New Advances in Colon and Rectal Surgeries

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Agenda

- Advances in minimally invasive abdominal surgery
  - Single incision laparoscopy (SILS)
  - Robotic surgery
    - Si vs Xi
  - Perfusion imaging
  - TAMIS

- Advances in anorectal surgery
  - Anal fistula surgery
    - ERAF, LIFT, Fat grafting
  - Hemorrhoids
    - Transanal Hemorrhoidal Dearterialization (THD)
  - Fecal incontinence
    - Sacral Nerve Stimulator (SNS)
Advances in Minimally Invasive Abdominal Surgery
Multiport Laparoscopy

Subtotal/Total Procto-Colectomy/
Low Anterior Resection

- 5mm Trochar
- 10/12mm Trochar
- Ileostomy site
- Extraction Site

Ileocolic Resection/
Right hemicolecstomy
Single Incision Laparoscopy
Single Incision Laparoscopy

• Clear Benefit
  • Cosmesis

• Hypothesized Benefit
  • Less pain
  • Fewer wound complications
  • Faster return to work

• Definite Drawbacks
  • Longer operative time/learning curve

• Hypothesized Drawbacks
  • Increased trocar site hernias
  • More pain
  • Increased cost
Single Incision Laparoscopy

  • Single blinded RCT of SILS vs Conventional Lap Colectomy (CLC) pts (25/arm)
  • Colonic neoplasms <4 cm
  • SILS pts had shorter LOS (4 vs 5 d – p<0.001)
  • Postop pain scores lower in at POD#1 & 2
    • 0 vs 3 p=0.002
    • 0 vs 2 p =0.014
  • Otherwise no difference

  • Retrospective case match of 20 SILS vs CLC for sigmoid diverticulitis
  • No difference in OR time, EBL, complications, incision length
  • LOS: SILS: 3.7d vs CLC: 5.0d (p=0.05)
  • SILS group used significantly less pain meds, had better POD#1 & 2 pain scores
Scars

Open J-Pouch

SILS Subtotal Colectomy

After Ileostomy closure

Laparoscopic Right Hemicolectomy

SILS Subtotal Colectomy

SILS RHC
Robotic Surgery
- Low pelvic surgery
- Similar outcomes as laparoscopy
- Easier single site surgery
- Improved ergonomics
Robotic Surgery

• Davis, et al: No difference in complications or LOS in Robot vs laparoscopic. Robotic cases were 1 hr longer and $2000 more expensive

• Kim, et al: Most of the studies reported robotic surgery showed a longer OR time, less EBL, shorter LOS, lower complication and conversion rates

• Keller, et al: Low volume surgeons had higher complication rate, longer LOS, higher cost. High volume had less EBL and ileus.
## Initial Clinical Data for da Vinci in Rectal Cancer

<table>
<thead>
<tr>
<th>Study Reference</th>
<th>Patient Population</th>
<th>Positive CRM, %</th>
<th>Conversion Rate, %</th>
<th>LOS days</th>
<th>Complication Rate, %</th>
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<tbody>
<tr>
<td>Pigazzi (2006)¹</td>
<td>6</td>
<td>NR</td>
<td>0.0</td>
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<td>Hellan (2007)²</td>
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<td>5</td>
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<td>Baik (2008)³</td>
<td>18</td>
<td>NR</td>
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<td>Patriti (2009)⁴</td>
<td>29</td>
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<td>Baik (2009)⁵</td>
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<td>Park (2010)⁶</td>
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<td>Pigazzi (2010)⁷</td>
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<td>0.7</td>
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<td>Bianchi (2010)⁸</td>
<td>25</td>
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<td>0.0</td>
<td>6.5</td>
<td>4</td>
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<tr>
<td>Baek (2010)⁹</td>
<td>64</td>
<td>0.0</td>
<td>6.0</td>
<td>5.0</td>
<td>23</td>
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<tr>
<td>Baek (2011)¹⁰</td>
<td>41</td>
<td>2.4</td>
<td>3.0</td>
<td>6.5</td>
<td>9</td>
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<tr>
<td>Kwak (2011)¹¹</td>
<td>59</td>
<td>1.7</td>
<td>0.0</td>
<td>NR</td>
<td>19</td>
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<tr>
<td>Park (2011)¹²</td>
<td>52</td>
<td>2.4</td>
<td>0.0</td>
<td>10.0</td>
<td>10</td>
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<tr>
<td>Kang (2013)¹³</td>
<td>165</td>
<td>4.2</td>
<td>0.6</td>
<td>10.8</td>
<td>21</td>
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<tr>
<td>D’Annibale (2013)¹⁴</td>
<td>50</td>
<td>0.0</td>
<td>0.0</td>
<td>8.0</td>
<td>10</td>
</tr>
</tbody>
</table>

- **Robotic**: 788 | 2.1% | 2.1% | 8.2 | 22%

- **MRC Classic**: 242 | 16.0 | 34.0 | 10.0 | 32%

- **COLOR II**: 739 | 10.0 | 17.0 | 8.0 | 49%

- **Lap**: 981 | 11.0% | 21.0% | 8.5 | 38%

- **MRC Classic**: 132 | 14 | N/A | 13.0 | 37%

- **COLOR II**: 364 | 10 | N/A | 9.0 | 37%

- **Open**: 496 | 11.0% | N/A | 10.1 | 37%

Studies selected based on highest quality of available literature; no statistical analysis has been performed; analysis may confirm that numerical differences are not statistically significant.
Robotics Outcomes for Rectal Cancer vs. Lap and Open Techniques

<table>
<thead>
<tr>
<th></th>
<th>Open (n=165)</th>
<th>Laparoscopic (n=165)</th>
<th>Robotic (n=165)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Margin*</td>
<td>10.3%</td>
<td>6.7%</td>
<td>4.2%</td>
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<tr>
<td>Estimated blood loss, mL*</td>
<td>275.4</td>
<td>140.1</td>
<td>133.0</td>
</tr>
<tr>
<td>Wound Infection*</td>
<td>4.8%</td>
<td>1.2%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Time to first flatus (days)**</td>
<td>3.0</td>
<td>2.4</td>
<td>2.2</td>
</tr>
<tr>
<td>Time to resumed soft diet (days)**</td>
<td>6.4</td>
<td>5.2</td>
<td>4.5</td>
</tr>
</tbody>
</table>

*Significant difference between laparoscopic and robotic
**Significant difference between open, laparoscopic, and robotic

Study limitations: retrospective, non-randomized study design

Si vs Xi – New technology

- Many new upgrades on new system
  - Boom
  - Arms
  - Trocars
  - Camera
  - Integrated energy
  - Table coordination
Si vs Xi – Boom arm

• Si
  • Fixed configuration
    • Adequate for pelvis
    • Difficult for multiple sites in abdomen
  • Arm clashing if trocars not offset

• Xi
  • Rotating Boom
    • Able to access multiple sites within abdomen and move throughout
  • Less Arm clashing
    • Trocars able to be placed in straight line
Si vs Xi - Arms

- **Si**
  - Arms move rotationally
  - Can lead to clashing ulness trocars offset
  - Somewhat fixed
  - Move when depressing one of two buttons

- **Xi**
  - More linear motion
  - Patient Clearance button
  - Arms can be manipulated simply by grasping
  - Still have 2 buttons
Si vs Xi - Trocars

- **Si**
  - Dedicated 12mm port for camera
  - 8mm for other instruments
  - Arms snapped around trocars
    - Enables use of other company trocars
- **Xi**
  - All trocars now 8mm
  - Arms magnetically dock
    - Must use Intuitive trocars
    - Can place inside of larger trocars
  - Faster docking
Si vs Xi - Camera

• Si
  • 3D HD, 0° and 30°
  • 12 mm, bulky camera
  • Dedicated camera port

• Xi
  • 3D HD, 0° and 30°
  • 8 mm, smaller camera
    • Able to “port hop”
    • Easier to use hand held
  • Can use any port
Si vs Xi – Integrated Energy

- **Si**
  - Requires external energy source
    - Purchased separately
    - System that you may be using for all other surgeries

- **Xi**
  - Integrated ERBE VIO dV system
    - Both monopolar and bipolar
    - Settings may be different than what you are used to
      - 1-10 scale
Si vs Xi – Integrated Table Motion

• **Si**
  - If patient needs to be repositioned robot will need to be undocked

• **Xi**
  - Have integrated table motion and boom motion enabling en bloc movement
    - Must purchase table separately
    - Trumpf Medical TruSytem 7000 table only
Perfusion Imaging

- Allows for evaluation of bowel perfusion
  - Injection of Indocyanine Green
  - Visualize under laser excitation
  - Spy – open surgery
  - Pinpoint – laparoscopic
  - Firefly – robotic

- Video
Firefly™ Shows Trend Toward Reduction in Leak Rate

The use of indocyanine green fluorescence to assess anastomotic perfusion during robotic assisted laparoscopic rectal surgery*

Mehraneh D. Jafari · Kang Hong Lee · Wissam J. Halabi · Steven D. Mills · Joseph C. Carmichael · Michael J. Stamos · Alessio Pigazzi

**Revision of Transection Point 19% 5%
Anastomotic leak rate 6% 18%
Diversion (Temporary Stoma) 75% 77%
Median level of anastomosis 3.5 cm 5.5 cm**

Example of revised transection point

Study limitations: retrospective non-randomized study design may result in sampling bias; no statistical analysis was performed

Robotic TAMIS

• TransAnal Minimally Invasive Surgery

• Benefits
  • Steadier camera – easier to get around difficult folds
  • Articulation of the instruments within a narrow space

• Drawbacks
  • Cost
  • Setup time

• Video
Advances in Anorectal Surgery
Anal Fistulae

• Surgical treatment (w/ success rate)
  • I&D
  • Seton – 20%
  • Fistulotomy – 80-100% (54% had continence affected)
  • **Endorectal Advancement Flap (ERAF)** – 54-88%
  • Biologic plug – 24-95% (accepted rate ~55%)
  • Fibrin Glue – 31-38%
  • **Ligation of intersphincteric tract (LIFT)** – 57-83%
  • Diversion – up to 81% (50% stomas never reversed)
  • Proctectomy – 100% (25-50% wound complications)
Endorectal Advancement Flaps (ERAF)

- Eisenstein, et al.
  - Largest series
  - 24 pts w/ ERAF for CD
  - 18 successful surgeries (75%)
  - 6 Failures – 5/6 ultimately closed
  - Successful pts
    - Less complex fistulae
    - More likely diverted
    - Longer duration of preoperative anti-TNF tx
Ligation of Internal Fistula Tract (LIFT)

- Technically less demanding than ERAF
- Similar results in non IBD fistulae
  - Very little evidence of efficacy in Crohn's
  - Much anecdotal evidence of efficacy
- BioLIFT – adds biologic mesh to repair
Stem Cell Therapy/Fat grafting

- Mesenchymal stem cells can be derived from adipose tissue
  - Can suppress inflammation
  - Can differentiate into a variety of tissues
  - Fistula healing in 71% of 24 pts
    - Similar results w/ Crohn’s and non-Crohn’s
- Further studies demonstrated up to 88% 1-yr closure rate.
- Advantages: No incisions, no sphincter injury
- Disadvantages: Small series, possible need for multiple procedures
• 21 pts w/ perianal fistulizing CD randomized into 3 dosage groups and placebo.
  • MSC prepared from BM aspirate
  • Surgery included seton removal, curretage, closure of internal orifice, MSC injection
24 mo results of a study that was reported as phase 2 data at 12 mos

- Adipose derived stem cells (ASCs) from fat aspirates which were cultured
- Surgery: Seton removed, curette tract, close internal orifice, cells injected into tract with mixture of fibrin glue

**Table 3. Efficacy of treatments**

<table>
<thead>
<tr>
<th>Efficacy parameter</th>
<th>12 months Modified PP set (n = 29)</th>
<th>12 months Modified ITT set (n = 35)</th>
<th>24 months Modified PP set (n = 26)</th>
<th>24 months Modified ITT set (n = 36)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete closure</td>
<td>23 (79.3)</td>
<td>28 (80.0)</td>
<td>21 (80.8)</td>
<td>27 (75.0)</td>
</tr>
<tr>
<td>Incomplete closure</td>
<td>6 (20.7)</td>
<td>7 (20.0)</td>
<td>5 (19.2)</td>
<td>9 (25.0)</td>
</tr>
<tr>
<td>p value(^a)</td>
<td>.0003(^b)</td>
<td>&lt;.0001(^b)</td>
<td>&lt;.001(^b)</td>
<td>&lt;.001(^b)</td>
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</tbody>
</table>

**Table 4. Long-term efficacy of treatments**

<table>
<thead>
<tr>
<th></th>
<th>Week 8</th>
<th>Month 12</th>
<th>Month 24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance of complete closure</td>
<td>27</td>
<td>23 of 26 (88.5%)</td>
<td>20 of 24 (83.3%)</td>
</tr>
<tr>
<td>Recurrence</td>
<td>3 of 26 (11.5%)</td>
<td>4 of 24 (16.7%)</td>
<td></td>
</tr>
<tr>
<td>Description of missing patients</td>
<td>1 case: patient withdrawal at month 12</td>
<td>1 case: patient withdrawal at month 12</td>
<td>2 cases: data missing at month 24</td>
</tr>
</tbody>
</table>

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Stem Cells Transl. Med. 2015 May;4(5):532-7
Stem Cell Therapy/Fat grafting - UCSD

- Prolonged seton drainage
- Often pts will have undergone multiple other attempts at repair which will have likely failed
- At the time of the fat grafting procedure
  - Exam under anesthesia – ensure infection is drained, fistula is mature
  - Curette out tract, remove seton – remove epithelialization
  - Can attempt primary repair – ERAF, LIFT, Plug
  - Adipose stem cells are harvested via liposuction from thighs
  - Spun down and separated
  - Injected into the area around the fistula tract
  - May take 6-8 weeks for optimal results
New Treatments for Hemorrhoids - THD

- Transanal Hemorrhoidal Dearterialization
  - Use doppler U/S to identify hemorrhoidal inflow and ligate
  - Include hemorrhoidopexy
  - Only for internal component
- Similar outcomes as hemorrhoidectomy
- Significantly less painful
Fecal Incontinence - SNS

- Sacral Nerve Stimulation
  - Effective for FI of all etiologies
  - Mechanism of action not entirely known
  - 70-90% effective across series at improving FI sx by 50%
  - 2 outpatient procedures
  - Can be done with local

- Adverse Events
  - Pain at surgical site
  - Seroma
  - Infection
  - Vaginal tingling
  - Hematoma

- Video
Cleveland Clinic Fecal Incontinence Score

<table>
<thead>
<tr>
<th></th>
<th>NEVER</th>
<th>RARELY</th>
<th>SOMETIMES</th>
<th>USUALLY</th>
<th>ALWAYS</th>
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<tr>
<td>SOLIDS</td>
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<td>3</td>
<td>4</td>
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<tr>
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<td>4</td>
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<tr>
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<td>4</td>
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<tr>
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<td>3</td>
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<td>LIFESTYLE ALTERATION</td>
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<td>3</td>
<td>4</td>
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</tbody>
</table>
SNS Data – Fecal Incontinence

• Ann Surg. 2010 Mar;251(3):441-9
  • Largest prospective series – 133 pts (120 implanted via stage 2)
  • 2 yr f/u – 83% pts with improvement, 43% had no further FI
  • Incontinence episodes per week decrease from 9.4 to 1.9

  • Randomized 30 pts w/ SNS to ON vs OFF
  • Significantly fewer FI episodes in ON
  • All pt selected to stay in ON

• Dis Colon Rectum 2010 Nov;53(11):1501-7
  • Review of 36 surgical revision procedures in 87 pts
  • 4 infections, 2 electrode breakage, 2 electrode displacement, 7 pain, 8 battery depletions, 9 loss of efficacy
Thank You!