The Fallopian Tube in the 21st Century: When, Why, and How to Consider Removal

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In January 2015, based on the available data on ovarian carcinogenesis and the safety of salpingectomy, both the American College of Obstetricians and Gynecologists (ACOG) and the American Cancer Society (ACS) recommended that surgeons should discuss the potential benefits of the prophylactic removal of the Fallopian tubes (FTs) for permanent contraception or during surgeries for benign pathologies with every woman at population risk for ovarian cancer (OC) [1, 2].

This is a potential revolution. Until the end of the 20th century, salpingectomy was considered to be an unworthy appendix of more complex gynecological surgeries or as an “emergency” measure to treat life-threatening conditions such as ruptured tubal pregnancies. However, increasing amounts of data are becoming available about the safety and efficacy of salpingectomy for the treatment of benign, malignant, and premalignant pathologies and the lack of any detrimental effects on ovarian hormonal functions.

Inflammatory diseases are the most important benign tubal disorders because of their frequency, consequences, and severity [3]. Often the infectious processes ascend from the lower genital tract, extend to the tube, and reach the peritoneal cavity, leading to pelvic inflammatory disease [3]. Such infections typically become chronic and cause permanent occlusion and enlargements of the tube (hydrosalpinx) that distort the reproductive pelvic architecture and cause infertility [4].

In tubal factor infertility caused by bilateral hydrosalpinx, in vitro fertilization (IVF) is now considered the first option rather than attempting to restore tubal function [5]. However, the hydrosalpinx themselves adversely affect IVF outcomes by reducing the implantation rate and increasing the risk of miscarriage.

Laparoscopic salpingectomy has been demonstrated to be an effective option for avoiding this negative reproductive interference. When laparoscopy is not recommended, hysteroscopic insertion of a specific device seems to be an alternative for the management of hydrosalpinx prior to IVF. Recently, a systematic review and meta-analysis of studies comparing the pregnancy outcomes of hydrosalpinx patients treated with salpingectomy versus those treated with proximal tubal occlusion prior to IVF showed comparable responses to controlled ovarian hyperstimulation and pregnancy outcomes between the groups, demonstrating that salpingectomy does not worsen the reproductive prognosis of patients for whom excisional surgery is chosen [3].

The other relevant benign condition that affects the FTs is ectopic pregnancy (EP). Between 1% and 2% of live births in developed countries are complicated by EP, in which the embryo implants outside the uterine cavity [6]. At least 93% of ectopic pregnancies are located in a FT. EP can be a life-threatening condition, and it is responsible for 6% of maternal deaths during the first trimester of pregnancy.

Fertility following EP is dependent on several factors, the most important of which is a prior history of infertility, whereas treatment choice does not seem to play a significant role. Recently, a multicenter randomized trial involved women with EP and a healthy contralateral tube who were randomly assigned to receive either salpingotomy or salpingectomy [7]. In this study, the cumulative ongoing pregnancy rates were not significant different between salpingotomy and salpingectomy. However, persistent trophoblasts occurred more frequently in the salpingectomy group than in the salpingotomy group (7% vs. <1%, relative risk: 15.0).

Historically, primitive malignancies of the FT were described as rare. In women with advanced peritoneal carcinoma, the involvement of the ovary usually hides and incorporates the Fallopian tube and results in a diagnosis of ovarian primary carcinoma. However, recent studies have led to the development of a new theory about the pathogenesis of epithelial OC that classifies type II neoplasms as cancers that are typically genetically unstable, aggressive, and present in advanced stages. Among these cancers, high-grade, serous cancer (HGSC) is the most common OC and is responsible for a higher death rate than the other types. Interestingly, the new proposed theory shifts the early events of carcinogenesis to the FT instead of the ovary, suggesting that type II tumors derive from the epithelium of the FT, whereas clear cell and endometrioid tumors derive from endometrial tissue migrating to the ovary by retrograde menstruation [8].

These observations have primarily been collected from women carrying BRCA1/2 mutations and undergoing prophylactic salpingo-oophorectomy. In these women, most of the incidentally diagnosed intraepithelial precursors of...
serous tubal intraepithelial carcinomas (STICs) were detected not in the ovary but in the fimbrial end of the FT. STICs were also subsequently diagnosed in many women who did not carry BRCA mutations undergoing operations for sporadic HGSC.

Based on these lines of evidence, prophylactic bilateral salpingectomy (PBS) without ovariectomy has been proposed to be a new preventive approach to reduce the risk of sporadic neoplasia in women at population risk of OC without exposing these patients to the adverse effects of iatrogenic premature menopause. Consistent preliminary data have demonstrated the safety of PBS in terms of both ovarian reserve preservation and surgical complications [9].

These findings are plausible considering that the ovarian blood supply is guaranteed both by infundibulopelvic vessels and by the ovarian branch of the uterine artery, which anastomose with each other at the tubal level. At the time of hysterectomy with salpingectomy, the whole infundibulopelvic blood volume, which was previously distributed between tubes and ovaries, becomes fully available to the ovaries [10].

When that salpingectomy is performed for permanent sterilization, the ovarian blood supply is guaranteed by both the infundibulopelvic vessels and the ovarian branch of the uterine artery, because the anastomoses are still available unless accidental deep coagulation inside the tubal-ovarian ligament occurs [10]. Thus, when laparoscopic or open salpingectomy is planned, it should be performed via coagulation and sectioning of the tube beginning from the very distal fimbrial end [11].

Therefore, a 2011 position paper by the Society of Gynecologic Oncology of Canada encouraged physicians to discuss the risks and benefits of PBS at the time of hysterectomy or tubal ligation with women at a population risk for OC, and this recommendation was confirmed in 2015 by the ACOG and the ACS [1, 2]. The advantage of PBS has also been estimated in terms of cost-effectiveness. A recent analysis showed that salpingectomy with hysterectomy for benign conditions reduces the OC risk at an acceptable cost and is a cost-effective alternative to tubal ligation for sterilization [12].

Surgical sterilization is the most used and successful permanent method worldwide. It is often achieved by partial resection or ligation (e.g., during a Caesarean section) or laparoscopic coagulation of the isthmic portion of the FT. However, the remnant segment of the transected tube frequently exhibits histological modifications that cause microreanastomotic procedures to be unsuccessful [13].

For those women (1%–2%) who rescind a previous decision for sterilization, the best method for becoming pregnant is IVF; therefore, bilateral salpingectomy does not have any disadvantages for these women, whereas tubal preservation with subsequent tubal disease could definitively impair the implantation of transferred embryos [14]. Considering the new theory of OC pathogenesis, even if tubal ligation also seems to reduce the risk of epithelial OC by 33% in both the general population and BRCA1 carriers, recent data have demonstrated that excisional tubal sterilization confers greater risk reduction (64%) than other methods and thus represents the more advisable sterilization procedure for adoption in clinical practice.

Something is already happening in the world. The most important evidence of changes in surgical practices is provided by OVCARE, members of which recently [15] demonstrated that their 2010 educational initiative was followed by a shift in surgical paradigm in their province that involved increases in the utilization of hysterectomy with PBS (56–35%, p < .001) and PBS for sterilization (0.5%–33%, p < .001) over the study period.

Previously, other international groups have published the results of their surveys on the topic. In South Carolina in 2013, 54% of physicians declared that they would perform PBS during hysterectomy primarily to reduce the risk of cancer and repeated operations, whereas only 7.2% of surgeons preferred salpingectomy as an interval sterilization procedure [16]. In 2014, in Connecticut, 60.7% of the respondents declared that they counseled women about the benefits of PBS at the time of hysterectomy [17]. In Italy, at least 80% of the 479 respondents declared that they performed PBS during hysterectomy for benign indications, primarily to reduce the risk of OCs but also to decrease the risk of reoperation [18]. Together, these data indicate an unequivocal increase in the level of agreement about the adoption of PBS over time with a geographical distribution that favors regions in which educational campaigns about the advantages of this new prophylactic surgery have at least been initiated.

Overall, there is still no beneficial or successful screening modality for OC, which is the fifth leading cause of cancer deaths among women and has the highest mortality rate among all types of gynecologic cancer [1]. Gynecological patients compose only a portion of the women who require abdominal or pelvic surgery. In the near future, PBS could be implemented during other surgeries (e.g., cholecystectomy and appendectomy) to extend the preventive potential even further to other women in the general population [9]. Therefore, with the official release of the ACOG Committee on Gynecologic Practice, the time has finally come to extend this information from specialist colleges to the entire medical community.

**Author Contributions**

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**References**


For Further Reading:

Implications for Practice:
Borderline ovarian tumors (BOTs) have been a challenge for patients, pathologists, and oncologists. For the group of patients with invasive implants, there is no consensus regarding standard therapy. Platinum-based regimens are recognized as the standard chemotherapy for ovarian cancer, achieving the highest response rates and the longest survival; however, this outcome does not seem to be the case in the setting of BOT with invasive implants. This meta-analysis examines the benefits, or lack thereof, of platinum-based adjuvant treatment for BOTs.