Update on Robotics
What is the Current State?

Charles E. Miller, MD, FACOG

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- Clinical Associate Professor, Department OB/GYN, University of Illinois at Chicago, Chicago, IL USA
- Director of Minimally Invasive Gynecologic Surgery, Advocate Lutheran General Hospital, Park Ridge, IL USA
- Director, AAGL/SRS Fellowship in Minimally Invasive Gynecologic Surgery, Advocate Lutheran General Hospital, Park Ridge, IL USA
ROBOTIC SURGERY HAS PROVEN TO BE A Viable ALTERNATIVE FOR MULTIPLE PROCEDURES IN MINIMALLY INVASIVE GYNECOLOGIC SURGERY
Advantages of robotic assistance in minimally invasive gynecologic surgery

• Eliminates tremor (filters movement)
• Scales down hand movement (more precise)
• Stereoscopic viewer at console
• Enables 3D imaging
• Steady image
• Advanced ergonomics – instrument articulation provides seven degrees of movement (mimics human wrist movement and eliminates fulcrum effect)
• Reduces physician fatigue
Disadvantages of robotic assistance in minimally invasive gynecologic surgery

- **Cost**
  - Robot $1.5 - $1.75 million
  - Reposable instruments (10 time use) - $250 (average cost per use)

- **Lack of tactile feedback (visual haptics)**

- **Need for well qualified assistant**

- **Learning curve (albeit short)**

- **Potential loss of laparoscopic (suturing) skills**
Robotic Assisted Laparoscopic Myomectomy

- Setup
  - Patient placed in dorsal lithotomy position
  - Place indwelling Foley catheter
  - Post hysteroscopy, place intrauterine manipulator
  - Place trocars at “bedside” above and lateral to uterus plus fibroids
  - Place patient in steep trendelenburg
  - Perform side docking
    - Patient-side cart with robotic arms brought to outside of either leg

UPDATE ON ROBOTICS: ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?
Tips to Maximize Success – 3 Port Technique

8mm da Vinci® Endoscope Port (RED):

- 8mm scope. If very complex will gain access through upper left quadrant with 5 scope to place endoscope port.

8mm da Vinci® Morcellation Port (BLUE):

- Monopolar Hotshears, Vessel Sealer, Harmonic Scalpel, Mega Needle Driver

8mm da Vinci® Instrument Port (YELLOW):

- Prograsps, Suction Irrigator, PK

5mm Optional Entry Port (WHITE):

- For gaining access into abdomen and insufflation in complex cases

When it is time to suture, the Monopolar Curved Scissors are removed and the bedside assistant passes the suture deliberately down the da Vinci 8mm cannula before inserting the Mega Needle Driver. CT-1/CT-2 SH needle will fit deliberately down the 8mm daVinci cannula. Remove needles at end of case.
UPDATE ON ROBOTICS:
ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?

Right Ovarian Endometrioma
UPDATE ON ROBOTICS:
ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?

Resection – Endometriosis Pelvic Sidewall, Uterosacral Ligament
(including ureterolysis)
UPDATE ON ROBOTICS: ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?

THE LAST FRONTIER

ROBOT ASSISTED ENDOMETRIOSIS SURGERY FOR DEEP INFILTRATIVE SURGERY

Currently, literature is comprised of only feasibility studies, no large case series and certainly no randomized controlled reports.
UPDATE ON ROBOTICS:
ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?

Robotic Assisted Endometriosis Surgery for Deep Infiltrative Disease

Nezhat C, Fertil Steril 2010; 94(7): 2758-60
Frick AC, JSLS 2011; 15: 396-99
Brudie LA, J Robotic Surgery, published on-line October 2011
Dulemba J, J Robotic Surg, published on-line June 2012

N =1

Robotic-Assisted Laparoscopic Management of Ureteral Endometriosis
Anna C. Frick, MD, MPH, Ebub E. Barudet, MD, Robert J. Stein, MD, Michelle Moro, MD, Tommaso Falcone, MD

N=2

Retrospective analysis of robot-assisted versus standard laparoscopy in the treatment of pelvic pain indicative of endometriosis
John F. Dalkasino, Csabi Pelai, Helen B. Paul

N=26 stage IV

Peri-operative outcomes of patients with stage IV endometriosis undergoing robotic-assisted laparoscopic surgery
Lorna A. Brudie · Giorgia Gaia · Sarfraz Ahmad · Neil J. Finkler · Glenn E. Bigsby IV · Giselle B. Gharani · James E. Kentrick IV · Joseph A. Rakowski · Jessica H. Groton · Robert W. Holloway

N=80 stage IV (2 parametrium, 6 rectovaginal septum, 10 sigmoid serosa, 4 cecum)

Robotic treatment of colorectal endometriosis: technique, feasibility and short-term results
A. Ercoli1,2, M. D’asta1, A. Fagotti1, F. Fanfani1, F. Romano1, G. Baldazzi1, M.G. Salerno1, and G. Scambia1

N=12
UPDATE ON ROBOTICS: ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?

Robotic versus standard laparoscopy for the treatment of endometriosis

Camran Nezhat, M.D.,* Michael Lewis, M.D.,* Sumathi Kotikela, M.D.,* Arathi Veeraswamy, M.D.,* Lily Saadat,* Babak Hajhosseini, M.D.,* and Geana Nezhat, M.D.†

### Demographics

<table>
<thead>
<tr>
<th></th>
<th>RAL (n = 40)</th>
<th>SL (n = 38)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y), mean (range)</td>
<td>35 (22–49)</td>
<td>33 (18–46)</td>
<td>.205</td>
</tr>
<tr>
<td>BMI mean (range)</td>
<td>24 (10–37)</td>
<td>23 (18–31)</td>
<td>.283</td>
</tr>
<tr>
<td>Patients with previous pelvic surgery, %</td>
<td>45% (18)</td>
<td>40% (15)</td>
<td>.481</td>
</tr>
</tbody>
</table>

Note: RAL = robot assisted laparoscopy; SL = standard laparoscopy; BMI = body mass index.


### Operative outcomes

<table>
<thead>
<tr>
<th></th>
<th>RAL (n = 40)</th>
<th>SL (n = 38)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean operative time (min) (range)</td>
<td>191 (135–295)</td>
<td>159 (85–320)</td>
<td>.045</td>
</tr>
<tr>
<td>Mean blood loss, ml (range)</td>
<td>60 (0–350)</td>
<td>65 (0–500)</td>
<td>.823</td>
</tr>
<tr>
<td>Intraoperative and postoperative complications</td>
<td>0</td>
<td>0</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Note: RAL = robot assisted laparoscopy; SL = standard laparoscopy; n/a = not available.

Peri-operative outcomes of patients with stage IV endometriosis undergoing robotic-assisted laparoscopic surgery

Lorna A. Brudie · Giorgia Gaia · Sarfraz Ahmad · Neil J. Finkler · Glenn E. Bigsby IV · Giselle B. Ghurani · James E. Kendrick IV · Joseph A. Rakowski · Jessica H. Groton · Robert W. Holloway

### Surgical Procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>RALH/BSO</td>
<td>48 (60%)</td>
</tr>
<tr>
<td>RALH/USO</td>
<td>9 (11.3%)</td>
</tr>
<tr>
<td>Modified radical hysterectomy</td>
<td>5 (6.3%)</td>
</tr>
<tr>
<td>USO or BSO only</td>
<td>10 (13%)</td>
</tr>
<tr>
<td>Ovarian cystectomies with excisions of endometriotic implants</td>
<td>4 (5%)</td>
</tr>
<tr>
<td>Appendectomy</td>
<td>3 (3.8%)</td>
</tr>
<tr>
<td>Ureterolysis</td>
<td></td>
</tr>
<tr>
<td>Unilateral</td>
<td>11 (13.8%)</td>
</tr>
<tr>
<td>Bilateral</td>
<td>18 (22.5%)</td>
</tr>
<tr>
<td>Moschowitz culdeplasty</td>
<td>1 (1.3%)</td>
</tr>
<tr>
<td>Placement of temporary intra-operative ureteral catheters</td>
<td>1 (1.3%)</td>
</tr>
<tr>
<td>Cystoscopy</td>
<td>2 (2.5%)</td>
</tr>
</tbody>
</table>

*RALH*: robotic-assisted laparoscopic hysterectomy, *BSO*: bilateral salpingo-oophorectomy, *USO*: unilateral salpingo-oophorectomy

### Peri-Operative Outcomes

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases (n)</td>
<td>80</td>
</tr>
<tr>
<td>Conversions to laparotomy</td>
<td>4 (5%)</td>
</tr>
<tr>
<td>Operative time (min)</td>
<td>115 ± 46</td>
</tr>
<tr>
<td>Estimated blood loss (ml)</td>
<td>88 ± 67</td>
</tr>
<tr>
<td>Blood transfusions</td>
<td>0</td>
</tr>
<tr>
<td>Hospital length of stay (days)</td>
<td>1.0 ± 0.37</td>
</tr>
<tr>
<td>Re-operation at 2 weeks post-operative for vaginal cuff abscess</td>
<td>1 (1.3%)</td>
</tr>
<tr>
<td>Pain relief at 8 weeks post-operative</td>
<td>79 (98.8%)</td>
</tr>
</tbody>
</table>

### Peri-Operative Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ureteral transaction</td>
<td>1 (1.3%)</td>
</tr>
<tr>
<td>Vaginal cuff abscess with incision and drainage</td>
<td>1 (1.3%)</td>
</tr>
<tr>
<td>Vaginal cuff hematoma</td>
<td>1 (1.3%)</td>
</tr>
<tr>
<td>Re-admission for nausea and vomiting (secondary to narcotic use)</td>
<td>1 (1.3%)</td>
</tr>
</tbody>
</table>
Use of robotic assistance in the treatment of deep endometriosis

- 5 year retrospective cohort study
  - Segmental bowel resection – 19
  - Excision of rectovaginal nodules – 23 (with and without rectal shaving)
  - Partial bladder resection – 5
  - Associated posterior vaginal resection – 12

- Findings
  - No conversions
  - No intra-operative complications

**Peri-Operative Data**

<table>
<thead>
<tr>
<th>Procedure/Medical Value</th>
<th>N = 43</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time (min)</td>
<td>200 (57–366)</td>
<td></td>
</tr>
<tr>
<td>Estimated blood loss (mL)</td>
<td>120 (100–1000)</td>
<td></td>
</tr>
<tr>
<td>Blood transfusions (N)</td>
<td>12 (2.3%)</td>
<td></td>
</tr>
<tr>
<td>Conversion to laparotomy (N)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Main surgical procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of RV5 nodules ± rectal shaving (N)</td>
<td>23 (53.5%)</td>
<td></td>
</tr>
<tr>
<td>Segmental bowel resection (N)</td>
<td>19 (44.2%)</td>
<td></td>
</tr>
<tr>
<td>Bladder resection (N)</td>
<td>5 (11.6%)</td>
<td></td>
</tr>
<tr>
<td>Ureterolysis (N)</td>
<td>2 (4.7%)</td>
<td></td>
</tr>
<tr>
<td>Associated vaginal resection (N)</td>
<td>12 (27.9%)</td>
<td></td>
</tr>
<tr>
<td>Associated surgical procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M/B ovarian cystectomy (N)</td>
<td>15 (34.9%)</td>
<td></td>
</tr>
<tr>
<td>M/B salpingectomy (N)</td>
<td>2 (4.7%)</td>
<td></td>
</tr>
<tr>
<td>M/B salpingo-ooophorectomy (N)</td>
<td>2 (4.7%)</td>
<td></td>
</tr>
<tr>
<td>Appendectomy (N)</td>
<td>3 (7.0%)</td>
<td></td>
</tr>
<tr>
<td>Hysterectomy (N)</td>
<td>3 (7.0%)</td>
<td></td>
</tr>
<tr>
<td>Myomectomy (N)</td>
<td>2 (4.7%)</td>
<td></td>
</tr>
<tr>
<td>Intra-operative complications (N)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Early post-operative complications (&lt;30 days) (N)</td>
<td>2 (4.7%)</td>
<td></td>
</tr>
<tr>
<td>Late post-operative complications (&gt;30 days) (N)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hospital stay (days) (N)</td>
<td>3 (2–8)</td>
<td></td>
</tr>
</tbody>
</table>

Data are expressed as median (range) or absolute number (%).

Robot Assisted Laparoscopy

- 22 consecutive robot assisted complete laparoscopic excisions of deep infiltrative endometriosis with colorectal involvement 3/10 to 5/11
  - Segmental resection
    - N=12
    - Median nodule 35mm
  - Shaving
    - N=10
    - Median nodule 30mm
  - Surgical technique
    - Umbilical access vs. right periumbilical (bowel resection)
  - Instrumentation
    - Monopolar scissors
    - Monopolar hook
    - Bipolar forceps
    - Large needle holder

UPDATE ON ROBOTICS: ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?

Robot Assisted Laparoscopy

Surgical and Anatomopathologic Findings

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resected patients (n = 12)</td>
<td></td>
</tr>
<tr>
<td>Operative time, median (range), min</td>
<td>370 (260–720)</td>
</tr>
<tr>
<td>Main nodule, larger axis, median (range), mm</td>
<td>35 (24–44)</td>
</tr>
<tr>
<td>Estimated blood loss, median (range), ml</td>
<td>100 (50–250)</td>
</tr>
<tr>
<td>Type of bowel resection</td>
<td></td>
</tr>
<tr>
<td>Sigmoid</td>
<td>2</td>
</tr>
<tr>
<td>Rectosigmoid</td>
<td>9</td>
</tr>
<tr>
<td>Rectum</td>
<td>1</td>
</tr>
<tr>
<td>Length of bowel resection, median (range), cm</td>
<td>13 (10–18)</td>
</tr>
<tr>
<td>Type of anastomosis</td>
<td></td>
</tr>
<tr>
<td>High (&gt;8 cm)</td>
<td>1</td>
</tr>
<tr>
<td>Medium/low (5–8 cm)</td>
<td>9</td>
</tr>
<tr>
<td>Ultra-low (≤5 cm)</td>
<td>2</td>
</tr>
<tr>
<td>Temporary ileostomy/colostomy</td>
<td>0</td>
</tr>
<tr>
<td>Associated vaginal resection</td>
<td>7</td>
</tr>
<tr>
<td>Associated ureteral resection and reimplanta</td>
<td>1</td>
</tr>
<tr>
<td>Non-resected patients (n = 10)</td>
<td></td>
</tr>
<tr>
<td>Operative time, median (range), min</td>
<td>280 (220–365)</td>
</tr>
<tr>
<td>Nodule, larger axis, median (range), mm</td>
<td>30 (18–38)</td>
</tr>
<tr>
<td>Estimated blood loss, median (range), ml</td>
<td>200 (100–350)</td>
</tr>
<tr>
<td>Inadvertent intraoperative rectal perforation</td>
<td>0</td>
</tr>
<tr>
<td>Temporary ileostomy/colostomy</td>
<td>0</td>
</tr>
<tr>
<td>Associated vaginal resection</td>
<td>6</td>
</tr>
</tbody>
</table>

UPDATE ON ROBOTICS: ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?

Robot Assisted Laparoscopy

**Post Operative Findings**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resected patients (n = 12)</td>
<td></td>
</tr>
<tr>
<td>Median hospital stay, days (range)</td>
<td>8 (6–10)</td>
</tr>
<tr>
<td>Median bladder catheter, days (range)</td>
<td>1 (1–10)</td>
</tr>
<tr>
<td>Median time to resume urinary function, days (range)</td>
<td>1 (1–10)</td>
</tr>
<tr>
<td>Median time to resume bowel function, days (range)</td>
<td>6 (5–8)</td>
</tr>
<tr>
<td>Hospital readmission, (%)</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>Non-resected patients (n = 10)</td>
<td></td>
</tr>
<tr>
<td>Median hospital stay, days (range)</td>
<td>5 (4–7)</td>
</tr>
<tr>
<td>Median bladder catheter, days (range)</td>
<td>1 (1–3)</td>
</tr>
<tr>
<td>Median time to resume urinary function, days (range)</td>
<td>1 (1–2)</td>
</tr>
<tr>
<td>Median time to resume bowel function, days (range)</td>
<td>3 (2–5)</td>
</tr>
<tr>
<td>Hospital readmission</td>
<td>0</td>
</tr>
</tbody>
</table>

**Six Month Follow Up**

Pre and post operative symptoms on VAS analogue scale (19 patients)

<table>
<thead>
<tr>
<th></th>
<th>Pre-operative</th>
<th>Post-operative</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dysmenorrhea, median (range)</td>
<td>10 (7–10)</td>
<td>1 (0–4)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Deep dyspaurenia, median (range)</td>
<td>9 (7–10)</td>
<td>0 (0–2)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Dyschezia, median (range)</td>
<td>6 (3–9)</td>
<td>0 (0–1)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Dysuria, median (range)</td>
<td>0 (0–2)</td>
<td>0 (0–1)</td>
<td>–</td>
</tr>
</tbody>
</table>
Robot Assisted Laparoscopy

- Median operative time and hospitalization comparable to historical conventional laparoscopy data \(^1,2,3\)

- Median blood loss and blood transfusion rate improved over historical conventional laparoscopy data \(^1,2\)

- Rectovaginal fistula in 13 patients undergoing vaginal resection (major risk at conventional laparoscopy) \(^1,4\)

\(^1\) Ercoli A, Hum Reprod 2012; 27(3):722-26
\(^3\) Fanfani F, Fertil Steril 2010; 94: 444-49
Robot Assisted Laparoscopy

- Multicenter retrospective study: 11/08 – 04/12, N=167
  Society of European Robotic Gynecological Surgery (SERGS)

- Patient profile
  - Age - 34 years +/- 7.3
  - Parity – 0.46
  - BMI – 23.7 (17, 3-38.6)
  - Previous surgery – 33.3% (39/117)
  - Previous ovarian surgery/cyst – 29.8% (35/117)
  - Preoperative hormonal treatment – 43.6% (51/117)
  - Preoperative GnRH agonists – 24.8% (29/117)
  - Preoperative MRI – 88.9% (104/117)
  - Preoperative ureteral stent(s) – 35.3% (N=24)
UPDATE ON ROBOTICS:
ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?

Robot Assisted Laparoscopy

Type of Surgical Procedure

R= rectum ; B= bladder ; U=ureter ; HT= hysterectomy
Robot Assisted Laparoscopy

- Mean number of arms used – 3.2 arms
- Left side docking – 78.5%
- Mean surgical duration (skin to skin) – 179 mins.
- Mean console time – 137 mins.
- Mean blood loss – 95.5 ml (5-2300 ml)
- Operative complications
  - 1 case of transfusion (0.6% / segmental rectal resection + stomia)
  - 1 case of lap conversion (0.6% / segmental rectal resection)
  - 2 rectal injuries/sutured (1.2% / rectal shaving)
Robot Assisted Laparoscopy

- Hospitalization stay – 4.02 days (1-20)
- Post operative complications – 17/167 (10.2%)
  - Urinary self catheterization – N=1 (0.6%)
  - Uretero vesical anastomosis leakage – N=1 (0.6%)
  - Ureteral fistula after ureterolysis – N=2 (1.2%)
  - Pelvic hematoma – N=1 (0.6%)
  - Urinary infections – N=8 (4.2%)
  - Abdominal wall abscess – N=1 (0.6%)
  - Vaginal cuff bleeding – N=2 (1.2%)
  - Vaginal cuff disclosure – N=1 (0.6%)
- Rate of reintervention – N=3 (1.8%)
UPDATE ON ROBOTICS: ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?

Robot Assisted Laparoscopy

- Mean follow up – 10.2 months

- Total asymptomatic recovery – 98.33% (98/113)
- Post operative persistent pelvic pain – 12.3% (14/113)
- Post operative urinary symptoms – 3.5% (4/113)
- Post operative digestive symptoms – 5.3% (6/113)

- Symptomatic recurrence – 10.2% (10/112)

- Fertility evaluation
  - 40.9% (43/105) with pregnancy desire
  - 13% of pregnancy
UPDATE ON ROBOTICS:
ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?

Robot Assisted Laparoscopy

Total Hysterectomy (N=28)

- Metrorrhagia – 47.1% (8/17)
- MRI – 82.3% (14/17)
- Uni or bilateral salpingo-oophorectomy – 64.3% (18/28)
- Uni or bilateral salpingectomy – 67.8% (19/28)
- Associated surgery
  - Rectal – 39.3% (11/28)
  - Bladder – 14.3% (4/28)
  - USL – 64.3% (18/28)
- Recurrence – 7.1% (2/115)
Robot Assisted Laparoscopy

Uterosacral +/- Ureteral DIE (N=115)

- Ureteral stent(s) – 15.6% (18)

- Main procedure
  - USL resection – 91.3% (105/115)
  - Ureterolysis – 54.8% (63/115)
  - Ureteral reimplantation – 2.6% (3/115)

- Associated procedures
  - Partial vaginectomy – 36.5% (42/115)
  - Rectal shaving – 53% (61/115)
  - Partial bladder resection – 6.1% (7/115)

- Recurrence – 9.6% (11/115)
- Fertility – 6.9% (8/115)
Robot Assisted Laparoscopy

Vesico Vaginal Septum +/- Bladder Involvement (N=23)

- Urinary SF – 61.1% (11/18)
- Main surgical procedure(s)
  - Partial bladder resection – 95.6% (22/23)
  - Bladder shaving – 26.1% (6/23)
- Associated procedures
  - Rectal – 26.1 (6/23)
  - USL – 30.4% (7/23)
  - HT – 17.4% (4/23)
- No fistula
- Vesico vaginal hematoma – 1/23 (4.3%)
- No re-operation

UPDATE ON ROBOTICS:
ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?
UPDATE ON ROBOTICS: ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?

Robot Assisted Laparoscopy

Recto-Vaginal Septum (N=88)

- Infertility – 35.9% (23/64)
- Dig symptoms – 57.8% (37/64)
- Rectal shaving – 77.3% (66/88)
- Rectal or sigmoid resection – 27.3% (24/88)
- Stoma – 1.14% (1/88)

- Associated procedures
  - Bladder – 6.8% (6/88)
  - USL – 69.3% (61/88)
  - HT – 12.5% (11/88)

- No fistula or abscess
- Recurrence – 10.2% (9/88)
- Fertility – 10.2% (9 pregnancies/88)
UPDATE ON ROBOTICS:
ENDOMETRIOSIS – WHAT IS THE CURRENT STATE?

Robotic Assisted Resection of Stage IV Endometriosis
Robotic Assisted Myomectomy
8mm da Vinci® Endoscope Port (RED):

- 8mm scope. If very complex will gain access through upper left quadrant with 5 scope to place endoscope port.

8mm da Vinci® Morcellation Port (BLUE):

- Monopolar Hotshears, Vessel Sealer, Harmonic Scalpel, Mega Needle Driver

8mm da Vinci® Instrument Port (YELLOW):

- Prograsps, Suction Irrigator, PK

5mm Optional Entry Port (WHITE):

- For gaining access into abdomen and insufflation in complex cases

When it is time to suture, the Monopolar Curved Scissors are removed and the bedside assistant passes the suture deliberately down the da Vinci 8mm cannula before inserting the Mega Needle Driver. CT-1/CT-2 SH needle will fit deliberately down the 8mm da Vinci cannula. Remove needles at end of case.
Enucleation Instrumentation

- Energy options for robotic myomectomy
  - Monopolar scissors or hook
  - Harmonic scalpel
    - Maximize cut to minimize tissue desiccation
    - Risk of uterine rupture during pregnancy

UPDATE ON ROBOTICS:
ROBOTIC ASSISTED MYOMECTOMY – WHAT IS THE CURRENT STATE?
Tissue Reapproximation

- Suture type
  - Absorbable
  - Taper needle

<table>
<thead>
<tr>
<th></th>
<th>Monofilament</th>
<th>Polyfilament</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>Slides through tissue</td>
<td>Maintains tissue tension</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>Tissue tension not maintained</td>
<td>Does not slide through tissue easily</td>
</tr>
</tbody>
</table>

- Multi-layer closure
  - Hemostasis
    - Avoid use of energy to reduce tissue destruction
  - Eliminate “dead” space
  - Reduce risk of uterine rupture during pregnancy

UPDATE ON ROBOTICS:
ROBOTIC ASSISTED MYOMECTOMY – WHAT IS THE CURRENT STATE?
Barbed Suture

- Stratafix™, Quill™, and V-Loc™ wound closure device
  - The barbs grasp tissue at numerous points providing distribution of tension across the wound
  - Eliminates the need for tying knots
UPDATE ON ROBOTICS:
ROBOTIC ASSISTED MYOMECTOMY – WHAT IS THE CURRENT STATE?

Barbed Suture

• Quill™
  – FDA approved 2004
  – Bidirectional spiral

• V-Loc™
  – FDA approved 2009
  – Unidirectional spiral

• Stratafix™
  – FDA approved 2012
  – Bidirectional, unidirectional
Barbed Suture

• Advantages of barbed suture
  – No knot tying required
  – Equally distributed tension throughout suture
  – Enables continuous suturing without backsliding
  – Provides hemostatic closure of myometrium

• Disadvantages of barbed suture
  – Cost

UPDATE ON ROBOTICS:
ROBOTIC ASSISTED MYOMECTOMY – WHAT IS THE CURRENT STATE?
UPDATE ON ROBOTICS:
ROBOTIC ASSISTED MYOMECTOMY – WHAT IS THE CURRENT STATE?

Robotic Assisted Myomectomy with Harmonic Ace® and Stratafix™

Robotic-assisted Myomectomy with Harmonic ACE™ and STRATAFIX™

Charles E. Miller, M.D.
Aarathi Chokkeri-Singh, M.D.
Kirsten Sasaki, M.D.
UPDATE ON ROBOTICS:
ROBOTIC ASSISTED MYOMECTOMY – WHAT IS THE CURRENT STATE?

Robotic Assisted Myomectomy
UPDATE ON ROBOTICS:
ROBOTIC ASSISTED MYOMECTOMY – WHAT IS THE CURRENT STATE?

Robotic Assisted Myomectomy
UPDATE ON ROBOTICS:
ROBOTIC ASSISTED MYOMECTOMY – WHAT IS THE CURRENT STATE?

Robotic Assisted Myomectomy
### Characteristics of studies comparing RLM and AM

<table>
<thead>
<tr>
<th>Source cases/Controls</th>
<th>Type of study</th>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
<th>Weight of myomas</th>
<th>Diameter of largest myoma</th>
<th>No. of myomas</th>
<th>Patient age, yr</th>
<th>Outcomes measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advincuila et al. 2007, 2009</td>
<td>Retrospective, case-controlled, matched for weight of myomas, BMI, age</td>
<td>Eligibility for LM</td>
<td>Myomas too large for safe laparoscopic entry</td>
<td>227.86 (241.54) vs 225.76 (226.28)</td>
<td>NA</td>
<td>NA</td>
<td>36.6 (4.9) vs 34.9 (4.4)</td>
<td>EBL, LOSH, operative time, complications, professional charges, hospital charges</td>
</tr>
<tr>
<td>Ascher-Welsh and Copes 2010, 7550</td>
<td>Retrospective, case-controlled</td>
<td>≤ 3 Myomas at MRI</td>
<td>Medical problems, previous uterine surgery</td>
<td>321.16 (243.87) vs 331.54 (348.83)</td>
<td>NA</td>
<td>2.35 (1.5) vs 1.68 (0.79)</td>
<td>36.5 (7.2) vs 37.2 (5.45)</td>
<td>EBL, postoperative hemorrhage, time, fever, complications</td>
</tr>
<tr>
<td>Baskat et al., 2011, 88/595</td>
<td>Retrospective, cohort</td>
<td>None</td>
<td>Not specified</td>
<td>223 (300) vs 263 (624.58)</td>
<td>7.7 (14.7) vs 7.5 (7.1)</td>
<td>7.7 (14.7) vs 7.5 (7.1)</td>
<td>37 (7) vs 37 (11)</td>
<td>EBL, operative time, LOSH, hemoglobin decrease, blood transfusion, complications</td>
</tr>
<tr>
<td>Handa et al., 2011, 77/48</td>
<td>Retrospective, cohort</td>
<td>Patients with symptoms</td>
<td>Not specified</td>
<td>NA</td>
<td>4.29 (1.79) vs 5.31 (2.57)</td>
<td>3.06 (1.84) vs 4.22 (3.36)</td>
<td>38.4 (6.6) vs 37.3 (5.6)</td>
<td>Age, BMI, gravity, parity, operative time, EBL, LOSH</td>
</tr>
<tr>
<td>Mancour et al., 2012, 38/21</td>
<td>Retrospective, cohort</td>
<td>Reproductive age group wanting fertility, uterine size ≤ 20 weeks, space in abdomen for port placement, absence of consensitability</td>
<td>Not specified</td>
<td>389 (170.4) vs 599.4 (367.7)</td>
<td>9.1 (2.0) vs 10.8 (4.8)</td>
<td>9.1 (2.0) vs 10.8 (4.8)</td>
<td>34.7 (4.4) vs 35.3 (4.7)</td>
<td>EBL, complications, hemoglobin decrease, pain score, operative time, hospital and surgeon charges, LOSH</td>
</tr>
<tr>
<td>Navi et al., 2012, 27/906</td>
<td>Retrospective, cohort</td>
<td>None</td>
<td>Not specified</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>38.26 (6.3) vs 35.78 (5.47)</td>
<td>EBL, complications, hemoglobin decrease, pain score, operative time, hospital and surgeon charges, LOSH</td>
</tr>
<tr>
<td>Senghu et al., 2010, 105/988</td>
<td>Retrospective, cohort</td>
<td>Patients wanting to retain uterus/fertility, myomas not &gt; 5 cm, myomas not &gt; 10 cm, patient able to tolerate steep Trendelenburg position</td>
<td>Vaginal myomectomy</td>
<td>NA</td>
<td>8.1 (3.2) vs 7.4 (4.8)</td>
<td>NA</td>
<td>36.2 (5.5) vs 36.4 (6.8)</td>
<td>Age, BMI, operative time, EBL, LOSH</td>
</tr>
</tbody>
</table>

AM = abdominal myomectomy; BMI = body mass index; EBL = estimated blood loss; LM = laparoscopic myomectomy; LOSH = length of hospital stay; MRI = magnetic resonance imaging; NA = not available; RLM = robotic assisted laparoscopic myomectomy.

*Unless otherwise indicated, values are given as mean (SD).*

UPDATE ON ROBOTICS:
ROBOTIC ASSISTED MYOMECTOMY – WHAT IS THE CURRENT STATE?

Robotic Assisted Laparoscopic vs. Abdominal and Laparoscopic Myomectomy: Systematic Review and Meta-Analysis

Significant advantages

- Robotic assisted myomectomy
  - Estimated blood loss
  - Blood transfusion
  - Length of hospital stay

- Open myomectomy
  - Operative time
  - Costs

- No difference
  - Complications
### Characteristics of studies comparing perioperative morbidity with RLM and LM

<table>
<thead>
<tr>
<th>Source cases/Controls</th>
<th>Type of study</th>
<th>Inclusion criteria</th>
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<th>Patient age, yr</th>
<th>Outcomes measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barakat et al., 2011, 89/93</td>
<td>Retrospective cohort</td>
<td>None</td>
<td>Not specified</td>
<td>223 (300) vs 96.65 (182.25)</td>
<td>7.7 (14.7) vs 6.7 (5.38)</td>
<td>NA</td>
<td>37 (7) vs 38 (15.3)</td>
<td>Operative time, EBL, decreased hemoglobin, LOHS, blood transfusion, complications</td>
</tr>
<tr>
<td>Bedient et al., 2009, 40/41</td>
<td>Retrospective cohort</td>
<td>None</td>
<td>Not specified</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Gargiulo et al., 2012, 174/115</td>
<td>Retrospective cohort</td>
<td>Patients with symptoms undergoing myomectomy</td>
<td>Not specified</td>
<td>160 (193) vs 201 (368)</td>
<td>7.3 (2.7) vs 7.5 (3.6)</td>
<td>3 (3.8) vs 2 (5)</td>
<td>38 (6.3) vs 39 (7.5)</td>
<td>Operative time, LOHS, EBL, conversion to open procedure or hysterectomy, complications</td>
</tr>
<tr>
<td>Nezhat et al., 2009, 15/35</td>
<td>Retrospective cohort</td>
<td>None</td>
<td>Not specified</td>
<td>116 (81.25) vs 156 (101.25)</td>
<td>5.1 (1.1) vs 6.4 (2.25)</td>
<td>3 (1.5) vs 4 (5)</td>
<td>39 (5.5) vs 41 (6.75)</td>
<td>Operative time, LOHS, EBL</td>
</tr>
</tbody>
</table>

EBL = estimated blood loss; LM = laparoscopic myomectomy; LOHS = length of hospital stay; NA = not available; RLM = robotic – assisted laparoscopic myomectomy.

*Unless otherwise indicated, values are given as mean (SD).
UPDATE ON ROBOTICS:
ROBOTIC ASSISTED MYOMECTOMY – WHAT IS THE CURRENT STATE?

Robotic Assisted Laparoscopic vs. Abdominal and Laparoscopic Myomectomy: Systematic Review and Meta-Analysis

Significant advantages

• Laparoscopic
  – Blood transfusion
  – Cost

• No difference
  – Estimated blood loss
  – Operative time
  – Complications
  – Length of hospital stay
Robotic Assisted, Laparoscopic, and Abdominal Myomectomy: A Comparison of Surgical Outcomes

- Retrospective case study at Cleveland Clinic
- Level of evidence: II
- N = 575 myomectomies
  - 393 (68.3%) abdominal
  - 93 (16.2%) laparoscopic
  - 89 (15.5%) robotic assisted

Barakat EE, et al., Obstet Gynecol 2011 Feb;117(2 Pt 1):256-65
## Robotic Assisted, Laparoscopic, and Abdominal Myomectomy: A Comparison of Surgical Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Abdominal N = 393</th>
<th>Laparoscopy N = 93</th>
<th>da Vinci N = 89</th>
<th>Overall P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical Time (min)</td>
<td>126.00</td>
<td>155.00</td>
<td>181.00</td>
<td>&lt;.001&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Myoma Weight (g)</td>
<td>263.00</td>
<td>96.65</td>
<td>223.00</td>
<td>&lt;.001&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Estimated Blood Loss (mL)</td>
<td>200.00</td>
<td>150.00</td>
<td>100.00</td>
<td>&lt;.001&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Hemoglobin Drop (g/dL)</td>
<td>2.00</td>
<td>1.55</td>
<td>1.30</td>
<td>&lt;.001&lt;sup&gt;4&lt;/sup&gt;</td>
</tr>
<tr>
<td>Length of Stay (days)</td>
<td>3.00</td>
<td>1.00</td>
<td>1.00</td>
<td>&lt;.001&lt;sup&gt;5&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup> Abdominal compared with laparoscopic, P=.142; abdominal compared with robotic, P=.003; laparoscopic compared with robotic, P=.083.

<sup>2</sup> Abdominal compared with laparoscopic, P<.001; abdominal compared with robotic, P=.360; laparoscopic compared with robotic, P=.021.

<sup>3</sup> Abdominal compared with laparoscopic, P<.001; abdominal compared with robotic, P<.001; laparoscopic compared with robotic, P=.818.

<sup>4</sup> Abdominal compared with laparoscopic, P=.061; abdominal compared with robotic, P<.001; laparoscopic compared with robotic, P=.431.

<sup>5</sup> Abdominal compared with laparoscopic, P<.001; abdominal compared with robotic, P<.001; laparoscopic compared with robotic, P=.506.
Robotic Assisted, Laparoscopic, and Abdominal Myomectomy: A Comparison of Surgical Outcomes

UPDATE ON ROBOTICS:
ROBOTIC ASSISTED MYOMECTOMY – WHAT IS THE CURRENT STATE?

Box plot comparing the maximum diameter of the removed myomas by the surgical approach

Box plot comparing the weight of the removed myomas by the surgical approach

Barakat EE, et al., Obstet Gynecol 2011 Feb;117(2 Pt 1):256-65
UPDATE ON ROBOTICS: ROBOTIC ASSISTED MYOMECTOMY – WHAT IS THE CURRENT STATE?

Robotic Assisted, Laparoscopic, and Abdominal Myomectomy: A Comparison of Surgical Outcomes

Box plot comparing the surgical time by the surgical approach

Box plot comparing the postoperative hemoglobin drop by the surgical approach

Barakat EE, et al., Obstet Gynecol 2011 Feb;117(2 Pt 1):256-65
Robotic Assisted Laparoscopic Myomectomy Compared with Standard Laparoscopic Myomectomy

- Retrospective study x 31 months
  - 115 consecutive laparoscopic myomectomy
  - 174 consecutive robot-assisted myomectomy
- Multiple layer closure
  - Barbed suture used for most laparoscopic myomectomy cases*
- Results
  - Robot-assisted myomectomy had significantly longer operative time – 195.3 vs. 118.3 (p<.001)
  - Robot-assisted myomectomy had higher estimated blood loss – 110.0 vs. 85.9 ml (p=.04)
  - No real difference in the following
    - Any hospital stay
    - Hospital stay >1 day
    - Re-operation
    - Any postoperative complications
    - Postoperative complications
    - Blood transfusion

* Use of barbed suture in the laparoscopic myomectomy group may account for differences.

Comparison of Robotic Assisted Laparoscopic Myomectomy and Traditional Laparoscopic Myomectomy

- Retrospective study (6/10 – 10/11)
  - Robotic assisted (N = 20) vs. laparoscopic (N = 22)
  - Robotic assisted: 66 (21.4%)

- Allocation based on finances

Perioperative variables of 42 women with uterine myomas who underwent robot-assisted laparoscopic myomectomy or traditional laparoscopic myomectomy

<table>
<thead>
<tr>
<th>Variables</th>
<th>RALM (n = 20)</th>
<th>TLM (n = 22)</th>
<th>P+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical time (min)</td>
<td>210 (165-293)</td>
<td>145 (113–195)</td>
<td>0.006</td>
</tr>
<tr>
<td>Docking time (min)</td>
<td>10 (8-11)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Console time (min)</td>
<td>100 (86–114)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Blood loss (mL)</td>
<td>175 (100-550)</td>
<td>200 (96–375)</td>
<td>0.26</td>
</tr>
<tr>
<td>Length of hospital stay (days)</td>
<td>4 (4–4)</td>
<td>4 (3–4)</td>
<td>0.21</td>
</tr>
<tr>
<td>Hemoglobin drop (g/dL)</td>
<td>1.0 (1.6–0.1)</td>
<td>1.1 (1.8–0.1)</td>
<td>0.68</td>
</tr>
<tr>
<td>Amount of day 1 postoperative abdominal drainage (mL)</td>
<td>84 (40–122)</td>
<td>124 (68–244)</td>
<td>0.01</td>
</tr>
<tr>
<td>Amount of postoperative abdominal drainage (total, mL)</td>
<td>170 (77–324)</td>
<td>353 (255–525)</td>
<td>0.04</td>
</tr>
<tr>
<td>Duration of abdominal drain placement (days)</td>
<td>3 (2.8–3)</td>
<td>3 (1.3–3)</td>
<td>0.22</td>
</tr>
<tr>
<td>Blood transfusion needed</td>
<td>4 (20%)</td>
<td>3 (14%)</td>
<td>0.69</td>
</tr>
<tr>
<td>Conversion to laparotomy</td>
<td>0 (0%)</td>
<td>2 (9%)</td>
<td>0.49</td>
</tr>
<tr>
<td>Complications</td>
<td>1 (5%)</td>
<td>3 (14%)</td>
<td>0.61</td>
</tr>
</tbody>
</table>

Data are expressed as the median (25–75% interquartile range) or number (%). *Wilcoxon rank sum test, χ²-test, or Fisher’s exact test, as appropriate. RALM, robot-assisted laparoscopic myomectomy; TLM, traditional laparoscopic myomectomy.
Comparison of Robotic, Laparoscopic, and Abdominal Myomectomy in a Community Hospital

- Retrospective: 322 consecutive myomectomy (2007-2009) procedures (data complete on 308 patients)
  - Abdominal: 169 (54.9%)
  - Laparoscopic: 73 (23.7%)
  - Robotic-assisted: 66 (21.4%)

Largest myoma on preoperative imaging, which was removed by abdominal, laparoscopic, or robotically assisted laparoscopic myomectomy
Pregnancy Outcomes Post Robot Assisted Myomectomy

- Retrospective multicenter study (10/05 – 11/10) – N = 872
- Results
  - 107 patients conceived
  - 127 pregnancies
  - 92 deliveries through 2011
  - Age at myomectomy 34.8 ± 4.5 years
  - Overweight or obese 57.4%
  - Mean number of myomata 3.9 ± 3.2
  - Uterine size 12.3 ± 3.1
  - Mean myoma size 7.5 ± 3.0 cm
  - Mean myoma weight 191.7 ± 144.8 g
  - Entry of myoma into endometrial cavity 20.6%
  - Operative time 174.6 ± 77
  - Estimated blood loss 134.5 ± 115.5
  - Time to conception 12.9 ± 11.5 months
  - ART 39.4%
  - SAB 18.9%
  - Preterm delivery (< 35 weeks) 17.4%
  - Uterine rupture (related to number of fibroids and anterior incision) 1%
  - Pelvic adhesions 11.4%

Impact of Lack of Tactile Feedback on Robot Assisted Myomectomy

- Objective – to determine if the lack of haptic feedback in robotic assisted laparoscopic myomectomy affects the number of fibroids remaining in-situ versus traditional laparoscopic myomectomy

- Retrospective Study (2:1 match)
  - 16 patients, robotic assisted myomectomy
  - 32 patients, traditional laparoscopic myomectomy

- Patients matched for number of fibroids removed and time of post operative ultrasound

Sasaki KJ, Cholkeri-Singh A, Sulo S, Steller C, Miller CE, Abstract #450206, 42nd AAGL Global Congress on Minimally Invasive Gynecology
Impact of Lack of Tactile Feedback on Robot Assisted Myomectomy

- Robotic and laparoscopic cohorts similar
  - p > 0.05
    - Age at surgery
    - Gravidity/parity
    - Number of ports used
    - Average number of fibroids removed
    - History of prior pelvic surgery
    - Post-operative fibroid numbers

- Findings
  - Higher admission rate in robotics group (33% vs. 7%), (p=0.22)
  - No difference in post-operative fibroid number (p=0.52), complication rate, operative time, and blood loss
  - No conversion