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# Oophorectomy

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## Introduction

Oophorectomy is the surgical removal of the ovary and can be unilateral or bilateral. Hysterectomy is the most common major gynecologic surgery, but salpingo-oophorectomy remains a frequent concomitant surgery.[1] Surgery for ovarian pathology alone is still often encountered in females of all ages. While surgical removal of one ovary does not grossly affect the hormonal milieu of a patient, bilateral oophorectomy will render a patient infertile and menopausal with ensuing physiologic changes and risks. Forward-thinking discussions should be held with the patient before undertaking an oophorectomy.

## Anatomy and Physiology

### Anatomy

The ovaries are the female gonads that are responsible for the production of the majority of a female's sex hormones as well as ovulation. In the infant and young child, ovaries are located intra-abdominally (around T 10) and are less than 2 cc.[2][3] As a female develops through adolescents, the ovaries descend below the pelvic brim and enlarge to approximately 10cc on average.[3] In the postmenopausal female, ovaries remain in the same adult location; however, radiographically, they are similar to the premenarchal ovary.

### Blood Supply

Blood supply is primarily through the ovarian artery, which runs through the infundibulopelvic ligament (i.e., IP ligament or suspensory ligament of the ovary); however, there are anastomoses with the ovarian branch of the uterine artery through the utero-ovarian ligament.[1] The ovarian artery is a branch directly off the aorta. The right ovarian vein will drain directly into the aorta; however, the left ovarian vein will drain to the left renal vein.[1] It should be noted that the IP ligament is in close proximity to the ureter, fallopian tube, and iliac vessels, and care must be taken to avoid injury to these structures during the steps of an oophorectomy.

### Lymphatics

There are three lymphatic drainage pathways for the ovary. The two most common routes are through the IP ligament to the paraaortic lymph nodes and through the ovarian ligament to the pelvic lymph nodes (internal iliac lymph nodes, external iliac lymph nodes, and obturator nodes).[4] A less common, albeit described, drainage is through the round ligament to the inguinal nodes.[4]

### Histology

Histologically, ovaries have a medulla, cortex, and mesothelium. The inner medulla is comprised of ovarian stroma with an array of spindle-shaped fibroblast-derived cells and their collagen matrix, as well as other active cell lines, including smooth muscle cells and luteinized stromal cells.[3] Together, this forms a reticular matrix that admixes with the cortex, interlacing with the follicles. The cortex contains hormonally active cells and a reservoir of

primordial follicles. The follicles are formed in utero, and, over time, these follicles undergo atresia or mature to ovulation. A follicle is made up of a primary oocyte surrounded by a concentric network of hormonally active cells mediated by positive and negative feedback systems. The outermost layer of the ovary, the mesothelium, is comprised of a single layer of flat to cuboidal to columnar epithelium.[3] Cancer of the surface epithelium is the most common ovarian cancer in women over age 20, but neoplasms can occur in any cell line.[3]

## Indications

### Adnexal Masses

Adnexal mass management depends on age, the evolution of mass, radiographic characteristics, tumor markers, disease process, and symptomatology.[5] If there is a concern for ovarian malignancy in an adult, gynecologic oncology should be consulted for treatment planning.[5] Management of suspected ovarian malignancies in the pediatric and adolescent population is managed by a multidisciplinary team. Regardless of the patient's age, when performing an oophorectomy for suspected, care should be taken to avoid intra-abdominal rupture and spillage of the mass.[5]

Simple cysts can be expectantly managed if asymptomatic up to 10 cm in the adult, but carry a risk of torsion.[5] Asymptomatic complex masses that are suspected teratomas and endometriomas can be expectantly managed with serial imaging, as well, but may end up eventually needing surgery.[6]

Ovarian cystectomy and/or oophorectomy can be performed during pregnancy (optimally in the second trimester) if there is a concern for malignancy, high torsion risk, or symptomatic.

When benign pathology is suspected, and an ovarian cystectomy is planned, there remains an inherent risk of an oophorectomy if ovarian stroma is denuded, the mass cannot be fully excised, or bleeding cannot be controlled.

### Torsion

If there is a concern for ovarian torsion, timely surgical intervention with detorsion and possible cystectomy is indicated. This preserves ovarian function and, thus, fertility. Oophorectomy should only be considered if the ovary is severely necrotic and friable.[7]

### Infection

Oophorectomy for pelvic inflammatory disease with tubo-ovarian abscesses (TOA) is rarely indicated. Antibiotics are the first-line treatment. Depending on the response to antibiotics and the size of TOA, drainage of the fluid can be considered.[5]

### Elective

Elective bilateral salpingo-oophorectomy (BSO) refers to the removal of both fallopian tubes and ovaries without specific indication, but rather at the time of a hysterectomy due to surgical nature and ease. This should be discussed with a patient in the pre-operative planning phase, and the risk of surgical menopause should not be taken lightly. A BSO for benign disease is associated with an increase in all-cause mortality if performed under 65 years of age.[8]

### Risk-Reducing

A risk-reducing BSO (however could be unilateral) refers to the removal of both fallopian tubes and ovaries to reduce the risk of re-operation or cancer. Risks of re-operation compared to risks of menopause should be discussed in patients with a history of pelvic inflammatory disease, TOAs, endometriosis, pelvic adhesions, or primary dysmenorrhea.[1] Other candidates for risk-reducing BSO include those with hereditary syndromes (such as BRCA mutations) that carry a substantially increased lifetime risk of ovarian malignancy or hormone-sensitive breast cancers.[1]

### Fertility Preservation

Oophorectomy for ovarian tissue cryopreservation is still considered experimental for fertility preservation, but this field is rapidly evolving. Since 2004, this process has achieved more than 100 live births.[9][10]

## Contraindications

There are no absolute contraindications to an oophorectomy, however since the ovaries provide beneficial hormones and fertility to a patient, oophorectomy (especially bilateral) risks versus benefits should be thoroughly discussed with the patient first. The effects of estrogens are complex, broad, and still being elucidated, but seem to play a prominent role in cardiovascular, bone, and psychosocial health.[11]

According to the Nurses' Health Study, BSO compared to ovarian conservation at the time of hysterectomy for benign pathology carries a decreased risk of breast and ovarian cancer, but it incurs an increased risk of all-cause mortality. [8] There is also an increased risk of fatal and non-fatal coronary heart disease and lung cancer without any increased survival.[8]

Specifically, in the pediatric and adolescent patient population with benign ovarian lesions, efforts should be made for ovarian sparing surgery.[12] In cases of torsion in the young patient, the goal is timely surgical management with detorsion and possible cystectomy.[7] Oophorectomy should only be considered if unavoidable.[7]

## Equipment

- Laparoscopic monitor
- Laparoscope (5/10 mm, 0/30 degrees)
- Carbon dioxide source/tubing for insufflation
- Two 5 mm trocars
- One 5 mm to 12 mm trocar (umbilical, larger if needing to remove adnexal mass)
- Atraumatic graspers
- Electrocautery/ligation device
- Endoscopic retrieval bag
- Scalpel (11/15 blade)
- Forceps
- Needle driver
- Absorbable sutures
- Incision dressing of choice

## Personnel

- Operating surgeon
- Surgical assist
- Scrub tech or scrub nurse

## Preparation

- Medically optimized

- No pre-operative antibiotics are indicated unless other indicated procedures are performed or if an infection is suspected
- Grounding pad
- Consider the need for Foley catheter placement
- Proper positioning and cushioning to avoid nerve injury
- Consider the utility of anti-slip pad underneath the patient
- Sequential compression devices of the lower extremities if meeting institutional criteria as well as deep venous thrombosis prophylaxis
- Aseptic surgical field

## Technique

Laparoscopic approaches should be considered for oophorectomies unless there is a concern for malignancy or otherwise indicating an open approach.

### Positioning

Consider the need for vaginal access. If needing access to the perineum or vagina for support, then the patient should be placed in the modified lithotomy position with care to avoid injury. Otherwise, adnexal surgery can be performed in the supine position. Depending on the length of the case, age of the patient, and size of the mass, consider placing a Foley/urinary catheter for bladder drainage.

### Entry and Setup

Entry to the abdomen is traditionally through the umbilicus; however, if there are concerns for adhesions, abnormal anatomy, or size of the adnexal mass, other locations such as Palmer's point are an option. Once intra-abdominal, accessory trocars should be strategically placed to both optimize the economy of motion during surgery and avoid injury. Anatomy of the anterior abdominal wall should be reviewed to avoid vessel (namely the inferior epigastric artery) and nerve injury with trocars or an open incision. The patient is then usually placed in the Trendelenburg position to give better exposure to the pelvic viscera.

### Surgical Steps

Traditionally, a right oophorectomy will be easier than a left oophorectomy due to the sigmoid colon. There are a few approaches oophorectomy, and none have shown to be superior. In one method, the IP ligament (with the ovarian artery) and the ureter are first identified. Then, an incision is made on the peritoneal surface (using either electrocautery or sharply) parallel to the IP between the ureter and IP. This retroperitoneal space is then dissected to increase the distance between the ureter and IP ligament. Once the IP is isolated from the ureter, it can be ligated.[1] The mesovarium is then serially ligated to the level of the utero-ovarian ligament, which is then ligated as well. Once the ovary is free, it can be removed in a specimen bag or through a port site if feasible. Of note, this dissection does not include the removal of the fallopian tube. Alternatively, the adnexa can be elevated, and if the ureter can be seen retroperitoneally and out of the operative space, the IP can be ligated without retroperitoneal dissection.[1] Dissection would continue as described above. Lastly, if ergonomically sensible, oophorectomy could begin at ligation of the utero-ovarian ligament, followed by serial ligation of the mesovarium, and end with ligation of the IP ligament.

### Special Considerations

If performing a risk-reducing oophorectomy, it is important to ligate the IP ligament 2cm proximal to the ovarian hilum to ensure no pathology is left behind. This tissue should undergo protocolized sectioning by the pathology department to ensure there is no malignancy.[1] If performing an oophorectomy on the left side, mobilization of the sigmoid may need to be performed to visualize all anatomy.[1] When removing a benign ovarian mass (with or

without oophorectomy), the mass can be placed in a bag and brought to the skin through a port (which may need to be extended) to drain or fragment out. Bag integrity should be maintained.[1]

## Complications

### Large Vessel

The risk of large vessel injury during gynecologic laparoscopic surgery range from 0.1% to 0.64%, but overall is a rare occurrence.[13] No surgical entry technique has been shown superior at preventing this.

### Genitourinary Tract

Genitourinary tract injury occurs in 1% to 2% of gynecologic surgeries with higher rates in those with predisposing risk factors.[13] Unfortunately, most ureteral injuries are unrecognized intraoperatively; therefore, one should have heightened awareness in the post-operative period.

### Nerve

Neuropathies occur in about 2% of major gynecologic surgeries.[14] Positional and retractor related neuropathies occur more often in those that are overweight, underweight, have mobility issues pre-operatively, prolonged surgeries, steep Trendelenburg positioning, or frequent repositioning intraoperatively.[13] Proper pre-op positioning is important to reduce this risk, but over time, most of these injuries improve or resolve.[13]

## Clinical Significance

Oophorectomy is generally a low risk and outpatient procedure; however, the indications and implications carry significant weight long-term. In the case of adnexal masses, the role of pre-operative evaluation with imaging and laboratory data is improving but is not perfect at predicting tissue histology.[5] Similarly, imaging is a helpful modality when torsion is suspected; however, this remains a clinical suspicion that is only surgically confirmed in 50% of cases, leaving room for improvement.[7] Surgical techniques for ovarian tissue cryopreservation are still being studied, and this form of fertility preservation remains in the experimental phase.[10]

## Enhancing Healthcare Team Outcomes

Oophorectomy alone or in conjunction with a hysterectomy has excellent outcomes. Most oophorectomies are performed as outpatient surgeries. Laparoscopic oophorectomy should be considered standard unless an open approach is otherwise indicated. As fertility preservation techniques evolve, the recommended technique for oophorectomy may change, as well, specifically with where to begin dissection and if electrocautery versus sharp dissection yield better outcomes.[9][10]

## Questions

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