Fibroids: Myomectomy and New Approaches (Didactic)

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AAGL
Advancing Minimally Invasive Gynecology Worldwide
Professional Education Information

Target Audience
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PG 113
Fibroids: Myomectomy and New Approaches (Didactic)

Tommaso Falcone, Chair
Faculty: Ted L. Anderson, Jon I. Einarsson

Course Description

This course is designed for all gynecologists who wish to expand their experience in the management of myomas. The course is designed to be case-based and each presentation will include several illustrative cases. The program will emphasize practical information with multiple video demonstrations of surgical techniques. The program will begin with a fundamental review of preoperative evaluation of patients with leiomyomas and appropriate selection of patients for intervention. Minimally invasive surgical and non-surgical approaches will be presented. Case presentations will show when medical or radiologic-based approaches may be acceptable. Conventional, robotic and single port laparoscopic approaches as well as laparotomy will be discussed within the context of specific cases.

Course Objectives

At the conclusion of this course, the participant will be able to: 1) Identify the concepts of selecting patients appropriately for surgery or other intervention; 2) analyze the role of different surgical and non-surgical minimally invasive techniques for the treatment of uterine fibroids; 3) assess techniques to safely perform laparoscopic myomectomy; 4) appraise the surgical approach to single port myomectomy; and 5) identify when myomectomy by laparotomy is indicated.

Course Outline

8:00 Welcome, Introductions and Course Overview T. Falcone
8:05 Which Myomas Require Intervention? T. Falcone
8:30 Hysteroscopic Approach to Myomas T.L. Anderson
8:55 What Limits a Conventional Laparoscopic Approach? J.I. Einarsson
9:20 Robotic Myomectomy -- Surgical Tips T. Falcone
9:45 Questions & Answers All Faculty
9:55 Break
10:10 Myoma Ablation and Uterine Artery Occlusion Techniques for the Management of Leiomyomas J.I. Einarsson
10:35 Single Port Myomectomy – Surgical Tips J.I. Einarsson
11:00 Tips to Prevent Excessive Blood Loss at Myomectomy T. Falcone
11:25  Abdominal Myomectomy as a Minimally Invasive Alternative to Hysterectomy for Large Fibroids  T.L. Anderson

11:50  Questions & Answers  All Faculty

12:00  Course Evaluation
PLANNER DISCLOSURE
The following members of AAGL have been involved in the educational planning of this workshop and have no conflict of interest to disclose (in alphabetical order by last name).
Art Arellano, Professional Education Manager, AAGL*
Viviane F. Connor
Consultant: Conceptus Incorporated
Frank D. Loffer, Executive Vice President/Medical Director, AAGL*
Linda Michels, Executive Director, AAGL*
Jonathan Solnik
Other: Lecturer - Olympus, Lecturer - Karl Storz Endoscopy-America

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Grants/Research Support: Elsevier
Consultant: Bayer Healthcare Corp., Conceptus Incorporated, Ferring Pharmaceuticals
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Stock Shareholder: TransEnterix
Speaker’s Bureau: Covidien, Abbott Laboratories
Other: Proctor - Intuitive Surgical

FACULTY DISCLOSURE
The following have agreed to provide verbal disclosure of their relationships prior to their presentations. They have also agreed to support their presentations and clinical recommendations with the “best available evidence” from medical literature (in alphabetical order by last name).
Tommaso Falcone*
Jon I. Einarsson
Consultant: Ethicon Endo-Surgery
Ted L. Anderson*
Georgine Marie Lamvu*
Asterisk (*) denotes no financial relationships to disclose.
Indications for Myomectomy

Tommaso Falcone, M.D
Professor & Chair
Department of Obstetrics & Gynecology
Cleveland Clinic

Learning Objectives

- Analyze the data on the impact of fibroids on obstetric outcomes
- List the benefits of myomectomy on fertility outcomes
- Discuss the impact of pregnancy on fibroid growth

Leiomyoma related hospitalization

- Wechter et al AJOG- 2011
- 2007 data from Nationwide inpatient sample (NIS)
  - 355,135 women were hospitalized
  - Excludes all minimally invasive interventions
  - Rates of myomectomy
    - Black: 9.2/10,000 women years
    - White: 1.3/10,000 women years
    - By 2050-31% increase in myomectomies

Impact of Race

- Huyck et al AJOG 2008
  - Black women present earlier (5.3 years) and more severe disease

Natural History of Fibroids

- Maverlos et al. Ultrasound Obstet Gynecol 2010
  - Women examined at least twice by a single sonographer at least 8 months apart (median 21 months)
  - Median age was 40 years; majority were under 5 cm
  - 21% of fibroids showed evidence of spontaneous regression.

Financial Disclosure

- I have no financial relationships to disclose
Indication for Surgery

- Abnormal Uterine Bleeding
- Pelvic pressure and pain
- Urinary or rectal symptoms
- Infertility - exclude other causes
- Recurrent Pregnancy Loss - exclude other causes
- Adverse pregnancy outcome

Myomectomy: Refuted reasons
ASRM practice committee 2008

- Size (>12 weeks)
- Cannot palpate the adnexae
- Symptoms will develop
- Surgery could be more difficult if surgery delayed
- Possible leiomyosarcoma
  - Sarcoma does not relate to size or rate of growth and more related to age (over 60)

Fibroids and Pregnancy loss

- Klatsky et al AJOG 2008 - Systematic review
  - Submucosal fibroids - associated with increased Spontaneous abortion rate
    - OR 3.85 (1:12-13.27)
  - Intramural fibroids -
    - OR 1.34 (1.04-1.65)
    - Early first trimester u/s OR 1.82 (1.43-2.3)
    - Number was more important than size

- Saravelos et al Hum Reprod 2011
  - 8% prevalence in patients with RPL (n=966)
  - Cavity distorting fibroid -
    - Early loss - no change
    - Mid-trimester loss - reduced significantly - Live birth 52%
  - Non-cavity distorting fibroids - no surgery & unexplained RPL
    - Live birth rate was 70%

Leiomyomas and Infertility

- Casini et al Gynecological Endocrinology 2006 - Infertile patients
  - Only RCT of surgery vs. no surgery & fertility outcome
  - SubMucous (SM) fibroids -
    - With surgery-PR-43%
    - Without surgery- PR-27%
  - Intramural (IM) fibroids - NS
    - With surgery-PR-56%
    - Without surgery- PR-41%
  - SM(IM)- P<.05
    - With surgery-PR-36%
    - Without surgery- PR-15%

Leiomyomas and Infertility

- Submucosal fibroids
  - PR after hysteroscopic resection up to 43%
    - Goldberg F&S 1995
    - Hart Br J Obstet & Gynecol 1999

PR = pregnancy rate
Hysteroscopic myomectomy:
- Shokeir et al. 2010 Fertil Steril 2010
  - Randomized matched trial
  - Unexplained infertility
  - Type 0 and Type 1 myomas
  - Hysteroscopic surgery was performed
  - PR significantly improved (63% vs. 28%)

Cavity Distorting Intramural Myomas
- Systematic Review – Pritts, Parker and Olive F&S 2009
  - Clinical Pregnancy rate/ Implantation rate/ongoing pregnancy rate/live birth rate-decreased
  - Spontaneous abortion rate is increased
  - Myomectomy vs. women with no fibroids
    - Clinical pregnancy rate is similar

Impact of Subserosal Fibroids on Fertility outcome
- Systematic Review – Pritts, Parker and Olive F&S 2009
  - Uniquely Subserosal fibroids have no impact on fertility or spontaneous abortion rates

Systematic Review – Fibroids and Fertility
- Pritts, Parker and Olive 2009
  - Effect on fertility – no intracavitary involvement
    - Pregnancy rate (24 studies): RR .89 (.8-1.0)
    - Implantation rate (14 studies): RR .79 (.69-.9)
    - Live-birth rate (16 studies): RR .78 (.69-.88)
    - Spontaneous abortion (16 studies): RR 1.8 (1.47-2.4)
  - Myomectomy for intramural fibroids (controls-fibroids in situ) (non-cavity distorting)
    - Pregnancy rate (2 studies): RR 3.7 (1.47-30)
    - Live-birth rate (1 study): RR .75 (.29-1.9)

Impact of Fibroids on IVF
- Variables that explain differences in results:
  - Location of the fibroids
  - Size of leiomyoma: large (>5-7cm) often excluded
  - Case-control studies: retrospective bias
  - Assessment of fibroids HSG vs. US vs. hysteroscopy (SIS was not used in the studies)
  - Contribution of the fibroid that does not distort the cavity may not be appreciated if there is a low PR or implantation rate

Effect of Intramural Fibroids on IVF Outcome
- Sunkara et al. HR 2010
  - Meta-analysis
  - Intramural fibroids without cavity distortion
  - 19 studies: 6087 cycles
  - Significant decrease in live-birth (RR 0.79, 95% CI .70-.88) and clinical pregnancy rates (RR 0.85, 95% CI .77-.94)
  - This does not mean that removal will restore PR to the levels expected in women without fibroids

HSG = hysterosalpingogram; US = ultrasound; SIS = saline-infusion sonogram

RR = relative risk
Impact of Fibroids on IVF: Conclusions

- Because of the lack of consistent or well-designed studies and high reported PR, prophylactic myomectomy pre-IVF if the cavity is normal should be individualized and not routine. No data for fibroids >5-7 cm.

Myomas & Pregnancy

- Growth of Myomas during pregnancy
  - 49-60% no change
  - 22-33% increase in size
  - 8-27% decrease in size
- Most of the growth is in the first trimester
- Mean increase is 12%
- 90% of women with fibroids detected in the first trimester will have regression of volume postpartum

Adapted from Stout et al. Leiomyomas at second trimester u/s Obstet Gynecol 2010

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Leiomomas (n=2140)</th>
<th>No Leiomomas (n=1738)</th>
<th>Unadjusted Relative Risk (95% CI)</th>
<th>Adjusted Odds Ratio (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breach presentation*</td>
<td>5.3</td>
<td>3.1</td>
<td>1.7 (1.4-2.1)</td>
<td>1.5 (1.2-1.9)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Placenta previa*</td>
<td>1.4</td>
<td>0.5</td>
<td>2.7 (1.8-3.9)</td>
<td>2.7 (1.8-3.9)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Caesarean delivery*</td>
<td>35.1</td>
<td>24.2</td>
<td>1.4 (1.3-1.5)</td>
<td>1.2 (1.0-1.4)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Obstructed</td>
<td>1.6</td>
<td>0.7</td>
<td>2.2 (1.4-3.5)</td>
<td>2.1 (1.3-3.5)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Pre-cannulated</td>
<td>30.4</td>
<td>7.4</td>
<td>4.1 (2.2-7.4)</td>
<td>8 (2.2-7.4)</td>
<td></td>
</tr>
<tr>
<td>Transcervical growth restriction*</td>
<td>1.7</td>
<td>1.3</td>
<td>1.3 (0.8-2.0)</td>
<td>1.2 (0.8-2.0)</td>
<td>.34</td>
</tr>
<tr>
<td>Pomer paranatal rupture of cervix*</td>
<td>3.3</td>
<td>2.6</td>
<td>1.4 (1.5-4.8)</td>
<td>1.3 (0.8-4.7)</td>
<td>.80</td>
</tr>
<tr>
<td>Pomer both at less than 37 wk*</td>
<td>35.1</td>
<td>18.5</td>
<td>1.3 (1.1-1.5)</td>
<td>1.3 (1.1-1.5)</td>
<td>.03</td>
</tr>
<tr>
<td>Pomer both at less than 40 wk*</td>
<td>35.1</td>
<td>18.5</td>
<td>1.3 (1.1-1.5)</td>
<td>1.3 (1.1-1.5)</td>
<td>.03</td>
</tr>
<tr>
<td>Uterine-as-transcervical death*</td>
<td>1.6</td>
<td>0.7</td>
<td>2.1 (1.3-3.4)</td>
<td>2.1 (1.2-3.6)</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

Adapted from Stout et al. Leiomyomas at second trimester u/s Obstet Gynecol 2010

<table>
<thead>
<tr>
<th>Outcome</th>
<th>5 cm or smaller (n=118)</th>
<th>Larger Than 5 cm (n=822)</th>
<th>Relative Risk (95% CI)</th>
<th>Adjusted Odds Ratio (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breach presentation*</td>
<td>4.4</td>
<td>6.4</td>
<td>1.0 (0.3-3.0)</td>
<td>1.0 (0.3-3.0)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Placenta previa*</td>
<td>1.4</td>
<td>1.4</td>
<td>1.0 (0.3-4.1)</td>
<td>1.0 (0.3-4.1)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Caesarean delivery*</td>
<td>34.6</td>
<td>33.2</td>
<td>1.0 (0.3-4.1)</td>
<td>1.0 (0.3-4.1)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Pre-cannulated</td>
<td>7.1</td>
<td>7.1</td>
<td>1.0 (0.3-4.1)</td>
<td>1.0 (0.3-4.1)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Uterine death</td>
<td>15.0</td>
<td>13.7</td>
<td>1.0 (0.3-4.1)</td>
<td>1.0 (0.3-4.1)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Pomer both at less than 37 wk*</td>
<td>0.3</td>
<td>16.1</td>
<td>0.0 (0.0-4.1)</td>
<td>0.0 (0.0-4.1)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Pomer both at less than 40 wk*</td>
<td>3.4</td>
<td>3.4</td>
<td>1.0 (0.3-4.1)</td>
<td>1.0 (0.3-4.1)</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

Klatsky et al AJOG 2007

Cumulative obstetric outcomes from included studies

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Fibroids (n=2807)</th>
<th>No Fibroids (n=3179)</th>
<th>RR</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cesarean</td>
<td>48.6% (1364/2807)</td>
<td>47.1% (1514/3179)</td>
<td>1.0</td>
<td>.001</td>
</tr>
<tr>
<td>Labor dystocia</td>
<td>6.5% (183/2807)</td>
<td>6.5% (207/3179)</td>
<td>1.0</td>
<td>.29</td>
</tr>
<tr>
<td>Placental abruption</td>
<td>1.1% (31/2807)</td>
<td>.7% (23/3179)</td>
<td>.001</td>
<td>.02</td>
</tr>
<tr>
<td>Sensory pain</td>
<td>1.2% (34/2807)</td>
<td>1.1% (35/3179)</td>
<td>1.0</td>
<td>.13</td>
</tr>
<tr>
<td>Postpartum hysterectomy</td>
<td>2.3% (65/2807)</td>
<td>2.1% (67/3179)</td>
<td>1.0</td>
<td>.78</td>
</tr>
<tr>
<td>Perioperative morbidity</td>
<td>0.2% (5/2807)</td>
<td>0.3% (10/3179)</td>
<td>&lt;.001</td>
<td>1.0-0.910</td>
</tr>
</tbody>
</table>

Klatsky et al AJOG 2007

Nomenclature of Professional Communication: International Consensus Meeting 2005...
Acute versus Chronic AUB for nonpregnant women of reproductive age

- **Chronic Abnormal Uterine Bleeding**
  - Bleeding from the uterine corpus, that is abnormal in duration, volume, regularity, and/or frequency and has been present for the majority of the last six (6) months.

- **Acute Abnormal Uterine Bleeding**
  - is an episode of bleeding that is of sufficient quantity to require immediate intervention to prevent further blood loss.

### Nomenclature of Professional Communication

#### AUB—Recommended Descriptive Nomenclature for Symptoms

*Fraser IS, Critchley HOD, Munro MG, et al.*

**Hum Reprod** 2007;22:635-43

**Fertil Steril** 2007;87:466-76

### Unresolved Issues

- **Volume**
  - Since the volumetric measurement of 5–80 mL is NOT practical in the clinical environment, what are practicable measures of menstrual volume?

- **Regularity**
  - Is ± 2–20 days a practical definition of a group who is primarily ovulatory?
How could / should FIGO’s PALM-COEIN system be used?

Classification Categorization

How could / should FIGO’s PALM-COEIN system be used?

Classification Categorization

Multiple Entity Examples

Classification Categorization

Single Entity Examples

References

Hysteroscopic Approach to Leiomyomata

Ted L. Anderson, MD, PhD, FACOG, FACS
Associate Professor of Obstetrics & Gynecology
Director, Division of Gynecology
Vanderbilt University Medical Center, Nashville, TN
ted.anderson@vanderbilt.edu

Minimally Invasive Gynecologic Surgery

Objectives

• Participants will be able to:
  – Assess submucosal leiomyomata appropriately
  – Compare approaches to hysteroscopic resection
  – Predict and manage common complications
  – Surgically manage submucosal leiomyoma patients

Minimally Invasive Gynecologic Surgery

Background

• Affects approximately 33% of women
  • Age and race variables up to 75%
• Varied symptoms, may be asymptomatic
  • Menorrhagia (30%), Pain (34%), Infertility (27%)
• Approximately 5% submucosal
  • Definitions
  • Identification


Minimally Invasive Gynecologic Surgery

Interventions

• Indications for treatment
  • Abnormal uterine bleeding
  • Pelvic pain / dysmenorrhea
  • Infertility
• General considerations
  • Desire for future fertility
  • Desire for uterine preservation
  • Aggressiveness vs expectations
• Co-morbidities

Minimally Invasive Gynecologic Surgery

Treatment Decisions

Complications

• Fibroid Evaluation
• Monopolar
• Bipolar
• Mechanical

Patient Management
Treatment Decisions

- Fibroid Evaluation
  - Monopolar
  - Bipolar
  - Mechanical
- Complications
- Patient Management

Submucosal Fibroid Types

- ESGE classification
- Intramural extension
  - Type 0: None
  - Type I: < 50%
  - Type II: > 50%

Preoperative Assessment (NC)

- The penetration level of the myoma into the myometrium
- The extension of the base with respect to the wall of the uterus
- The location at fundus, body or lower segment

Uterine Evaluation

- Sensitivity 100%
- Specificity 94%
- Predictive Value
  - Abnormal scan: 81%
  - Normal scan: 100%
  - Precise mapping: Polyp vs fibroid

Ultrasound Mapping

- Saline Infusion Sonography
  - As sensitive as hysteroscopy for intracavitary pathology
  - Less uncomfortable than hysteroscopy when both performed in the office
  - Added benefit of myometral evaluation
3-D Reconstruction

- As accurate as 2D saline infusion sonography
- Faster, more accurate interpretation, especially of submucosal component
- Comparable to hysteroscopy for intracavitary lesions


Magnetic Resonance (MRI)

- Better visualization and mapping of individual fibroids
- More accurate characterization of number, location, and volume of fibroids
- Additional information gained may not justify additional cost


Monopolar Current

Loop electrodes at 45° and 90° angulations

- Most commonly used method
- Loop resection or bulk vaporization
- Risk for hyponatremia


Fibroid Evaluation

Monopolar

Bipolar

Mechanical

Complications

Patient Management

Energy Flow

- Generator to active electrode
- Sodium Vapor Pocket
- Contacts tissue
- Instantaneous cellular rupture
- Cutting is non-mechanical
- Energy Flow
  - Return electrode
  - Controlled Thermal Effect
  - Vapor pocket proportional to voltage

Bipolar Current

Bipolar Resection

- 1.6 mm (5 Fr) in diameter
- Focused Tissue Effects
- Ball Tip
  - Vaporization
  - Desiccation
- Spring Tip
  - Vaporization
  - Desiccation
- Twizzle Tip
  - Vaporization
  - Pin-point cutting

Return Electrode

Active Electrode 4 x 2.5 mm

Insulator

Spring

Twizzle

Ball
• Just as effective as monopolar
• Pencil-type electrode, loop, or bulk vaporization
• Decreased (not absent) risk of fluid absorption

Hysteroscopic Morcellator

• Operate in Saline
• Mechanical
  • No thermal injury
• Remove Tissue Pieces
  • Clear visual field
• Are Easy to Use - Office use?
• Facilitate Removal Type 0 and I Myomas

Hysteroscopic Morcellator - TruClear

• FDA Approved 2005
• Dedicated Fluid Pump
• Tissue Removed with Suction
• Offset Lens Hysteroscope
• Inner/Outer Rotating-Oscillating Blades
• Different Serrated Cutter for Polyps
• Hysteroscopic Sheath 9 mm OD

Hysteroscopic Morcellator - MyoSure

• FDA Approved 2009
• Standard Set-up Fluid/Suction
• Tissue Removed with Suction
• Offset Lens Hysteroscope
• Inner/Outer Rotating-Oscillating Blades
• Hysteroscopic Sheath Outer Diameter 6.25 mm
Complications
- Fluid absorption
- Gas embolism
- Perforation
- Hemorrhage
- Incomplete resection

Fluid Absorption
- Objectives of fluid distension
  - Overcoming myometrial resistance, maximize visualization
  - Create and maintain electrosurgical environment
- Challenges of fluid absorption
  - Minimize fluid medium absorption and consequences
- Drivers of fluid absorption
  - Pressure, time, procedure invasiveness, comorbidities
- Pathways of fluid absorption
  - Direct vascular channels
  - Peritoneal absorption

Nonionic (Hypotonic) Media
- 1.5% Glycine (200 mOsm/L)
  - Metabolized to ammonia/urea + water
  - Hyperammonemia + hypo-osmolal hyponatremia
- 3% Sorbitol (178 mOsm/L)
  - Metabolized to fructose + glucose
  - Hyperglycemia + hypo-osmolal hyponatremia
- 5% Mannitol (274 mOsm/L)
  - Essentially inert (only ~10% metabolized)
  - Metabolized to glucose
  - Half-life ~15 min; acts as osmotic diuretic

Nonionic (Hypotonic) Media
- Significant Morbidity
  - Headache
  - Nausea, vomiting
  - Lethargy, confusion, stupor
  - Muscle aches and twitches
  - Seizure
- Significant Mortality
  - Cerebral edema – herniation
  - Pulmonary edema
  - Cardiac arrhythmias
  - Coma
  - Death

Ionic (Isotonic) Medium
- Normal Saline
- Lactated Ringers
- Pure fluid overload
  - Tissue edema
  - Pulmonary edema
- Treat with lasix

Factors Affecting Intravasation
- Surgery that opens larger vascular channels
  - Resection of myoma > endometrial ablation
  - Lysis of intracavitary adhesions
  - Division of uterine septum
- Partial perforation
  - Cervical/lower segment tear
  - False passageway
- Excessive operating time
- Excessive intrauterine pressure
  - MAP approximately 75 mm Hg
  - 40-110 mm Hg required to distend uterus
Mitigating Risk

- Iso-osmolar fluids preferentially
  - Chilled fluid decreases absorption
- Appropriate distension pressure
- Cervical vaspressin or GnRH analogs
- Timely purposeful procedure
- Fluid management system
- Pre-designate STOP
  - 1000 cc for hypotonics
  - 2500 cc for isotonics
- Communication between team members

Treatment of Hyponatremia

- Early detection, rapid initiation of treatment
  - Loop diuretic such as furosemide for rapid diuresis
  - Regular monitoring of electrolytes, intake, and output
  - Restrict fluid intake, provide supplemental oxygen
- Sodium <120 requires critical care setting
  - Engage a specialist in critical care medicine
  - 3% saline with abnormal cardiac or neuromuscular function, or sodium <120 mmol/L
- Correct sodium gradually (1 - 2 meq/l/hr) to 130

Gas Embolism

- Heart
  - Pulmonary vasoconstriction
  - Pulmonary vascular resistance
  - PAP
  - RV ejection
  - RV end systolic/diastolic vol.
  - Acute right heart failure
  - CVP
  - Cardiac Output

Factors Predisposing Gas Embolism

- Unpurged gas bubbles in the inflow line
- Inadequate uterine flushing of bubbles
- Piston-like action of repetitive insertions
- Excessive intrauterine pressure
- Proportionate to size of instruments
- Trendelenburg patient positioning
- Presence of large intramural venous channels
  - (e.g. vascular myoma)
- Surgical penetration into the myometrium
- Disruption and exposure of vasculature
- Excessive operating times

Gas Embolism with Electrosurgery

- No clinically significant difference in gas produced by monopolar or bipolar
- Composition – soluble: H+, CO, CO2, & O2
- Enters venous circulation
  - equilibrate with pulmonary clearance
  - exceed pulmonary clearance

## Treatment of Gas Embolism

- **Stop case**
  - stops further air entry
- **Stop nitrous oxide if using**
  - prevent bubble expansion
- **Left lateral decubitus**
  - prevents air lock in the right heart
- **Evacuate**
  - embolized air in through CVP or PA line
- **Maintenance of cardiac output**
  - raise BP and push air out
- **Closed chest cardiac massage / respiratory care**

## Perforation Risk

- **Cervical dilation (most often)**
- **Rigid instrument placement**
- **Challenging access**
  - Cervical stenosis
  - Asherman’s syndrome
- **Altered myometrium**
- **Uterine anomaly**
- **Menopause (up to 10x)**

## Management of Uterine Perforation

- **Fundal without RF Energy**
  - Discontinue and observe
- **Fundal with RF Energy**
  - Laparoscopy / laparotomy to inspect for visceral injury
- **Lateral**
  - Laparoscopy to inspect for broad ligament hematoma
- **Anterior**
  - Cystoscopy
- **Remove excessive distention media**
  - Delayed fluid absorption issues

## Uterine Perforation

- **Rare overall**
  - 0.1 – 0.5% in simple hysteroscopy
- **Up to 5% in operative hysteroscopy cases**

  - **Consequences**
    - Inconsequential
    - Vessel injury
    - Visceral injury

## Perforation Prevention

- **EUA with empty bladder**
- **Cervical preparation, adequate dilation**
- **Avoid using dilators like a sound**
- **Gentle insertion of instruments**
- **Advance electrode only if unobstructed view**
- **Do not advance scope with electrode extended**
- **Do not advance activated electrode**
- **Ultrasound or laparoscopy assistance**

## Hemorrhage

- **Greatest risk with myomectomy (2.5%)**
- **Look for cervical tear / partial perforations**

  - **Mitigating risk**
    - vasopressin
    - preop GnRH agonist

---

*References:
Need for Staged Procedures

- Type II (ESGE) Hysteroscopic Myomectomy
  - Increased risk of:
    - Excessive fluid absorption
    - Electrolyte abnormalities with non-electrolyte media
    - Excessive bleeding
    - Incomplete resection
    - Need for additional procedure
    - Increased operative time
  - Applies even to experienced hysteroscopic surgeons


Table: Need for Staged Procedures

<table>
<thead>
<tr>
<th>Score</th>
<th>Group</th>
<th>Complexity and Operative Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 4</td>
<td>I</td>
<td>Low complexity hysteroscopic myomectomy</td>
</tr>
<tr>
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<td>II</td>
<td>Consider preparing with GnRH analog and/or for two-stage surgery</td>
</tr>
<tr>
<td>7 to 9</td>
<td>III</td>
<td>Recommend an alternative non-hysteroscopic technique</td>
</tr>
</tbody>
</table>

Griffith = gonadotropin-releasing hormone.

Minimally Invasive Gynecologic Surgery

Need for Staged Procedures

- 57 myomectomies compared with ESGE system
- NC more accurately predicted differences between groups I and II with respect to:

  - completed procedures, fluid deficit, and operative time

<table>
<thead>
<tr>
<th>Score</th>
<th>Group</th>
<th>Suggested Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 4</td>
<td>I</td>
<td>Low complexity hysteroscopic myomectomy</td>
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<td>Recommend an alternative non-hysteroscopic technique</td>
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Minimally Invasive Gynecologic Surgery

Treatment Decisions

- Fibroid Evaluation
  - Monopolar
  - Bipolar
  - Mechanical

- Complications

- Patient Management

  - Adequate pre-operative assessment
    - Measure twice, cut once
  - Consider appropriateness of hysteroscopy
  - Consider specific surgical tools available
  - Counsel patients regarding fluid management
    - Excessive absorption and consequences
  - Procedure termination, need for additional procedure(s)
  - Be aware of risks and vigilant for complications
  - Know your surgical limits

Minimally Invasive Gynecologic Surgery
References


Questions?

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References

What limits a conventional laparoscopic approach?

Jon I Einarsson MD MPH
Director of MIGS
Brigham and Women’s Hospital
Associate Professor of Obstetrics and Gynecology
Harvard Medical School

DISCLOSURE
I have the following financial relationship with a commercial entity producing health-care related products and/or services
Consultant Ethicon Endo-Surgery

Objectives
- Discuss steps of conventional laparoscopic myomectomy
- Describe the limitations of the conventional laparoscopic approach
- Describe tips and tricks to overcome some of those limitations

Our data – LM vs. RALM

<table>
<thead>
<tr>
<th></th>
<th>LM (n=115)</th>
<th>RALM (n=174)</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Operative time (min)</td>
<td>118.3</td>
<td>195.1</td>
<td>&lt;.0001</td>
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<tr>
<td>EBL (ml)</td>
<td>85.9</td>
<td>110.0</td>
<td>0.04</td>
</tr>
<tr>
<td>Conversions to laparotomy</td>
<td>0</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>Weight of fibroids (g)</td>
<td>201 (1-1473)</td>
<td>159 (8-780)</td>
<td>NS</td>
</tr>
<tr>
<td>Median n of fibroids</td>
<td>2 (1-25)</td>
<td>3 (1-16)</td>
<td>NS</td>
</tr>
<tr>
<td>Largest fibroid (cm)</td>
<td>7.5 (2.2-16.5)</td>
<td>7.3 (3.1-13.8)</td>
<td>NS</td>
</tr>
<tr>
<td>Blood transfusions n(%)</td>
<td>1(0.9)</td>
<td>10(5.7)</td>
<td>NS</td>
</tr>
<tr>
<td>Hospital stay &gt;1 day n(%)</td>
<td>4(3.5)</td>
<td>29(16.9)</td>
<td>OR 5.73</td>
</tr>
</tbody>
</table>

Brief description of our technique
- Two parallel trocars on surgeon side
- Facilitates suturing – especially in the setting of a horizontal hysterotomy
- Inject dilute vasopressin subserosally – avoid using more than 10 units every 30 minutes
- Consider diluting the vasopressin in a Marcaine cocktail – possible pain relief at the hysterotomy site
- We like to use large volumes, 20 units of vasopressin in 400 ml of saline – we inject 200 ml (10 units) at a time
- RCT ongoing comparing blood loss in using 200 vs 60 ml of diluted vasopressin solution

Step 1 - Vasopressin injection
Step 2 – Hysterotomy
- Carry the incision into the fibroid
  - find the right plane
- We prefer the Harmonic due to minimal lateral thermal spread
- A horizontal incision is preferred for suturing with two ipsilateral trocars

Step 3 – Fibroid extraction
- Rock and Roll
- Needs quite a bit of force
- Avoid entering the cavity if possible – will do this deliberately in women who have completed their childbearing – easy to pluck out the submucosal fibroids this way

Step 4 – Closure of endometrial cavity
- Close cavity separately (if entered) with small (3/0) monofilament (Monocryl)
- Take care not to place sutures inside the uterine cavity
- Intracorporeal knot tying
- We will not close the cavity separately in patients who are not of reproductive potential

Step 5 – Hysterotomy closure
- Close hysterotomy in layers making sure to approximate all dead-space
- We use bidirectional barbed suture routinely
- 0 PDO (equivalent to 2/0 PDS)
- This suture has a needle on each end and barbs that are directed in an opposite direction to the needles
- Use as many layers as needed to securely approximate the edges

Bidirectional barbed suture
- We tack the first needle into the anterior abdominal wall on the right side to avoid tangling
- First bite taken and suture pulled through until resistance is met (middle of suture)
- First layer completed, needle cut away
- Second layer taken with other needle
- The hysterotomy closure is “time sensitive” – as long as the hysterotomy is open there is going to be active bleeding
- Cover hysterotomy with adhesion barrier (interceed)
Step 5 – Hysterotomy closure

- We close the serosa in a baseball configuration.
- No evidence that a baseball closure reduces adhesion risk.
- A recent RCT in a sheep model showed no difference in adhesion formation between vicryl and barbed suture.

Step 6 - Morcellation

- We need better tissue morcellators.
- Try to stay on the surface (peel an orange).
- Make sure to get all the pieces out.
- Time consuming in the setting of large or calcified fibroids.
- 12-40 grams per minute.
- 1000 grams takes 25-83 minutes to morcellate.

Limits

- Surgeon experience
- Size
- Number
- Location
- What is the ultimate goal of surgery? Fertility preservation? Volume reduction?
- Blood loss – will the pt accept a transfusion?

Surgeon experience

- Most important factor
- Move strategically and control the situation at all times.
- Gradually build up.
- Need high volumes (>50/year) to become really good.
- Rapid suturing is important.
Size
- The largest specimen weight for a myomectomy in our group is 3080 g.
- Does not tell the whole story.
- MUCH easier to remove one large fibroid rather than multiple small ones (raisin bread).
- Time for extraction can be excessive – a minilaparotomy may be advisable with manual morcellation with a 10 blade.
- Also consider hand assisted surgery.

Laparoscopically assisted myomectomy
- Hybrid procedure.
- Fibroids usually removed laparoscopically and suturing and fibroid extraction performed through a minilaparotomy incision (4-5 cm).
- Challenging for posterior fibroids.
- Longer recovery time than LM.
- Also can be done hand assisted, but then the incision is larger – around 7 cm.

Hand assisted video

Number
- Have removed over 60 fibroids in one patient, but our median number is 2 per case.
- Important to have a discussion with the patient about limitations. It is not always possible to remove all fibroids. Small ones may be left behind.
- Preoperative evaluation is very important for mapping.

Location
- Intramural vs submucosal vs intracavitary vs subserosal.
- Cervical – watch out for uterines – clip at origin if necessary.
- Broad ligament – usually pretty easy – open peritoneum and peel out – again stay away from major vessels.
Preoperative evaluation
- MRI is obtained on most patients
- Delineates location, characteristics and size of fibroids
- Detects adenomyosis
- Helps with preoperative counseling and planning

Goal of surgery?
- Fertility preservation
  - prefer not to embolize or use permanent clips, but
  - OK to use clips and remove at end of case
  - Important to take care of any fibroids in vicinity of cavity
  - Close endometrium separately
- No Fertility preservation
  - OK to remove the whole top of uterus and close
    on mass – shortens and simplifies procedure
  - No need to close endometrium separately
  - Remove submucosal fibroids laparoscopically

Tips for limiting blood loss
- Use high volume vasopressin – 20 units in 400 ml of saline – inject 200 ml
- Use lupron preoperatively to build blood counts
  - may make dissection of fibroids more difficult
  - IF the fibroids are already necrotic
- Be quick
- Avoid making an incision close to ascending uterines
- Use clips on the uterine arteries
- Consider preop embolization
- Consider using cell saver

Laparoscopic uterine artery occlusion

Case in point
- 39 y/o G0 – Jehovah’s witness
- Heavy bleeding despite Lupron for 6 months
- H/H 9/29 despite repeated iv iron infusions
- Wants pregnancy in near future
- Multiple fibroids on imaging, overall uterine size 19.5x17.2x8.6cm – 10 cm intracavitary fibroid – total uterine weight approx 1500 grams
- EMB benign

Video
Thank you

References

Robot-Assisted Laparoscopic Myomectomy

Tommaso Falcone, M.D.
Professor and Chair
Department of Obstetrics & Gynecology

Learning Objectives
- Analyze if a laparoscopic approach to the management of a fibroid uterus gives similar results to a laparotomy
- List the benefits of Laparoscopic myomectomy
- Discuss the possible technical limitations of laparoscopic myomectomy
- Discuss the role of robotics

Financial Disclosure
- I have no financial relationships to disclose.

Retrospective clinical trials comparing myomectomy by conventional laparoscopy, robotically-assisted myomectomy and laparotomy have shown all the following EXCEPT

| No difference in short-term surgical outcomes between laparoscopy with and without robotic assistance | 92750 |
| Longer operative times of robotic surgery compared with laparotomy | 92751 |
| Cost analysis shows that costs were higher with robotic myomectomy compared with myomectomy by laparotomy | 92752 |
| Long term resolution of symptoms and other quality of life indicators demonstrate similar outcomes with all surgical approaches | 92749 |
Summary of Literature on Robotic Myomectomy Surgery

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Number of Robotic Cases</th>
<th>Type of Study</th>
<th>Removed Myomas Weight</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advincula</td>
<td>2004</td>
<td>35</td>
<td>Preliminary experience</td>
<td>Mean = 223.2 ± 544.1g</td>
<td>Robotic myomectomy is a new promising approach</td>
</tr>
<tr>
<td>et al</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mao SP</td>
<td>2007</td>
<td>1</td>
<td>Case report</td>
<td>Not available</td>
<td>Successful robotic-assisted excision of large uterine myoma measuring 9x8x7cm</td>
</tr>
<tr>
<td>et al</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>et al</td>
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<td></td>
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<tr>
<td>George A</td>
<td>2009</td>
<td>77</td>
<td>Effect of the BMI on the surgical outcome</td>
<td>Median = 235g (range 21.2 - 980g)</td>
<td>Obesity is not a risk factor for poor surgical outcome in robotic myomectomy</td>
</tr>
<tr>
<td>et al</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bedient CE</td>
<td>2009</td>
<td>40</td>
<td>Comparing robotic to laparoscopic myomectomy</td>
<td>Mean = 210g (range 7 - 1076g)</td>
<td>No difference in relation to short term surgical outcome measures</td>
</tr>
<tr>
<td>et al</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Robotic trial

- Robotic myomectomy versus laparotomy
  - Ascher- Walsh & Capes JMIG 2010
  - Robot N= 75; 4 ports- 3 robotic and 1 assistant; Control- N=50;
  - Inclusion criteria were 3 myomas or fewer
  - Mean BMI 20-21
  - Duration of surgery 192 minutes versus 138 minutes
  - Uterine Weight 320 g; LOS 0.5 days versus 3 days
  - Less blood loss; less febrile morbidity
Robot vs. laparoscopic Myomectomy

- 2 separate teams with 2 separate expertise (Gargiulo et al Obstet Gynecol 2012)
- N= 115 scope myomectomy
- N= 174 robot myomectomy
- Median # of myomas - 2 vs 3
- Weight - 201 (1-1.5 kg) vs 159 g (8-780 g)
- Median dimension 7.5 cm

Gargiulo et al 2012

- OR time: 118 minutes (laparoscopy) vs. 195 minutes (robot)
- Robot case had a higher odds of admission to hospital and having a longer than 1 day hospital stay
- Risk of complications were the same but note that transfusion rate was 0.9% in the scope myomectomy group vs. 5.7% in the robot group

Cleveland Clinic Obstet Gynecol 2011

<table>
<thead>
<tr>
<th></th>
<th>Abdominal (n=393)</th>
<th>Laparoscopic (n=93)</th>
<th>Robotic (n=89)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age years</td>
<td>36.93 (5.61)</td>
<td>39.57 (9.17)</td>
<td>36.62 (5.18)</td>
<td>&lt;</td>
</tr>
<tr>
<td>Weight Kg</td>
<td>75.5 (62.8,90.7)</td>
<td>64.8 (59.1, 76.66)</td>
<td>68.04 (57.6, 82.5)</td>
<td>&lt;</td>
</tr>
<tr>
<td>Height cm</td>
<td>163.92 (13.17)</td>
<td>164.02 (6.19)</td>
<td>163.63 (6.62)</td>
<td>0.97</td>
</tr>
<tr>
<td>BMI kg/m2</td>
<td>27 (23,32)</td>
<td>24.1 (22, 28.1)</td>
<td>25.1 (22.1, 29.4)</td>
<td>&lt;</td>
</tr>
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</table>

Maximum Diameter of the Resected Myoma (in cm) by Surgical Approach

<table>
<thead>
<tr>
<th></th>
<th>Abdominal</th>
<th>Laparoscopic</th>
<th>Robotic</th>
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</thead>
<tbody>
<tr>
<td>Overall</td>
<td>&gt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>RM vs LM</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>NS</td>
</tr>
</tbody>
</table>

Weight of the Resected Myomas (in grams) by Surgical Approach

<table>
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</table>

The Actual Operative Time (in minutes) by Surgical Approach

<table>
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</tr>
</thead>
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<tr>
<td>RM vs LM</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>NS</td>
</tr>
</tbody>
</table>
### The Intra-operative Blood Loss (mL) by Surgical Approach

![Box plot showing blood loss by surgical approach.](Image)

- Overall P < 0.001
- RM vs. LM NS

### The Postoperative Hemoglobin Drop (gm/dL) by Surgical Approach

![Box plot showing hemoglobin drop by surgical approach.](Image)

- Overall P < 0.001
- RM vs LM NS

### Technical Limitations - robot approach - What are the solutions?

- Procedures are longer
  - Requires training
- Most important learning step is port placement
- Matthews et al JMIG 2010
- Mean distance from symphysis pubis to the umbilicus less than 16 cm, 100 % required port placement above the umbilicus.

### Port placement

- Should we use the fourth arm
- Accessory port/ports

### Technical considerations

- Uterine manipulator
- 8-10 cm between the endoscope and the top of the elevated uterus
- Accurate myoma “mapping”
  - No tactile feedback
Side Docking – 4 arm
Cost analysis

- Advincula et al JMIG-2007
  - Hospital charges Robot-$30,000 versus $13,000 for laparotomy
- Behera et al JMIF 2012-
  - Cost: AM $4937/ LM $6219 and RM $7299
- Reimbursement
  - What will we get in the future?

Conclusion

- Robotic Surgery may have some advantage over conventional surgery.
- Robotics may help the suturing task
- There is a learning curve
- Robotic times are longer
- Costs?

Case 1

- 35 year old G1P0010
- Uterine fibroids and desires future fertility
- Patient has a history of menorrhagia in 2006.
- Missed AB at approx 8 weeks.
- Severe vaginal bleeding and a drop in H&H that necessitated a 2 unit transfusion of blood.
- Show MRI—would you do this case robotically?
Case 3

- 29 year old G0 presents with a history of enlarging abdominal girth mass and what was thought to be an umbilical hernia.
- Patient strongly desires future fertility
Bocca S, Stadtmauer L, Oehninger S. Uncomplicated full term pregnancy.

Advincula AP, Song A, Burke W, Reynolds RK. Preliminary experience with

Matthews C, Schubert C, Woodward A, Gill E. Variance in abdominal wall

Ascher-Walsh C, Capes T. Robot-assisted laparoscopic myomectomy is an


References


References


Koehler-Walsh C, Capes T. Robot-assisted laparoscopic myomectomy is an improvement over laparotomy in women with a limited number of myomas. J Minim Invasive Gynecol 2010;17:306-310.


Myoma ablation and UAO techniques

Jon Ivar Einarsson MD MPH
Director of Minimally Invasive Gynecologic Surgery
Brigham and Women’s Hospital
Associate Professor
Harvard Medical School

DISCLOSURE

I have the following financial relationships with a commercial entity producing health-care related products and/or services.
Consultant for Ethicon-Endosurgery

Objectives

- Describe various available myoma ablation methods
- Describe various available UAO methods
- Discuss other treatment options on the horizon

Uterine Conservation for Benign Conditions: Historical Perspective

Occlusive and Ablation Treatments for Uterine Fibroids

- Uterine artery embolization (UAE)
- Magnetic resonance-guided focused ultrasound (MRgFUS)
- Laparoscopic uterine artery occlusion (L-UAO)
- Doppler-guided uterine artery occlusion (D-UAO)
- Radiofrequency ablation (RFA)
  - Halt
  - VizAblate
  - Cryomyolysis

Uterine fibroid embolization

- Involves an injection of trisacryl gelatin microspheres, polyvinyl alcohol particles, or gelatin sponge into the uterine arteries for occlusion
- Effective in appropriately selected patients
- Patients with multiple fibroids or large fibroids have less favorable outcomes
- Patients with submucosal fibroids or pedunculated fibroids on a stalk smaller than 2 cm are not ideal candidates

**Uterine Artery Embolization: Results**

Clinical Efficacy From Fibroid Registry Data
- Significant and durable improvement in symptoms and quality of life, measured at 6 and 12 months
- Mean symptom score (UFS-QOL) reduced from 58.61 to 19.23 ($P < 0.001$)
- Mean quality of life score rose to 86.68 from 46.95 ($P < 0.001$)
- >85% of patients had at least a 10-point improvement in symptoms
- 82% of patients were pleased with their outcome


---

**Potential Complications of Uterine Artery Embolization**

- Embolization to nontarget organs and tissues (eg, ovaries)
  - Ovarian failure as high as 13.6% (increased risk for women older than 45 years)
- Uterine necrosis and sepsis
- Passage of submucous myomata
- Postembolization syndrome
- Local (hematoma, ecchymoses)
- Mortality


---

**Uterine Artery Embolization**

Current status (ACOG):
- Based on current evidence, it appears that uterine artery embolization, when performed by experienced physicians, provides good short-term relief of bulk-related symptoms and a reduction in menstrual flow.
- Remains investigational with regard to preservation of fertility

**Uterine fibroid embolization**

- UFE is associated with shorter hospital stay (1 vs 2.5 days) and quicker return to normal activities (15 vs 44 days) when compared with abdominal myomectomy
- Goodwin et al Obstet Gynecol. 2006;107:1275-1282
- One study found that UFE and laparoscopic myomectomy have similar recovery rates — complications were more common in the UFE group


---

**RCT comparing surgery and UFE**

- 106 pts UFE vs 51 surgery (43 hyst, 8 myomect) via laparotomy
- No significant differences in SF-36 scores at one year (POM)
- UFE with shorter hospital stay (1 vs 5 days) and quicker return to work
- At one year symptom scores were better in surgery group
- Complication rates similar — however most complications in surgery group were during initial hospitalization while most of the UFE complications occurred after hospital discharge
- Nine percent of the UFE group required re-embolization or hysterectomy at one year of follow-up


---

**EMMY trial**

- RCT comparing 88 UAE vs 89 abdominal hyst pts
- Rate of minor complications higher for UAE
- Shorter hospital stay in UAE group
- Similar symptom relief in both groups
- 23.5% of the women in the UFE group had undergone a hysterectomy at 24 months and 18.4% at 5 years.
- This trial has been faulted for high rates of technical failure during UAE — perhaps indicating lack of expertise by the radiologists in this trial

**Fertility after UFE**

- RCT between UFE and myomectomy among 121 women with reproductive plans with an intramural fibroid larger than 4 cm
- Mean follow up at interval report was 2 years
- Embolization was less invasive (shorter hospital stay, shorter recovery)
- Statistically significantly more pregnancies (78% vs 50%), live births (48% vs 29%) and fewer miscarriages (23% vs 64%) in the myomectomy group


**MRI guided focused ultrasound**

- Fibroids located and mapped with MRI
- Ultrasound beams are focused on fibroids and cause intense heat and destruction
- Patient prone on MRI table for 2-4 hours
- Not recommended for women of childbearing potential, or for submucosal fibroids, multiple fibroids, fibroids near bowel or bladder or where abdominal scars are in the way of the ultrasound beams

Fennessy et al. Radiology 2007;243(3):885-93

**MRgFUS**

- A study of 109 women found a 13.5% and 9.4% myoma volume reduction at 6 and 12 months
- 80% reported symptom improvement at 6 months
- 28% required alternative treatment within 12 months
- This treatment is not covered by most insurance plans – costs $18,000 to $26,000 out of pocket
- Treatment times were conservative (on average 10% NPV) in the early trials and further refinements are underway


**MRgFUS success appears to be dose dependent**

<table>
<thead>
<tr>
<th>NPV (%)</th>
<th>Count</th>
<th>Any symptom improvement (%)</th>
<th>Alternative treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–10</td>
<td>69</td>
<td>38</td>
<td>48</td>
</tr>
<tr>
<td>10–20</td>
<td>55</td>
<td>47</td>
<td>44</td>
</tr>
<tr>
<td>20–30</td>
<td>37</td>
<td>57</td>
<td>35</td>
</tr>
<tr>
<td>30–40</td>
<td>26</td>
<td>73</td>
<td>23</td>
</tr>
<tr>
<td>Over 40</td>
<td>29</td>
<td>79</td>
<td>17</td>
</tr>
</tbody>
</table>

NPV – non perfused volume

**UK NICE Guidelines on MRgFUS**

- Based on 4 published case series
  - 71%-88% and 51%-91% achieved a 10-point reduction in UFS symptom severity scale at 6 and 12 months, respectively
  - Reintervention rate – 12%-34% (follow-up 6-12 months)
  - "Current evidence on the safety and efficacy of magnetic resonance image (MRI)-guided transcutaneous focused ultrasound for uterine fibroids is such that this procedure should only be used with special arrangements for consent and for audit or research."


**MRgFUS: Symptom Durability**

<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>Duration</th>
<th>NPV</th>
<th>SSS Reduction</th>
<th>Volume Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stewart et al, 2007</td>
<td>416</td>
<td>24 months</td>
<td>38.0%</td>
<td>~ 50%</td>
<td>20% (6 months)</td>
</tr>
<tr>
<td>Funaki et al, 2009</td>
<td>91</td>
<td>24 months</td>
<td>~ 54%</td>
<td>57%</td>
<td>39.5%</td>
</tr>
<tr>
<td>Lénárd et al, 2008</td>
<td>135</td>
<td>12 months</td>
<td>16.3%</td>
<td>39%</td>
<td>17.0%</td>
</tr>
<tr>
<td>Fennessy et al, 2007</td>
<td>160</td>
<td>12 months</td>
<td>16.7%</td>
<td>47%</td>
<td>N/A</td>
</tr>
<tr>
<td>Kim et al, 2011*</td>
<td>40</td>
<td>36 months</td>
<td>32%</td>
<td>48%</td>
<td>32%</td>
</tr>
</tbody>
</table>

*9 (22.5%) patients had needed reintervention at 3 years, 2 hyst, 2 myomectomies. 5 UFEs
Laparoscopic uterine artery occlusion

- The uterine arteries are located and permanently occluded laparoscopically
- Requires dissection of the origin of the uterine artery from the internal iliac vessels
- Currently being performed at BWH in women with multiple fibroids who desire uterine conservation and have completed their childbearing
- The largest fibroids are removed concurrently – this may reduce the necrosis and pain following the occlusion of the uterine arteries
- Allows for diagnosis and treatment of other potential pathology
- Good for "bag of marbles"
- Requires advanced laparoscopic skills

L-UAO vs UAE

- Hald and Istre 2007: 58 women randomized to UAE or L-UAO (29 in each group) followed for six months
  - No significant difference in mean reduction in PBAC scores
  - Fewer women in the UAE group complained of menorrhagia at six months, however (4% vs 21%, P = 0.044)
  - Pain med requirements significantly higher after UAE
- Hald and Istre 2009: same patients followed up to 73 months (median 48 months)
  - Higher hysterectomy rate in L-UAO group (28% vs 7%; P = 0.041)
  - Clinical failure/symptom recurrence rate higher in L-UAO group (48% vs 17%; P = 0.02)
  - All UAE patients had complete infarction vs 23% of L-UAO pts

Why Might UAE Be Superior to L-UAO?

- Proximal laparoscopic UA occlusion might not block distal cervicovaginal anastomoses
- Greater propensity towards technical failure of the laparoscopic approach?
  - Visualization of retroperitoneal vessels is more tenuous with laparoscopy, especially with large uteri
  - Unlike angiography, cannot rule out vascular anomalies (aberrant UA, duplicate UA)

Vaginal uterine artery occlusion

- The uterine vessels are located and clamped transvaginally without an incision
- A doppler sensor at the end of the clamp recognizes the pulsation of the uterine artery
- The patient has an epidural and the clamp is left in place for 6 hours
- Cystoscopy is performed prior to and after clamp placement


Clamp in place
### Volumetric, Image-Guided Ablation
- Optimizes ablated volume of targeted fibroid
- Avoids multiple passes of energized needles through the serosa
- Not a global therapy—treats the fibroids that are likely to be symptomatic
- Incites thermal fixation and coagulative necrosis
- Avoids infarction-related postembolization syndrome seen with UAE

### Radiofrequency Ablation
- RF volumetric ablation has been used in many organs in the body, including uterine fibroids, liver, lung, kidney, spine, and pancreas
- Studies in uterine fibroids have used off-the-shelf RF ablation devices with laparoscopic, percutaneous, and transvaginal approaches

### VizAblate
- VizAblate® is an intrauterine ultrasound (IUUS)-guided radiofrequency ablation system designed to treat submucosal and intramural fibroids
  - Combines RF ablation with intrauterine ultrasound
  - Inserted transvaginally
  - Performed by gynecologists
  - Short procedure time

### Halt 2000 Ablation System
- Ultrasound guided laparoscopic RF fibroid ablation
- FDA approved 2010
- Currently completing a clinical trial in the US
- Preliminary data from Garza et al on 31 pts showed promising results at 12 months follow up
VizAblate CV Handpiece

Scalable ablation from 1cm to 4cm in diameter

8mm diameter shaft

VizAblate™ Treatment Planning Software

- The graphical overlay enables the gynecologist to plan a safe and predictable ablation
- The red oval indicates the ablation zone
- The green oval indicates the thermal safety boundary. Outside this area, there is no significant risk of thermal injury.

Clinical Status

- The VizAblate System was granted the CE Mark in December, 2010
- Safety has been demonstrated
  - > 120 peri- and prehysterectomy procedures
  - Treatment of > 55 women for symptomatic relief without any issues relating to ablation safety

Cryomyolysis

- Involves localizing fibroids laparoscopically, with ultrasound or MRI and destroying them with extreme cold
- Preliminary studies have shown significant reduction in fibroid volume and symptom improvement
- No suturing required
- Can result in severe adhesion formation
- Not recommended for women planning childbearing
- Experimental and limited experience

In conclusion

- Several non-surgical methods available
- UFE has the longest track-record
- MRgFUS is promising, but needs refinement and recognition by payers
- Other non-invasive options on the horizon, time will tell where they will fit into current landscape of treatment options

Thank you
References

- ACOG. Obstet Gynecol. 2004;103:94–95
- Pipirt et al. Obstet Gynecol. 2003;103:1–2
- ACOG. Obstet Gynecol. 2004;103:403–404
Single port myomectomy – surgical tips

Jon Ivar Einarsson MD MPH
Director of Minimally Invasive Gynecologic Surgery
Brigham and Women’s Hospital
Associate Professor
Harvard Medical School

Objectives

- Discuss the advent and current status of single port surgery in gynecology
- Describe further innovations such as hybrid NOTES procedures
- Discuss tips and tricks for performing single port myomectomy

Single incision surgery

- The current trend began in 2007 with the successful completion of a single incision cholecystectomy by Rao and Curcillo (two separate sites)
- Single incision surgery has been performed for years and was a common approach for a laparoscopic tubal ligation 20 years ago
- This time around, a lot of progress has been made in the field of endoscopy and surgeons and industry were looking for the next “new thing”
- Natural Orifice Trans-Endoluminal Surgery (NOTES) was proposed as the next new thing, but progress has been very slow in this field
  - Lack of instrumentation
  - Lack of interest from industry – focused on single port
  - Resistance among hospital staff and administrators
  - No reimbursement for “experimental procedures”

Many options

DISCLOSURE

I have the following financial relationships with a commercial entity producing health-care related products and/or services.

Consultant for Ethicon-Endosurgery

Single port demonstration
Single Incision Surgery

- **Benefits**
  - Better cosmetic outcome – maybe for some patients
  - Less pain - ??
  - Faster recovery - ??

- **Disadvantages/limitations**
  - Increased cost and disposable instruments
  - Triangulation is limited with traditional instruments
  - Challenging to perform suturing and fine dissection
  - Longer operative times for some procedures

Instrumentation

- **Instrumentation - optics**

Robotic single port surgery

- **Future of Single Incision Surgery**
  - May add value for certain procedures
  - Cholecystectomy
  - Adnexectomy
  - Hysterectomy? – Has been difficult to get gynecologists in USA and elsewhere to adopt this via multiport
  - Robotic surgery may enable more suture intense tasks to be performed through a single incision
  - If the only benefit of single incision surgery is cosmetic who should absorb the added cost?
  - The hospital?
  - The surgeon?
  - The patient?
  - Well designed prospective trials are urgently needed
  - Enthusiasm for single port surgery seems to be less now than a couple of years ago
### Single incision (n=35) vs Multiport (n=35)

<table>
<thead>
<tr>
<th></th>
<th>Single Incision</th>
<th>Multiport</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of surgery (min)</td>
<td>72.7</td>
<td>48.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pain score on POD #1</td>
<td>2.3</td>
<td>2.2</td>
<td>0.477</td>
</tr>
<tr>
<td>Return to work (days)</td>
<td>5.3</td>
<td>5.9</td>
<td>0.274</td>
</tr>
<tr>
<td>Cosmetic results 1 month post op</td>
<td>8.7</td>
<td>7.7</td>
<td>0.004</td>
</tr>
<tr>
<td>Cosmetic results 6 months post op</td>
<td>9.1</td>
<td>8.4</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Lee et al. British Journal of Surgery 2010;97:1007-12

### Single port hysterectomy RCT (LAVH)

<table>
<thead>
<tr>
<th></th>
<th>Single port (n=50)</th>
<th>Multiport (n=50)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR time (minutes)</td>
<td>122</td>
<td>127</td>
<td>0.44</td>
</tr>
<tr>
<td>Estimated blood loss (ml)</td>
<td>146</td>
<td>166</td>
<td>0.36</td>
</tr>
<tr>
<td>Pain score (24h)</td>
<td>3.64</td>
<td>5.08</td>
<td>0.01</td>
</tr>
<tr>
<td>Pain score (48h)</td>
<td>1.94</td>
<td>2.84</td>
<td>0.04</td>
</tr>
<tr>
<td>Cumulative Post op analgesics</td>
<td>74.4 mg</td>
<td>114.8</td>
<td>0.001</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>3.7</td>
<td>3.9</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Chen et al. Obstet Gynecol 2011;117(4):906-12

### Single port hysterectomy RCT (TLH)

- 68 patients randomized to TLH with single port vs multiport
- 4 cases of single port converted to multiport
- No statistically significant difference in pain scores
- Significantly higher total requests for analgesics in the single port group
  - 11.3 vs 7.7, p<0.001
  - Jung et al. Surg Endosc 2011 Feb 7

### Single incision hysterectomy

### How to morcellate?

### Single port myomectomy

Problems with single port surgery
- Optical access and operative access are meshed together
- Cramming 3-4 tubes through a small hole

Potential improvement
- Decouple the optical access from the operative access
- Optical access through the posterior cul-de-sac
- OASIS = Orifice Assisted Small Incision Surgery

Surgical tips
- Select your patients appropriately
  - Is this the right procedure for this patient?
- Consider OASIS – much easier suturing and triangulation
- Consider using barbed suture for myometrial closure
  - Growing data demonstrating safety and increased efficacy
- Use high volume vasopressin – we use 20 units in 400 ml saline and inject 200 ml
- Morcellate through the umbilicus

Conclusion
- The potential advantages and future role of single port surgery are uncertain at this time
- Single port myomectomy is a challenging procedure
- Using hybrid NOTES or OASIS may facilitate the performance of a small port myomectomy

References
- Lee et al. British Journal of Surgery 2010;97:1007-12
- Jung et al. Surg Endosc 2011 Feb 7
Techniques to minimize blood loss

Tommaso Falcone, M.D.
Professor & Chair
Cleveland Clinic

Financial Disclosure

➢ I have no financial relationships to disclose.

Learning Objectives

➢ List some general approaches to minimizing blood loss at a myomectomy procedure
➢ Discuss the role of vasopressin in minimizing blood loss
➢ Discuss the role of uterine artery ligation prior to myomectomy

Preoperative GnRH agonist

➢ Lethaby A, Vollenhoven B, Sowter MC
  • Preoperative GnRH analogue therapy before hysterectomy or myomectomy for uterine fibroids. Cochrane database 2011 CD 000547

Preoperative Treatment with GnRH agonists

➢ Agonist and iron treatment increases preoperative hemoglobin
➢ Doesn’t seem to improve blood loss at surgery
  • Campo et al Hum Reprod 1999
  • Fibroids 107 were intramural & 67 were subserosal; mean diameter 4.7 cm; blood loss about 200ml

Interventions to reduce hemorrhage during myomectomy

➢ Bupivacaine plus epinephrine vs. placebo - not clinically different
➢ Oxytocin no difference
➢ No data on normal saline alone
Cochrane review

- Misoprostol versus placebo
  - Significant reduction in blood loss; no effect on blood transfusion rate. 400mcg 1 hr before the procedure
- IV bolus of tranexamic acid
- Gelatin thrombin matrix (ex. FloSeal)
  - Significantly reduced blood loss at myomectomy and need for transfusion

Use with caution in these disease states

- Asthma:
- Cardiovascular disease
- Goiter: Use with caution in patients with a goiter with cardiac complications.
- Migraine
- Renal impairment
- Seizures
- Vascular disease

Vasopressin

- Cochrane review: Compared with placebo 2 trials - significant reduction in blood loss
- Antidiuretic Hormone Analog; Hormone, Posterior Pituitary
  - Approved for central diabetes insipidus
  - Pitressin®: 20 units/mL (1 mL)
  - Half-life elimination: Nasal: 15 minutes; Parenteral: 10-20 minutes
  - I.V. infiltration: May lead to severe vasoconstriction and localized tissue necrosis.
  - Water intoxication

Vasopressin dose - different surgeon recommendations from the Listserv

- Inject into the myometrium surrounding fibroid or the pseudocapsule area
- 1 amp- 20 units in 500 cc-use 30-50mL
- 10 units in 100ml of saline (use 400mL)
- 20 units in 400 ml and inject 100-150 mL
- 200 units in 100ml
- 20 units in 50 ml

Vasopressin

- Glasser MH Minilaparotomy myomectomy JMIG 2005
- Ten mL of a dilute vasopressin solution (six units in 60 mL NaCl) is then injected intracervically about 1 to 2 cm deep at both the 8 o’clock and 4 o’clock positions.
Use of barbed suture

- Alessandri et al JMIG 2010- reduced blood loss (drop of hgb of 0.6 versus 0.9; no blood transfusion)
- Einarsson et al showed no difference in blood loss

Cochrane review

- Pericervical tourniquet
- 2 trials showed significant reduction in blood loss and need for blood transfusion

Laparoscopic bulldog clamps

Yasargil-type Temporary Occlusion Clamps- Aesculap

Uterine Artery Ligation

- Bae JH et al F&S 2011- no difference in blood loss w/without ligation
- Lubin Liu et al F&S 2011- less blood loss with temporary occlusion of the uterine artery

Other observations

- Perioperative cell salvage
- Improper plane of dissection
- Multiple uterine incisions
References

Abdominal Myomectomy: Minimally Invasive Alternative to Hysterectomy for Large Fibroids?

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Objectives

Participants will be able to:

• Assess the impact of leiomyomata on patients
• Compare advantages / disadvantages of myomectomy and hysterectomy for fibroids
• Counsel patients knowledgeably regarding surgical options for fibroids

Leiomyomata Background

• Affects approximately 33% of women
  • Age and race variables up to 75%
• Accounts for appx 30% of hysterectomies

Hospital Discharges 1979-2001

- 6,091,700 hysterectomies
  • Ave age: 45.2
  • Rate 1979: 2.4/1000
  • Rate 2001: 2.3/1000
  • African Am: 3.3/1000
  • Caucasian: 1.8/1000
  • Hysterectomy 12x more common than myomectomy
  • Hysterectomy rate stable; myomectomy rate doubled
  • No differences in morbidity with respect procedure or race

- 500,000 myomectomies
  • Ave age: 35.6
  • Rate 1979: 0.11/1000
  • Rate 2001: 0.21/1000
  • African Am: 0.4/1000
  • Caucasian: 0.1/1000

Why Myomectomy?

★ Pain
  • Dysmenorrhea, dyspareunia, abdomino-pelvic pain
★ Bleeding
  • Amount, duration, anemia
★ Infertility
  • Submucous vs intramural fibroids
★ Mass effect
  • Compression of bladder, bowel, ureter, stomach, etc.
  • Rapidly growing leiomyoma

Disclosure

I have no financial relationships to disclose.
Leiomyosarcoma

- Not from "malignant degeneration" of myomata
- Distinct genetic origin
- Incidence between 0.13-0.29% of leiomyomata
- Less than 0.26% of rapidly growing fibroids


Leiomyosarcoma

- Rapid uterine growth in premenopausal women
- Almost never associated with leiomyosarcoma
- Rapid uterine growth in postmenopausal women
- Often associated with pain and bleeding
- Increased level of LDH isoenzyme 3
- Increased uptake of gadolinium on MRI (40-60 seconds)
- Approaches 100% diagnostic accuracy


Impact on Fertility

- 75 myomectomy patients
  - No other cause of infertility
  - Uterus at least twice normal size or submucous fibroid
  - At least two years follow-up
- 37 patients conceived – 49.3%

Age of Patients (Years) | Total Number of Patients
--- | ---
21-25 | 2
26-30 | 31
31-35 | 12
36-40 | 5
41-45 | 10
Total | 75

"...decision regarding operation on patients in their 40’s should depend upon how strongly the patient feels about childbearing."

"...for some of those who never conceive, it is important to have been able to try"


Impact on Fertility

- Fibroids that distort cavity impact fertility
  - Decrease pregnancy rate by 70% (RR 0.32; CI 0.10-0.70)
  - No evidence for intramural or subserosal impact
  - Assess fertility potential aside from fibroids
  - Possible increased risk
    - myoma degeneration and pain
    - Spontaneous abortion, premature labor and delivery
    - abnormal fetal lie, dysfunctional labor patterns
    - placental abruption, need for operative intervention
    - postpartum hemorrhage


Laparoscopic vs Abdominal

- Guidelines for laparoscopic myomectomy
  - <16 weeks uterus or, 1 or 2 fibroids, < 8 cm
  - No difference with respect to fertility outcome
- Laparoscopic
  - Less pain, shorter hospitalization, shorter recovery
  - Longer operative time, more blood loss


Comparative Morbidity

- Retrospective cohort study, 3 year interval
  - 197 hysterectomies, 197 myomectomies
  - Primary outcome – perioperative morbidity
    - 40% in hysterectomy, 39% in myomectomy
  - Secondary outcomes
    - Fever morbidity, hemorrhage
    - Unintended major procedures, rehospitalization
    - Life threatening events

Comparative Morbidity

Myomectomy patients younger, weighed less, smaller uterine size
- Crude morbidity odds ratio for myomectomy 0.93 (0.63 – 1.40) ns
- Adjusted odds ratio for myomectomy 1.46 (0.77 – 2.77) ns

Comparative Morbidity

- Hysterectomy group: more blood loss, 13% complications
  - 2 cystotomy, 1 uterinal injury, 3 bowel injuries, 8 cases of loss, 6 pelvic abscesses
- Myomectomy Group: 5% complications
  - 3 cystotomy, 2 reparations for perforation, 6 cases of loss

Preoperative Preparation

- GnRH analogs prior to myomectomy
  - 3 months therapy, reversible in 3 months
  - Decreased blood flow and decreased arterial size
  - Alterations in the extracellular matrix of the myoma
  - Necrosis, especially in submucosal myomas.
- GnRH analogs prior to hysterectomy
  - 3 months therapy, reversible in 3 months
  - Smaller uterus, less blood loss
  - Increased likelihood of transverse incision or vaginal hysterectomy

Intraoperative Management

- Vasopressin (20 units in 50-100 cc saline)
  - Inject into serosa or pseudocapsule
- Penrose tourniquet at uterine base
  - Through windows in broad ligament
- Conflicting studies on superiority
  - Reperfusion issues
  - Trapped blood issues

Women’s Attitudes

- 18 women, age 31-49, 14 Caucasian, 4 African American
- All had uterine fibroids
- Hysterectomy (10) or myomectomy (8)
  - All with college degree, all but 1 advanced degree
  - Sample distributed across 12 states
  - 17/18 proactive in researching information
    - Books, internet, friends
    - Given pamphlets by gynecologist; invited to ask questions
    - Did not know what questions to ask


Minimally Invasive Gynecologic Surgery

Women’s Attitudes

- 7/8 women with myomectomy “shopped around”
  - Did not necessarily believe doctors’ opinions were correct
  - Willing to go out of state to get “right doctor”
- Women with hysterectomy more trusting
  - 6/10 had procedure with their “usual gynecologist”
- Decisions influenced by varied factors
  - Attitude toward body, opinion / experience of friends or family or partner, internet research, attitude toward doctors, relationship with doctor
- No differences with respect to gender of GYN

Myomectomy Surgical Counseling

- Focus on expectations of patient
- Risk of new fibroid growth (up to 30%)  
- Growth of fibroid too small to detect
- Conversion to hysterectomy for complications
- Discuss all alternatives
  - Data suggest patient hear less than we think

Decision Making

- First decide IF, then decide HOW
- Exactly what is “minimally invasive”?
- Abdominal myomectomy vs hysterectomy
  - Also consider
    - vs laparoscopic myomectomy
    - vs laparoscopic hysterectomy
    - vs embolization

References

CULTURAL AND LINGUISTIC COMPETENCY

Governor Arnold Schwarzenegger signed into law AB 1195 (eff. 7/1/06) requiring local CME providers, such as the AAGL, to assist in enhancing the cultural and linguistic competency of California's physicians (researchers and doctors without patient contact are exempt). This mandate follows the federal Civil Rights Act of 1964, Executive Order 13166 (2000) and the Dymally-Alatorre Bilingual Services Act (1973), all of which recognize, as confirmed by the US Census Bureau, that substantial numbers of patients possess limited English proficiency (LEP).

California Business & Professions Code §2190.1(c)(3) requires a review and explanation of the laws identified above so as to fulfill AAGL's obligations pursuant to California law. Additional guidance is provided by the Institute for Medical Quality at http://www.imq.org

Title VI of the Civil Rights Act of 1964 prohibits recipients of federal financial assistance from discriminating against or otherwise excluding individuals on the basis of race, color, or national origin in any of their activities. In 1974, the US Supreme Court recognized LEP individuals as potential victims of national origin discrimination. In all situations, federal agencies are required to assess the number or proportion of LEP individuals in the eligible service population, the frequency with which they come into contact with the program, the importance of the services, and the resources available to the recipient, including the mix of oral and written language services. Additional details may be found in the Department of Justice Policy Guidance Document: Enforcement of Title VI of the Civil Rights Act of 1964 http://www.usdoj.gov/crt/cor/pubs.htm.

Executive Order 13166, "Improving Access to Services for Persons with Limited English Proficiency", signed by the President on August 11, 2000 http://www.usdoj.gov/crt/cor/13166.htm was the genesis of the Guidance Document mentioned above. The Executive Order requires all federal agencies, including those which provide federal financial assistance, to examine the services they provide, identify any need for services to LEP individuals, and develop and implement a system to provide those services so LEP persons can have meaningful access.

Dymally-Alatorre Bilingual Services Act (California Government Code §7290 et seq.) requires every California state agency which either provides information to, or has contact with, the public to provide bilingual interpreters as well as translated materials explaining those services whenever the local agency serves LEP members of a group whose numbers exceed 5% of the general population.

If you add staff to assist with LEP patients, confirm their translation skills, not just their language skills. A 2007 Northern California study from Sutter Health confirmed that being bilingual does not guarantee competence as a medical interpreter. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2078538.