CANCER ARISING FROM ENDOMETRIOSIS: CLINICAL IMPLICATIONS

Farr R. Nezhat, MD, FACOG, FACS
Professor, Department of Obstetrics, Gynecology & Reproductive Science
Icahn School of Medicine at Mount Sinai
Director, Division of Minimally Invasive Gynecologic Surgery & Robotics
Department of Obstetrics & Gynecology, Division of Gynecologic Oncology
Mount Sinai St. Luke’s and Roosevelt
Adjunct Professor, Department of Obstetrics, Gynecology & Reproductive Medicine
State University of New York at Stony Brook, School of Medicine
Director, Division of Minimally Invasive Gynecologic Surgery
Department of Obstetrics & Gynecology
Winthrop University Hospital

New York, NY


The patient is a 29yo P0 who was found to have a left 2.6x3.6cm ovarian cyst (dermoid vs endometrima) during her evaluation for infertility for one year.

Ob/Gyn History: Para 0, regular mestural cycles, mild dysmenorrhea. Not obese or overweight. Denies any STDs or pelvic infections.

No Past Medical or Surgical
She had laparoscopy, left ovarian cystectomy for a presumed dermoid cyst, and dilation and curettage.

Laparoscopy: Pelvic endometriosis.

Pathology

- Left Ovarian Cyst: Well-differentiated endometrioid adenocarcinoma

- Endometrial Curettages: Proliferative Endometrium, polypoid fragments of endometrium with complex endometrial hyperplasia with marked atypia
After consulted with Gyn Oncologist and Neg. Metastatic W/U

Laparoscopic Robotic assisted surgical staging followed by chemotherapy, Taxol & Carb.

Successful Spontaneous pregnancy x 2

NED X4 Years.
Objectives

- Overview of endometriosis and ovarian cancer
  - Pathogenesis of malignant transformation of endometriosis
- Clinical applications
- Future investigation
The malignant transformation of endometriosis was first suggested by Sampson in 1925.

Ovarian Cancer in Women with Endometriosis

- Epidemiological, histological and molecular studies suggested a link between endometriosis and invasive epithelial ovarian cancer, based on frequent co-occurrence in surgical specimens, particularly the histological subgroups endometrioid and clear cell ovarian carcinoma.


Overview of endometriosis and ovarian cancer

Figure 1. Gross features of endometrioid adenocarcinoma associated with endometriosis of the ovary. A unilocular cyst contain inner nodules (carcinoma) is seen. The inner flat areas are also recognized (endometriosis).

Figure 4. Atypical endometriosis (left) is seen near the inner endometrioid adenocarcinoma cells. HE, x100.
## Relative Risk of Ovarian Cancer in Women with Endometriosis

<table>
<thead>
<tr>
<th>Subtype</th>
<th>Crude OR (95% CI)</th>
<th>p value</th>
<th>Stratified only OR (95% CI)*</th>
<th>p value</th>
<th>Stratified and adjusted OR (95% CI)†</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invasive Clear-cell</td>
<td>1.49 (1.34–1.65)</td>
<td>&lt;0.0001</td>
<td>1.53 (1.37–1.70)</td>
<td>&lt;0.0001</td>
<td>1.46 (1.31–1.63)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Clear-cell</td>
<td>3.73 (3.04–4.58)</td>
<td>&lt;0.0001</td>
<td>3.44 (2.78–4.27)</td>
<td>&lt;0.0001</td>
<td>3.05 (2.43–3.84)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Endometrioid</td>
<td>2.32 (1.94–2.78)</td>
<td>&lt;0.0001</td>
<td>2.20 (1.82–2.66)</td>
<td>&lt;0.0001</td>
<td>2.04 (1.67–2.48)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mucinous</td>
<td>1.09 (0.76–1.58)</td>
<td>0.63</td>
<td>1.04 (0.71–1.51)</td>
<td>0.86</td>
<td>1.02 (0.69–1.50)</td>
<td>0.93</td>
</tr>
<tr>
<td>High-grade</td>
<td>1.11 (0.96–1.29)</td>
<td>0.16</td>
<td>1.16 (1.00–1.35)</td>
<td>0.056</td>
<td>1.13 (0.97–1.32)</td>
<td>0.13</td>
</tr>
<tr>
<td>Low-grade</td>
<td>2.02 (1.38–2.97)</td>
<td>&lt;0.0001</td>
<td>2.22 (1.48–3.31)</td>
<td>&lt;0.0001</td>
<td>2.11 (1.39–3.20)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td><strong>Serous</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borderline</td>
<td>1.26 (1.05–1.50)</td>
<td>0.012</td>
<td>1.19 (0.99–1.43)</td>
<td>0.062</td>
<td>1.12 (0.93–1.35)</td>
<td>0.24</td>
</tr>
<tr>
<td>Mucinous</td>
<td>1.27 (0.97–1.67)</td>
<td>0.078</td>
<td>1.19 (0.90–1.57)</td>
<td>0.23</td>
<td>1.12 (0.84–1.48)</td>
<td>0.45</td>
</tr>
<tr>
<td>Serous</td>
<td>1.31 (1.05–1.63)</td>
<td>0.015</td>
<td>1.28 (1.02–1.61)</td>
<td>0.034</td>
<td>1.20 (0.95–1.52)</td>
<td>0.12</td>
</tr>
</tbody>
</table>

OR—odds ratio. *Stratified by age (5 year categories), ethnic origin (non-Hispanic white, Hispanic white, black, Asian, and other). †Stratified by age (5 year categories), ethnic origin (non-Hispanic white, Hispanic white, black, Asian, and other), and adjusted for duration of oral contraceptive use (never, <2 years, 2–4.99 years, 5–9.99 years, ≥10 years), and parity (0, 1, 2, 3, ≥4 children).

**Table 3**: Association between history of endometriosis and the histological subtypes of ovarian cancer

There is a recognized association between endometriosis and clear cell, low-grade serous and endometrioid ovarian cancer, but the overall risk of ovarian cancer amongst women with endometriosis remains low, with a relative risk ranging from 1.3 to 1.9, which means that at worst the life-time risk of ovarian cancer is increased from ~1 in 100 to 2 in 100.

Johnson & Hummelshoj, for the WES Montpellier Consortium, *Hum Reprod* 2013
Objectives

- Overview of endometriosis and ovarian cancer
- Pathogenesis of malignant transformation of endometriosis
- Clinical applications
- Future investigation
Features shared by endometriosis and cancer

Pollaco et al. *Gynecological Endocrinology*, 2012
DOI: 10.3109/09513590.2011.650761
Clinical Applications
Clinical Applications

- **Ovarian cancer**
  - 2\textsuperscript{nd} most common gynecologic malignancy in developed countries

- **in the U.S.**
  - 22,000 new cases
  - 14,000 cancer-related deaths expected from ovarian cancer in 2013

- **lifetime risk is 1:70 and the average age at diagnosis of ovarian cancer in the US is 63 years old**

30% diagnosed at Stage I-II. Better prognosis

However 50% ovarian cancers diagnosed early stage need another surgery (unexpected diagnosis) and most are Endometrioid and Clear cell carcinoma

>60% diagnosed in advanced stages (majority are High Grade Serous). Poor prognosis
STAGE I OVARIAN CARCINOMA: DIFFERENT CLINICAL PATHOLOGIC PATTERNS

76 PATIENTS WITH STAGE I OVARIAN CARCINOMA UNDERWENT SURGICAL STAGING AND CYTOREDUCTION

Fertil Steril 2007;88(4):906-10
<table>
<thead>
<tr>
<th>Clinical Features</th>
<th>Ovarian Serous Papillary CA (n=22)</th>
<th>Ovarian Endometrioid CA (n=40)</th>
<th>Ovarian Clear Cell CA (n=10)</th>
<th>Mixed endometrioid/clear cell CA (n=4)</th>
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</thead>
<tbody>
<tr>
<td>Average age</td>
<td>61.05</td>
<td>52.9</td>
<td>58.6</td>
<td>52.2</td>
</tr>
<tr>
<td>Asymptomatic pelvic mass</td>
<td>13</td>
<td>3</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Symptomatic pelvic mass</td>
<td>2</td>
<td>19</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Abnormal Vaginal bleeding</td>
<td>1</td>
<td>19</td>
<td>1</td>
<td>99</td>
</tr>
<tr>
<td>H/o breast CA</td>
<td>8</td>
<td>--</td>
<td>1</td>
<td>--</td>
</tr>
<tr>
<td>BRCA mutations, tested</td>
<td>4</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Ascites</td>
<td>2</td>
<td>--</td>
<td>1</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pathology</th>
<th>Serous Papillary n (%)</th>
<th>Endometrioid n (%)</th>
<th>Clear cell n (%)</th>
<th>Mixed endometrioid and clear cell n (%)</th>
<th>Total n (%)</th>
<th>P value</th>
<th>RR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>22 (30)</td>
<td>40 (53)</td>
<td>10 (13)</td>
<td>4 (5)</td>
<td>76 (100)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bilateral ovarian tumors</td>
<td>11 (14)</td>
<td>3 (4)</td>
<td>1 (1.3)</td>
<td>1 (1.3)</td>
<td>16 (21)</td>
<td>0.00027</td>
<td>0.27</td>
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<tr>
<td>Ovarian endometriotic cyst</td>
<td>1 (1.3)</td>
<td>29 (38)</td>
<td>7 (9)</td>
<td>3 (4)</td>
<td>40 (53)</td>
<td>0.0000001</td>
<td>23.33</td>
</tr>
<tr>
<td>Pelvic endometriosis</td>
<td>1 (1.3)</td>
<td>14 (18)</td>
<td>1 (1.3)</td>
<td>1 (1.3)</td>
<td>17 (22)</td>
<td>0.038</td>
<td>6.05</td>
</tr>
<tr>
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<td>Serous Papillary n (%)</td>
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<td>Clear cell n (%)</td>
<td>Mixed endometrioid and clear cell n (%)</td>
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<td>P value</td>
<td>RR</td>
</tr>
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<tr>
<td>Endometrial carcinoma</td>
<td>1 (1.3)</td>
<td>17 (22)</td>
<td>1 (1.3)</td>
<td>--</td>
<td>19 (25)</td>
<td>0.0086</td>
<td>7.0</td>
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<tr>
<td>Endometrial polyp / Hyperplasia</td>
<td>3 (4)</td>
<td>11 (14)</td>
<td>2 (3)</td>
<td>2 (3)</td>
<td>16 (21)</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>4 (5.3)</td>
<td>28 (36)</td>
<td>3 (4.3)</td>
<td>2 (3)</td>
<td>16 (21)</td>
<td></td>
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</tr>
</tbody>
</table>
Results

- **Nonserous ovarian** carcinomas comprised over 2/3 of the stage I ovarian carcinomas

- Most patients with **serous** carcinoma presented with **asymptomatic** pelvic masses

- Nonserous carcinomas presented with **pelvic pain**, **abnormal vaginal bleeding**, with or without a **pelvic mass**

- **Endometrial abnormalities 36%**

- (Hyperplasia and carcinoma)
Recent studies suggest EOC can be divided into two groups based on shared genetic mutations and observed progression from a precursor lesion

- **Type 1**
  Low-grade serous, endometrioid, and clear cell carcinomas present at an earlier stage. These are more indolent, are associated with PTEN, BCL2 and/or ARID1A mutation, and likely arise from endometriosis.

- **Type 2**:
  - High grade serous CA, usually present in advanced stage
  - Commonly show p53 mutations
  - Usually **not** associated with adjacent borderline serous tumors, and likely arise from tubal epithelium


What Screening, Diagnostic and Preventive Opportunities are Available to Practitioners for Women with Endometriosis?

- Screening for genetic mutations in ovarian cancer is just the beginning, and an emerging concept of a dual model of ovarian carcinogenesis divides ovarian carcinomas into two groups.

- High-grade serous carcinomas tend to present at an advanced stage, are associated with TP53 mutations, and likely arise from tubal epithelium.

- Low-grade serous, endometrioid, and clear cell carcinomas present at an earlier stage. These are more indolent, are associated with PTEN, BCL2 and/or ARID1A mutation, and likely arise from endometriosis.

- Currently however, there is not sufficient data to recommend mutation screening tests in patients with endometriosis.


What Screening, diagnostic and Preventive Opportunities are Available to Practitioners for Women with Endometriosis?

**Pelvic U/S**

- useful in the identification of ovarian endometrioma with homogeneous hypoechogenic cystic features and those with mural malignant changes

- difficult to detect relatively small endocystic echogenic components with this modality

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Endometrioma with diffuse, homogenous hypoechogenic features

Endometrioma with mural malignant features
What Screening and Diagnostic Opportunities are Available to Practitioners for Women with Endometriosis?

- **MRI**
  - more useful to both visualize endometriomas and possibly detect malignant transformation
  - hyperdense mural nodules within the ovary and rapid growth of an endometrioma can be visualized on MRI – associated with malignant transformation
  - In a cohort study comparing MRI findings of 10 patients with ovarian adenocarcinoma to 10 patients with benign endometriomas, Tanaka and colleagues found mural nodules in all 10 malignancies but in only 3 of the benign cases

What Preventative Measures can be Offered to Women with Endometriosis?
Endometriomas Classifications

- A Clinical and histologic classification of endometriomas
Nezhat Classification

Type 1

Primary endometrioma

- Same origin as peritoneal endometriosis
- Difficult to remove due to fibrosis
- Removed in pieces
Nezhat Classification

Type II:
Secondary endometrioma
- Follicular or luteal cyst invaded by cortical endometriosis
Nezhat Classification

- IIA: superficial endometriosis implants without penetration of cyst, thus cyst easily separable from cortex
Nezhat Classification

- IIB: endometriosis area deeper, cyst wall adherent to cortex
Nezhat Classification

- IIC: endometriosis is deep invading cyst and cyst wall, difficult separation between cortex and cyst
What Preventative Measures can be Offered to Endometrioma?

- Most endometriomas are composed of endometrial implants, which invade a functional cyst
- Hormonal therapy
  - hormonal therapy alone however often fails to cause total regression of endometriomas, and is most effective following thorough surgical excision of endometriomas and associated endometriosis.
  - a review of the literature by Vercellini and colleagues comparing diligent post-operative oral contraceptive versus sporadic use demonstrated a pooled odds ratio of 0.21 (95% CI 0.11-0.40) for ovarian endometrioma recurrence
  - Koga et al presented similar findings, with GnRH agonists, OCPs, levonorgestrel IUD, and pregnancy


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What Preventative Measures can be Offered to Women with Endometriosis?

When endometriosis is diagnosed, surgical resection remains the most effective treatment.
Tubal ligation

- 38% ↓ Endometrioid carcinoma
- 52% ↓ Clear cell carcinoma
- 19% ↓ High-grade serous carcinoma
“For women at population risk (average) for ovarian cancer, salpingectomy should be considered (after completion of childbearing) at the time of hysterectomy, in lieu of tubal ligation, and also at the time of other pelvic surgery”
220 cases and 416 controls entered the study

Information on hormonal and surgical treatments, and other reproductive factors was extracted from medical records according to pre-specified protocols
Hormonal and surgical treatments for endometriosis and risk of epithelial ovarian cancer

ANNA-SOFIA MELIN\textsuperscript{1,2}, CECILIA LUNDHOLM\textsuperscript{1}, NINOA MALKI\textsuperscript{1}, MARJA-LIISA SWAHN\textsuperscript{2}, PÄR SPARÈN\textsuperscript{1} & AGNETA BERGQVIST\textsuperscript{1,3}

\textsuperscript{1}Department of Medical Epidemiology and Biostatistics, Karolinska Institute, Stockholm, \textsuperscript{2}Department of Obstetrics and Gynecology, Karolinska University Hospital, Huddinge, and \textsuperscript{3}Department of Clinical Science and Education, Södersjukhuset, Karolinska Institute, Stockholm, Sweden

Strong reduction in risk of epithelial ovarian CA:

- One-sided oophorectomy, multivarian analysis (OR 0.19, 95\%CI 0.28-0.62)
- Complete extirpation of endometriotic tissue (OR 0.30, 95\%CI 0.25-0.55)
There is now an unprecedented opportunity to develop a comprehensive plan for screening women with endometriosis for early detection and prevention of specific types of ovarian cancer.
Ovarian Cancer

- **Lifetime risk (general population):** 1.4 %
- **BRCA 1 mutation carrier:** 60 %
  - BRCA 2 mutation carrier: 30%
  - HNPCC 10%
  - **Endometriosis** 2-3%

King MC, Marks JH, Mandell JB. Breast and ovarian cancer risks due to inherited mutations in BRCA1 and BRCA2. Science. 2003;88:S11-S3
Both, the gynecologist and the general practitioner should pay special attention to patients with endometriosis and the following history:

- Long-standing endometriosis
- Endometriosis diagnosed at an early age
- Endometriosis associated with infertility and/or history of infertility treatment
- Patients with ovarian endometriomas
How should we approach treatment options for women with endometriosis who are determined to be at an increased risk for ovarian cancer?

- Identification of all women with endometriosis, either surgically documented or self-reported by symptoms

- Hormonal treatment aimed at reducing the risk of recurrent endometriosis and endometriomas

- Careful follow up of ovarian endometriomas with imaging studies, particularly MRI when Us is suspicious, to detect any characteristics changes such as mural formation

- Fertility preservation; embryo, egg and tissue freezing should be considered.
How should we approach treatment options for women with endometriosis who are determined to be at an increased risk for ovarian cancer?

- **Treatment planning:**
  - Complete surgical resection of all endometriotic foci in women undergoing surgical treatment, with tissue evaluation of ovarian endometriomas to rule out malignancy.
  - Oophorectomy and salpingectomy should be individualized based on the patient's risk and desires.
Future Studies

- Further research is needed to understand the genomic and immunologic pathways of endometriosis
  It may be accomplished by larger studies with direct evaluation of endometriosis tissue
The Roosevelt Hotel  New York, New York

For more information, please visit:
Thank you