tr>
<td>Guillonneau et al (2003)</td>
<td>1000</td>
<td>15.5% (pT2) 31.1% (pT3)</td>
<td>Intercourse</td>
<td>86% at 12 mo</td>
<td>No pads</td>
<td>82.3% at 12 mo</td>
</tr>
<tr>
<td>Rozet et al (2005)</td>
<td>600</td>
<td>14.6% (pT2) 28.2% (pT3)</td>
<td>Intercourse</td>
<td>84% at 6 mo</td>
<td>No pads</td>
<td>84% at 12 mo</td>
</tr>
</tbody>
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### Robotic Prostatectomy

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<th>Transfusion Requirements, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tewari et al (2003)</td>
<td>200</td>
<td>180</td>
<td>1.2</td>
<td>7</td>
<td>133</td>
<td>0</td>
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<tr>
<td>Patel et al (2005)</td>
<td>200</td>
<td>141</td>
<td>1.1</td>
<td>7.2</td>
<td>75</td>
<td>0</td>
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### Robotic Prostatectomy

#### Functional Outcomes

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<th>Series</th>
<th>Number of Patients</th>
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<th>Definition of Continence</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Badani et al (2007)</td>
<td>2786</td>
<td>12.0</td>
<td>Intercourse</td>
<td>75.2% at 12 mo</td>
<td>51 pad per day</td>
<td>95% at 12 mo</td>
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<tr>
<td>Ahlering et al (2004)</td>
<td>140</td>
<td>12.3% (pT2) 48.8% (pT3)</td>
<td>Not reported</td>
<td>Not reported</td>
<td>No pads</td>
<td>76% at 3 mo</td>
</tr>
<tr>
<td>Patel et al (2003)</td>
<td>200</td>
<td>5.7% (pT2) 28.9% (pT3)</td>
<td>Not reported</td>
<td>Not reported</td>
<td>No pads</td>
<td>96% at 6 mo</td>
</tr>
<tr>
<td>Joseph et al (2003)</td>
<td>325</td>
<td>9.9% (pT2) 32.7% (pT3a)</td>
<td>IIEF &gt;21</td>
<td>66% at 6 mo</td>
<td>No pads</td>
<td>96% at 6 mo</td>
</tr>
</tbody>
</table>
Robotic vs Lap Prostatectomy

*Cancer-specific Outcomes*

<table>
<thead>
<tr>
<th>Series</th>
<th>Case Type</th>
<th>Number of Patients</th>
<th>Positive Margin</th>
<th>PSA Recurrence</th>
<th>Cancer-Related Deaths (%)</th>
<th>Actuarial Biochemical Free Survival</th>
<th>Receiving Adjuvant Treatment</th>
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</thead>
<tbody>
<tr>
<td>Badani et al (2007)</td>
<td>Robotic</td>
<td>2700</td>
<td>12%</td>
<td>7.3% at 22 mo</td>
<td>.0007 (71 months of follow-up)</td>
<td>84% at 5 y</td>
<td>2.5%</td>
</tr>
<tr>
<td>Guillonneau et al (2003)</td>
<td>Laparoscopic</td>
<td>1000</td>
<td>15.5% (pT2) 31.1% (pT3)</td>
<td>9.5% at 36 mo</td>
<td>Not reported</td>
<td>90.5% at 3 y</td>
<td>Not reported</td>
</tr>
</tbody>
</table>

Robotic Esophageal Myotomy Setup
daVinci Surgical System

• Limitations:
  – Bulky
  – Surgeon not at the bedside
  – No tactile feedback: “tissue feel”
  – Break down
  – Expensive

Restricted Access to Patient
Where Am I?

Next Generation Surgical Robotics
The Surgeon – Before and After Surgical Robotics
Our future or another tool?

Fig 67