surgeries

Systematic Review

Opportunistic Salpingectomy at the Time of General Surgery Procedures: A Systematic Review and Narrative Synthesis of Current Knowledge

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Abstract: Opportunistic salpingectomy (OS) for the primary prevention of ovarian cancer is performed by gynecologists. Advocates have suggested expanding its use to other surgical specialties. General surgeons are the other group to routinely perform intraperitoneal operations in women and could play a role in ovarian cancer prevention. Herein, we review the current evidence and perioperative factors requiring consideration prior to OS implementation in select general surgery cases. A systematic search was conducted for English-language studies evaluating OS during general surgery. The primary outcomes of this study were the feasibility and safety of OS during general surgery procedures. Secondary outcomes included pre-operative considerations (patient selection and the consent process), operative factors (technique and surgical specialty involvement), and post-operative factors (follow-up and management of operative complications). We evaluated 3977 studies, with 9 meeting the eligibility criteria. Few studies exist but preliminary evidence suggests relative safety, with no complication attributable to OS among 140 patients. Feasibility was reported in one study, which showed the capacity to perform OS in 98 out of 105 cholecystectomies (93.3%), while another study reported quick visualization of the fallopian tubes in >80% of cases. All patients in the included studies were undergoing elective procedures, including cholecystectomy, interval appendectomy, colorectal resection, bariatric surgery, and laparoscopic hernia repair. Studies only included patients $\geq$ 45 years old, and the mean age ranged from 49 to 67.5 years. Gynecologists were frequently involved during the consent and surgical procedures. OS represents a potential intervention to reduce the risk of ovarian cancer. Ongoing studies evaluating the general surgeon's understanding; the consent process; the feasibility, operative outcomes, and risks of OS; and surgeon training are required prior to consideration.

Keywords: opportunistic salpingectomy; general surgery; cholecystectomy; ovarian cancer prevention

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1. Background

Currently there are no successful screening modalities for the early detection of epithelial ovarian malignancy. This results in many patients presenting with advanced stage disease that confers substantial morbidity and mortality [1]. A growing body of evidence suggests that the majority of ovarian cancers originate from the fimbriated ends of the fallopian tube [2–4]. Because most ovarian cancers originate in the fallopian tubes, opportunistic salpingectomy (OS) (i.e., removing the fallopian tubes for the primary prevention of ovarian cancer in average-risk females) at the time of surgical procedures for other indications has been advocated by gynecologists [5–8]. By removing the fallopian tubes in the general population (compared with no surgical intervention), an estimated 49%

reduction in the likelihood of ovarian cancer could be achieved [8], with a number needed to treat of approximately 300 in a Canadian population [8–10]. The potential risk reduction suggested from such trials has been extended to OS, where salpingectomy occurs at the time of other surgery; however, the risk reduction of OS remains unclear. These results can be achieved without oophorectomy and therefore reduces the risk of menopause induction or a reduction in ovarian reserves and its associated risks [11,12]. Importantly, further study on the role of vascular or nerve damage and menopause induction from OS remains under evaluation. Despite ongoing studies, the American College of Obstetricians and Gynecologists (ACOG), the Society of Obstetricians and Gynecologists of Canada (SOGC), and other international gynecologic societies support OS during the time of other procedures, such as hysterectomy or Cesarean section (C-section), after appropriate consent discussions [13–17]. Although no level I studies currently exist, a growing body of evidence suggests both a reduced malignancy risk and potentially reduced costs from modeling studies that apply early data from OS [5,10,18,19]. Despite calls for general surgeons to perform OS at the time of intra-abdominal operations on non-gynecologic organs, few studies have evaluated the feasibility of OS during these procedures [10,20]. To date, no summary of the evidence for general surgeons exists.

Advocates for OS have suggested conducting the prophylactic surgery at the time of prolapse surgery [21,22], pelvic surgery [23], during a C-section [24], or during urologic surgery [25]. While the potential prophylactic benefit has been demonstrated in several studies [5,18,19], the operative risks and potential hormonal effects present risks that require further study [26–28]. Despite several studies evaluating OS, few studies have summarized a general surgeon's understanding of the risks and benefits of OS to enable proper patient selection or consent. Similarly, it remains unclear whether general surgeons would provide a safe and effective technical delivery of this procedure and what the post-operative care, follow-up, education, and management of gynecological complications would entail.

The objective of this study is to conduct a systematic review with a narrative synthesis summarizing OS for general surgeons and evaluating the literature discussing OS in general surgery. We aim to characterize perioperative considerations that require evaluation prior to the implementation of OS during general surgery and the current evidence for each area of concern. This study will summarize each topic of interest and the evidence to guide future studies evaluating OS during general surgery.

2. Methods

2.1. Study Design and Formulation of Research Questions

A comprehensive systematic review was completed in keeping with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) and Meta-analysis Of Observational Studies in Epidemiology (MOOSE) guidelines (Supplemental Material S1) [29,30]. The population comprised subjects $\geq$ 18 years old undergoing any general surgery procedure. The intervention was OS, described as the removal of macroscopically normal fallopian tubes intended for primary ovarian cancer prevention during an operation undertaken for another purpose. This definition is modified from that of the ACOG, with the removal of their definition's specification that the procedure be completed during pelvic surgery [15]. Outcomes of interest included feasibility, safety outcomes, and any quantitative or qualitative results evaluating the consent process, operative technique, or post-operative care, with the aim of this study being to characterize all pre- intra-, and post-operative aspects to consider for the evaluation of this technique during general surgery procedures. This study was not prospectively registered but was submitted for local study review and was deemed exempt from ethics board review based on the study protocol presented in Supplementary Material S2.

2.2. Search Strategies

The medical librarian developed and executed comprehensive searches in Ovid MEDLINE, Ovid EMBASE, Scopus, Web of Science Core Collection, and Cochrane Library

(Wiley) on 6 October 2021 with an updated search on 11 March 2024. All relevant keywords and controlled vocabulary related to OS were carefully selected. Searches were restricted to the English language and by publication date from 2010 to the present (Appendix A). Earlier studies were eliminated because OS has only been well defined and considered since the 2012 publication by Tone et al. [31,32]. Refer to the appendices for full-text search strategies. In addition to subscription databases, the research team reviewed the first 200 Google Scholar results for inclusion.

2.3. Study Inclusion and Exclusion Criteria

Articles were systematically reviewed and selected based on the following inclusion criteria: (1) the study evaluated OS during any general surgery procedures, and (2) the study reported at least one outcome of interest. Non-published studies, non-English studies, animal studies, and studies with patients <18 years old were excluded. Per PRISMA and MOOSE guidelines, two reviewers independently screened the studies and extracted data, with disagreements resolved by third-party adjudication.

2.4. Primary and Secondary Outcomes

The primary outcomes of this study were the feasibility and safety of OS during general surgery procedures. Feasibility was defined as the rate of OS completion during an index general surgery procedure. Safety was defined by any complication associated with OS during general surgery procedures, as defined by the original study. Secondary outcomes included pre-operative considerations, including patient selection and the consent process; operative factors, including technique and surgical specialty involvement; and post-operative factors, including the follow-up and management of operative complications. Outcomes were determined a priori, and due to limited studies meeting the inclusion criteria, both qualitative and quantitative data were extracted and summarized from the included studies. Statistical comparisons of studies and pooled analyses of outcomes were also limited due to heterogeneity. Therefore, we summarize the outcomes from all the included studies and discuss key tendencies in the data.

2.5. Risk of Bias Assessment

Study-bias assessment was completed independently by two authors, with disagreements resolved by third-party adjudication. Included non-randomized studies were assessed for quality using the Methodological Index for Non-Randomized Studies (MINORS) [33], whereby non-comparative scores can be assessed as follows: 0–4 = very low quality; 5–8 = low quality; 9–12 = moderate quality; and 13–16 = high quality.

3. Results

3.1. Study Selection and Overview of Included Studies

A total of 3977 results were retrieved, and 1898 unique results remained for the initial title and abstract screening. Following the title and abstract screening, 22 manuscripts remained for full-text review, with 9 meeting all the study eligibility criteria (Figure 1). Studies included one multicenter prospective observational study, one prospective observational study, one retrospective observational study, two surveys, and four other studies. A summary of all the included studies is presented in Table 1.

Table 1. Summary of the included studies.

Study	Design	Demographics	Sample Size	Key Findings
* Bellamy et al. (2017) [34]	Survey	Surgeons (gynecologists and general surgeons) and primary-care physicians	20	- 12/15 (80%) of general surgeons were unaware of the tubal origin of high-grade serous ovarian cancer - Respondents suggested that written or oral presentations providing information would be beneficial
* Bonavina et al. (2020) [35]	Reply to Tomasch et al. (2020)	N/A	N/A	- Suggest collaborating with gynecologists to facilitate patient selection and consent - Suggest transvaginal ultrasound to workup patients pre-operatively for adhesions - Suggest peritoneal washing for cytology to rule out STIC
Hughes et al. (2021) [36]	A recursive Markov model was constructed to evaluate the cost effectiveness of OS during general surgery procedures	Elective appendectomy, cholecystectomy, hernia repair, and colon resection.	N/A	- Predicts that OS during general surgery procedures would reduce ovarian cancer deaths by 6.7% - Performing OS or BSO in patients > 50 produces cost savings with a 3% discount rate - Predicts healthcare cost savings of USD 626 million per year in the United States
Matsuo et al. (2023) [37]	A decision-analytic model to simulate the cost, quality-adjusted life-years, ovarian cancer cases, and deaths prevented	Laparoscopic cholecystectomy	N/A	- Additional costs were USD 1898–USD 1978 - 30–39 cases of ovarian cancer prevented per 5000 OS and 12–16 related deaths - incremental cost-effectiveness ratio of USD 11,162 to 26,463
* Myriokefalitaki et al. (2014) [38]	Retrospective observational study	Patients undergoing elective oncologic colorectal resection; mean age 67.5 years	n = 34 patients with OS	- 14.2% of colorectal cases had concomitant adnexectomy - When salpingectomy was performed, malignant ovarian disease was present in 59% of pathologic specimens - There was no difference in the incidence of major complications between joint gynecological procedures and colorectal surgery

Table 1. *Cont.*

Study	Design	Demographics	Sample Size	Key Findings
* Sagmeister et al. (2023) [39]	Prospective observational study	Patients undergoing elective bariatric surgery	n = 31	- The adnexa could be visualized in 81% of women - Reaching the fallopian tubes took an average of 3.5 min
Tomasch et al. (2018) [40]	Survey	Patients undergoing elective laparoscopic cholecystectomy; mean age 56 years	n = 20	- 19/20 (95%) of participants would be likely to consent to an OS during elective laparoscopic cholecystectomy - Requirement for additional information was commonly cited as a barrier to consent - 55% of patients would require > 1 week to make a decision about their consent
Tomasch et al. (2020) [20]	Multicenter prospective observational study	Patients undergoing elective laparoscopic cholecystectomy for benign disease; mean age 55 years	n = 105	- OS feasible in 98/105 (93.3%) of patients - The median additional time required for salpingectomy was 13 min - 83/105 (79%) of cases did not require an additional port - 32/105 (30%) required a new device to complete the OS - No intraoperative or post-operative complications attributable to salpingectomy
Irons et al. (2017) [41]	Case report	49-year-old patient undergoing low anterior resection for rectal cancer	n = 1	- This patient underwent OS and was found to have bilateral ovarian cancer, suggesting a theoretical benefit of OS during colorectal resections - Gynecologist performed the salpingectomy

* Abstract, commentary, or editorial. OS: opportunistic salpingectomy; BSO: bilateral salpingo-oopherectomy; STIC: serosal tubal intraepithelial carcinoma.

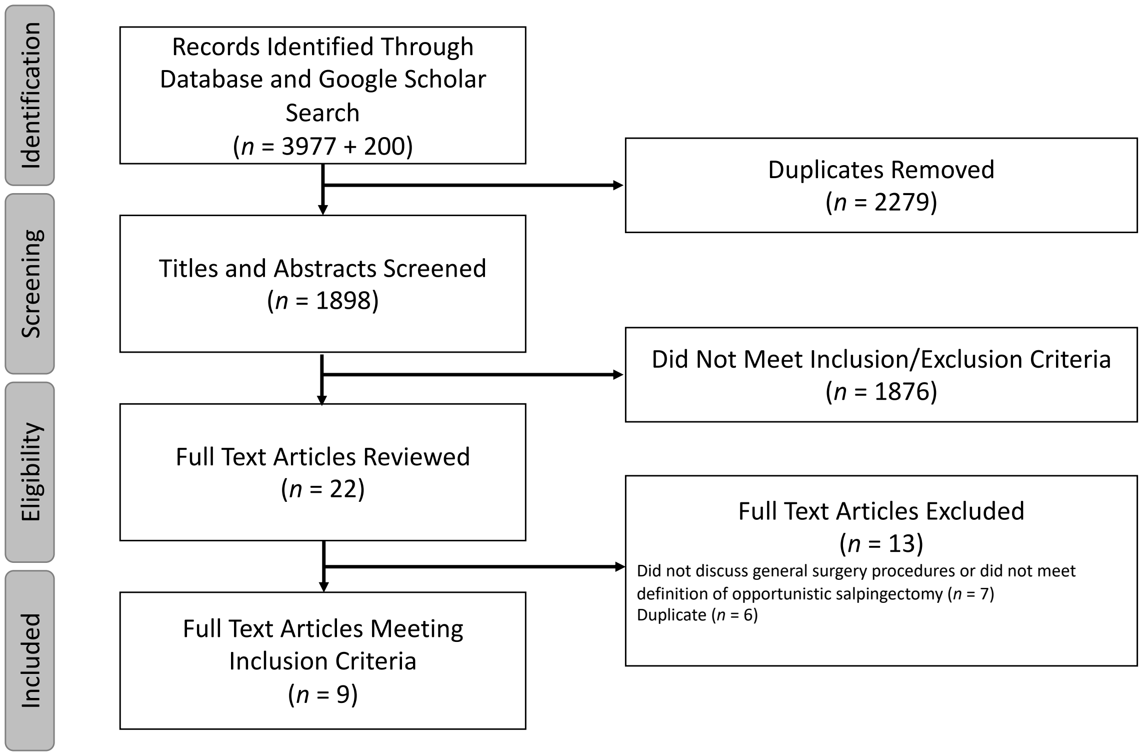

Figure 1. PRISMA diagram of included studies.

3.2. Outcomes

Assessment of the primary outcomes, feasibility and safety, was reported in four studies. Safety data were available from three studies, with one being a case report [20,38,41]. Of the 140 patients reported in these studies, no post-operative complications were attributed to OS. Feasibility was only reported by Tomasch et al. (2020), who reported that out of 105 cholecystectomies, OS was feasible in 98 (93.3%) [20]. Feasibility during other procedures was not evaluated.

In terms of secondary outcomes, patient selection was discussed in six studies. All patients in the included studies were undergoing elective procedures, which included cholecystectomy, interval appendectomy, colorectal resection, and laparoscopic hernia repair. Studies only included patients $\geq$ 45 years old, and the average age ranged from 49 to 67.5 years. None of the studies reported other patient demographics, including comorbidities, functional status, or the American Society of Anesthesiologists (ASA) class. In the two studies evaluating a case series of patients undergoing OS, procedures were initially performed alongside a gynecologist, followed by general surgeons performing the procedure independently after a training period. The training duration was not described; however, Myriokefalitaki et al. (2014) found similar perioperative outcomes for patients receiving OS with gynecology assistance compared to general surgeons alone [38]. On the other hand, both surveys that were completed suggested that gynecologists should be involved in the consent process for surgery or that surgeons would need additional training to provide informed consent [20,35,41]. This is further supported by Bellamy et al. (2017), who found that most general surgeons are not aware of the tubal origin of ovarian cancer [34]. Training programs or techniques provided to general surgeons for the surgical technique or for consent were not described.

The surgical technique was overtly described by Tomasch et al. (2020), who characterized that OS required a median 13 min to perform following a cholecystectomy and required at least one additional port in 14.3% of cases. Importantly, they note that in 30.5% (32/105) of cases, a different instrument or a new instrument was required to complete the OS and that a gynecologist was involved in 24.8% of cases. Only Tomasch et al. (2020) reported follow-up for up to 30 days; however, no specific gynecologic follow-up was outlined.

3.3. Study Risk of Bias Assessment and Loss to Follow-Up

Of the included studies, all were non comparative and had an average MINORS criteria score of 9. Four studies could not be assessed using the MINORS criteria due to being abstracts or commentaries, as noted in Table 1. This places the assessed studies as being of moderate quality (i.e., 9–12) on average, with two being of low quality, one moderate, and two being of high quality (Supplemental Material S3; Table S1). Notably, all studies were non-comparative, and MINORS scores were categorized as low, moderate, or high quality accordingly [33].

4. Discussion

This systematic review summarizes the evidence and considerations for OS in the general surgery population. Notably, the systematic search of all studies evaluating OS during general surgery procedures highlights the scarcity of evidence evaluating this important question, limiting the definitive conclusions achievable with the current evidence and highlighting a need for future research. The discussion focuses on the evidence for OS from the gynecology literature that may be applicable to other surgical patients and reviews the basis for opportunistic procedures in general surgery. This is followed by a discussion on the safety, feasibility, and perioperative considerations for OS during general surgery procedures.

4.1. Learning from Gynecologists: Current Evidence for Opportunistic Salpingectomy

Five types of ovarian cancer exist, with OS specifically aimed at reducing high-grade serous carcinoma. Over 85% of ovarian cancers, including serous carcinomas, are of epithelial origin and have less than a 50% 5-year survival rate [1]. With the lack of screening modalities, and evidence for the fallopian tubes as the origin for pelvic serous carcinoma, bilateral salpingectomy has been shown to reduce ovarian serous carcinoma [19], and it can be preferred to tubal ligation or partial salpingectomy when performing permanent sterilization [13–17]. Further, to reduce the risk of epithelial ovarian cancer, major North American guidelines, including those from the ACOG and the SOGC, recommend OS for average-risk women who have completed childbearing and who are undergoing pelvic surgery for benign disease [15,42,43]. Current guidelines identify eligible patients as 18 years and older who are undergoing a hysterectomy or permanent sterilization. Notably, OS refers only to patients with an average risk of ovarian malignancy, and patients at high risk due to a significant family history or with known germline mutations should be seen and treated by general gynecologists or gynecologic oncologists, as they require different pathology techniques for review. Because of this, collaboration and training for general surgeons intending to complete an OS should include knowledge regarding patient risk evaluation. The safety and feasibility of OS have been confirmed by large North-American population-based retrospective cohort studies [18,44], with more recent evidence by Hanley et al. (2022) demonstrating a clear reduction in ovarian cancer [19]. Data supporting the long-term ovarian cancer risk reduction by bilateral salpingectomy are derived from over 30 years of follow up [8,9]. These studies have reported similar outcomes, with the only difference being an increase or approximately 10–16 min to the overall operating time, with no increase in complications, length of stay, recovery time, or readmission rates [44]. Despite this evidence, it is also important to note that the data demonstrating no difference in outcomes are inconsistent across studies—the Cochrane review of RCTs suggests no difference in surgical adverse events but noted that perioperative events were rare and that the studies were underpowered for evaluating these outcomes; it also suggested no evidence of the surgical induction of menopause or a reduction in ovarian reserves as a result of OS during a hysterectomy [12,27]. However, other large non-randomized studies have suggested a potential for earlier menopause symptoms and a higher risk of hemorrhage and oophorectomy [26,28]. Certainly, ongoing prospective and randomized trials, including STOPOVCA and SALSTER, will be valuable to determine whether OS incurs additional risks [45,46]. Additionally, it is important to note that the ACOG guideline indicates that the approach to hysterectomy should not be modified to accommodate an OS [15]. Similarly, the SOGC guideline emphasizes that no additional surgical steps should be taken to perform an OS if the fallopian tubes are inaccessible [2].

Meta-analysis and large-population-sourced data have supported a reduction in ovarian malignancy by up to 50% following OS in the general population, with a number needing treatment of approximately 300 in a Canadian population [8–10]. Despite these benefits and the reduced malignancy risk, surgeons should also discuss the continued risk of ovarian cancer following OS since certain types of epithelial ovarian cancer do originate from the ovary itself [47]. Counselling should also include OS as an effective permanent contraceptive without options for reversal in the future. In addition to these considerations, training and collaboration with gynecologists is needed, along with a consideration of the important aspects discussed below.

4.2. Prophylactic Surgery and Opportunism in General Surgery

The concepts of surgical opportunism and prophylactic procedures are well established and have long been explored and employed in general surgery. Prophylactic surgery generally refers to an intervention performed before the development of pathology, often on the basis of specific risk factors. Opportunistic surgery, sometimes termed "incidental", refers to a surgical procedure performed either for treatment or prophylaxis at the time of another index procedure. While both may increase procedural risks, the benefits achieved may lead to an overall risk reduction that ultimately provides value to patients. With regards to oncology, prophylactic mastectomy [48,49], colectomy [50], and gastrectomy [51] are recommended for high-risk patients with germline mutations. Therefore, while opportunistic procedures are not widely considered, OS represents a potentially novel technique for general surgeons to further provide a malignancy risk reduction to patients through a concurrent procedure that carries limited risk [52–55]. However, prior to implementing these interventions, surgeons and researchers should consider the following pre-, intra-, and post-operative factors that require planning and assessment.

4.3. Patient Selection and Feasibility

All the current studies evaluating OS during general surgery procedures have done so during elective procedures. It has been considered during elective appendectomy, cholecystectomy, hernia repair, bariatric surgery, and both benign and malignant colorectal resections. Notably, consideration of salpingo-oopherectomy, even prior to the pathophysiological understanding of the tubal origin of ovarian cancers, has long been considered during oncologic colorectal resections for post-menopausal women. A systematic review by Banerjee et al. (2005) suggested that it is likely most feasible during distal sigmoid or upper rectal cancers when working in the pelvis in patients who are post-menopausal, ranging in age from 56.5 to 69 years [56]. In that study, they highlighted findings from a randomized controlled trial evaluating oophorectomy during malignant colorectal resections that may suggest a trend toward a survival benefit [57]. Regardless of these findings, including the 93.3% feasibility during cholecystectomy shown by Tomasch et al. (2020), existing studies suggest that OS may be feasible during any laparoscopic procedure. Additionally, Sagmeister et al. (2023) demonstrated that the fallopian tubes could be visualized in >80% of cases within only 3.5 min (without any lysis of adhesions) [39]. While limited evidence currently exists to cite an exact feasibility rate, the previously demonstrated 93.3% success rate is certainly promising, and it is reasonable to believe that the feasibility would be even greater in surgeries with pelvic access. On the other hand, Tomasch et al. (2020) noted that adhesions were the primary reason for the inability to complete an OS, which many general surgery patients may experience. However, achieving 100% safety, rather than 100% feasibility, should be the focus of these opportunistic procedures. Overall, because emergency surgery procedures carry an increased risk of post-operative complications [58], and considering the consent process we discuss below, studying the practice of OS during elective procedures offers the most controlled setting for evaluation. As such, the current literature evaluating OS during general surgery focuses on patients $\geq$ 45 years old undergoing elective surgery.

Despite current studies focusing on elective patients, it should be noted that the number of peri-menopausal (i.e., 46–60-year-old) women undergoing emergency general surgery is substantial, with a 26% increase over a 20-year period [59]. Regardless, cost analyses of OS during general surgery have predicted savings and mortality benefits for patients from age 40 upward [37,60]. Additionally, females younger than 45 also represent a large proportion of general surgery patients who could benefit from this procedure if they have completed their childbearing years. Investigating patient interest and feasibility for OS during emergency general surgery or for patients <45 years old is therefore important, as it may offer a large pool of patients who would benefit from OS in the future [59]. In these circumstances, weighing the benefits and limitations of a difficult consent process and the physiologic risk of surgery in patients who are already potentially unwell need to be considered.

4.4. Consent

There are both patient and provider considerations for the consent prior to an OS. For patients, there is both a knowledge and emotional aspect to salpingectomy. Patient knowledge is generally limited, and women often have preconceived notions regarding OS or prophylactic bilateral oophorectomy, which gynecologists report as a substantial barrier to the consent process [61]. Additionally, the emotional and psychosocial aspects of OS are also considerations. Tomasch et al. (2018) evaluated this best in general surgery, with 20% of females reporting that OS would affect their sexuality, and 15% reporting that it would affect their femininity. Similarly, 10% reported that OS may affect them psychologically [40]. These perceptions highlight unique considerations for surgeons conducting consent discussions about OS during general surgery procedures.

General surgeon knowledge regarding the benefits, risks, and alternatives for OS is also a substantial limitation to effective consent. The study by Bellamy et al. (2017) strongly supports this notion, indicating that most general surgeons are not aware of the tubal origin of ovarian cancer, the very justification for OS. A poor understanding of ovarian cancer and inexperience in managing the disease would currently limit the ability of general surgeons to obtain consent from patients [34]. Beyond these aspects, the rate of OS technical success, the likelihood for ovarian cancer despite OS, and the risks of complications are currently beyond the scope of most general surgeons.

If OS is considered, effective training for general surgeons to enable informed consent will be crucial. The two studies reporting larger case series of general surgeons performing OS provided training through support from gynecology, however, training resources and additional continued education that limit the burden of training for gynecologists would be valuable. More recently, decision aids to guide OS consent discussions have been developed, and tailoring these to general surgeons may provide a helpful resource [62]. While training may facilitate a general surgeon's capability to provide OS, a question that remains unanswered is whether general surgeons would be interested in pursuing OS or the training to accrue those skills. Additionally, it remains unclear (with likely variation across provinces) if general surgeons providing this service would receive any renumeration. In the study by Tomasch et al. (2020), renumeration was not available and was reported as a barrier to completing these procedures [63].

Considering these points, it appears that accurate, clear, and concise information for both patient and provider would be required to facilitate effective consent discussions prior to OS implementation during general surgery procedures [64]. Van Lieshout et al. (2021) have recently developed a patient decision aid for opportunistic salpingectomy in women undergoing pelvic gynecologic surgery, but it remains unclear how effective this tool will be, especially with regard to the psychosocial considerations discussed above, and whether it would be applicable to patients undergoing general surgery procedures [62]. In terms of provider education, surgeon education programs could be created to improve awareness and understanding, as at least one group has proposed [65]. Defining the training requirements and clearly outlining key elements for training programs that enable general surgeons to identify appropriate patients and to obtain informed consent will be an important step moving forward. The two studies reporting case series of general surgeons performing OS provided training through support from gynecologists; however, training resources that limit the burden for gynecologists in training general surgeons will be valuable. Despite this growing body of patient and provider information, and considering the technical operative aspects we discuss in the next section, close collaboration with gynecologists during the initial implementation and evaluation would be imperative, but measures should also allow for the adequate renumeration of gynecologists assisting with the training in or completion of these procedures.

4.5. Surgical Technique

In addition to training required for patient selection and consent, training to enable the safe technical OS delivery by general surgeons at the time of laparoscopic or open surgery will be needed, ensuring that necessary precautions are taken to avoid damage to nearby critical structures, including the ovary and the associated infundibulopelvic (IP) ligament. Indeed, damage to the ovarian blood supply, typically within the IP ligament but with some anatomical variants, presents a risk of inducing early menopause and needs to be highlighted. As discussed above, the risk of oophorectomy may be increased with OS and should be understood by surgeons and patients pre-operatively [26]. For both laparoscopic and open procedures, the fallopian tube is identified and elevated by the fimbriated end; the mesosalpinx is then ligated to separate the fallopian tube from the ovary, beginning at the fimbriae and moving medially toward to the cornua of the uterus. It should also be highlighted that in some circumstances, especially in cases of reoperation, the ureter may be adhered to or closely associated with the ovary and associated structures, and careful anatomical considerations are needed. While technically straightforward, specific anatomical knowledge and technical training is required. In addition to safety, additional training may also minimize the number of additional ports required to perform an OS [66–70]. Additionally, the use of alternative instruments, including bipolar or other cautery devices, may be needed in these cases and require consideration. Fortunately, the learning curve for time and movement optimization during a straightforward OS appears to be <10 cases, and simple curriculums appear effective for training [71,72]. Despite the availability of these training processes, the current studies delivered training via gynecologists, which was feasible at their centers. However, time constraints and renumeration for gynecologists to provide this training may not be feasible at every center and should be highlighted.

4.6. Safety and Post-Operative Management

Evidence for the post-operative safety, follow-up, and management of general surgery patients undergoing OS is limited. Currently, substantial evidence suggests that the addition of OS to hysterectomy, myomectomy, and C-section procedures does not substantially increase operative risks [52–55,60,73]. Preliminary evidence evaluating concomitant OS during general surgery procedures suggests that it may be safe without a substantial risk of gynecologic complications [20]. However, because a small number of complications such as bleeding or inadvertent injury to the ovarian blood supply are expected (<1%) [15], collaborating closely with gynecologists when these complications occur is likely to reduce the associated morbidity. In addition to education allowing for the identification of these complications, general surgeons should ensure that they receive adequate training to appropriately interpret pathology findings. Formal training programs to train general surgeons about the evaluation of specific post-operative complications and the interpretation of pathology following OS is needed ensure not only safe patient selection and technical delivery but also proper post-operative care. As with other aspects of care discussed above, collaboration with gynecologists during the early implementation of these post-operative care and assessment procedures will also be needed.

4.7. Limitations

This study remains limited, primarily due to the novelty of evaluating OS during general surgery procedures. Our systematic search highlights that very few studies have evaluated OS, few patients have been included in these studies, and heterogeneity in technique, population, and outcomes is widespread. This limited statistical analysis and any major conclusions from being drawn from this study. The results and discussion points within this systematic review should therefore be used to direct future questions to inform the areas of interest that we discussed above. Additionally, because of this novelty and the small-sized studies, we cannot comment on the efficacy of OS during general surgery procedures. Even within gynecological oncology practices, no level I evidence for OS currently exists, and the application of OS remains variable [61]. Due to the age of patients receiving OS, it is predicted that ovarian cancer benefits are unlikely to be noted until at least 20 years following its implementation [31]. Overall, the current evidence in general surgery evaluates patients $\geq$ 45 years old undergoing elective intra-abdominal procedures. The collaboration and early involvement of gynecologists to enable well-informed consent and to optimize the surgical technique is common in these studies and is prudent in the early evaluation and development of these approaches. If growing evidence of the feasibility of OS by general surgeons is demonstrated, formal training programs to educate surgeons on key patient selection, consent, technical, and post-operative aspects of care would be of great benefit.

5. Conclusions

The use of OS by gynecologists is increasing, with a growing body of evidence suggesting efficacy for the primary prevention of ovarian cancer. Few studies have evaluated pre- intra-, or post-operative considerations for use in OS by general surgeons, and no current studies exist with adequate control groups. Therefore, OS by general surgeons should continue to be performed in the context of clinical studies. Ongoing research evaluating general surgeons' understanding, the consent process, and the feasibility, operative outcomes, and risks from OS is required prior to its routine consideration.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/surgeries5020023/s1, Supplemental Material S1: PRISMA checklist; Supplemental Material S2: Study Outline; Supplemental Material S3: MINORS quality assessment of included studies; Table S1: MINORS assessment of included studies. References [1–5,10,18,20] are cited in the Supplementary Materials.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Database	Search Strategy
MEDLINE **Ovid MEDLINE(R) ALL** 1946 to March 08, 2024	salpingectom*.mp. salpingo-oophorectom*.mp. (tubal adj3 excision*).mp. tubectom*.mp. ((tube* or tubal) adj3 remov*).mp. or/1–5 Prophylactic Surgical Procedures/ and (fallopian or tubal or tubes or tube).ti,ab,kf. prophyla*.ti,ab,kf. opportunistic.ti,ab,kf. ((prevent* or elective or optional) adj3 (surg* or procedure*)).ti,ab,kf. or/7–10 6 and 11 (hysterectom* or gyn?ecolog* or urogyn?ecologic* or uro-gyn?ecologic*).ti. (c?esarean or c-section*).ti. 13 or 14 12 not 15 animals/ humans/ 17 not (17 and 18) (veterinary or rabbit or rabbits or animal or animals or mouse or mice or rodent or rodents or rat or rats or murine or hamster* or pig or pigs or piglets or swine or porcine or horse* or equine or cow or cows or cattle or bovine or goat or goats or sheep or lambs or ovine or monkey or monkeys or trout or marmoset$1 or canine or dog or dogs or feline or cat or cats or zebrafish).ti. 19 or 20 16 not 21 limit 22 to english language limit 23 to yr = "2010-Current"
Embase **Ovid Embase** 1974 to 2024 March 08	salpingectom*.mp. salpingo-oophorectom*.mp. (tubal adj3 excision*).mp. tubectom*.mp. ((tube* or tubal) adj3 remov*).mp. or/1–5 prophylactic surgical procedure/ and (fallopian or tubal or tubes or tube).ti,ab,kw. prophyla*.ti,ab,kw. opportunistic.ti,ab,kw. ((prevent* or elective or optional) adj3 (surg* or procedure*)).ti,ab,kw. or/7–10 6 and 11 (hysterectom* or gyn?ecolog* or urogyn?ecologic* or uro-gyn?ecologic*).ti. (c?esarean or c-section*).ti. 13 or 14 12 not 15 animal/ human/ 17 not (17 and 18) (veterinary or rabbit or rabbits or animal or animals or mouse or mice or rodent or rodents or rat or rats or murine or hamster* or pig or pigs or piglets or swine or porcine or horse* or equine or cow or cows or cattle or bovine or goat or goats or sheep or lambs or ovine or monkey or monkeys or trout or marmoset$1 or canine or dog or dogs or feline or cat or cats or zebrafish).ti. 19 or 20 16 not 21 limit 22 to english language limit 23 to yr="2010–Current"

Database	**Search Strategy**
Cochrane Library via Wiley	#1 salpingectom* #2 salpingo-oophorectom* #3 tubal NEAR/3 excision* #4 tubectom* #5 MeSH descriptor: [Salpingectomy] explode all trees #6 (tube* or tubal) NEAR/3 remov* #7 (81-#6) #8 [mh "Prophylactic Surgical Procedures"] AND (fallopian or tubal or tubes or tube) #9 prophyla* #10 opportunistic #11 (prevent* or elective or optional) NEAR/3 (surg* or procedure*) #12 {OR #8–#11} #13 #7 AND #12 #14 (hysterectom* or gyn?ecolog* or urogyn?ecologic* or uro-gyn?ecologic*):ti #15 (c?esarean or c-section*):ti #16 #14 OR #15 #17 #13 NOT #16 [Limit Publication Date: 2010–2021]
Scopus	(TITLE-ABS-KEY (salpingectom* OR salpingo-oophorectom* OR (tubal W/3 excision*) OR tubectom* OR ((tube* OR tubal) W/3 remov*)) AND TITLE-ABS-KEY (prophyla* OR opportunistic OR ((prevent* OR elective OR optional) W/3 (surg* OR procedure*)))) AND NOT TITLE (hysterectom* OR gynecolog* OR gynaecolog* OR urogynecologic* OR urogynaecologic* OR uro-gynecologic* OR uro-gynaecologic* OR cesarean OR caesarean OR c-section*) AND NOT TITLE (veterinary OR rabbit OR rabbits OR animal OR animals OR mouse OR mice OR rodent OR rodents OR rat OR rats OR murine OR hamster* OR pig OR pigs OR piglets OR swine OR porcine OR horse* OR equine OR cow OR cows OR cattle OR bovine OR goat OR goats OR sheep OR lambs OR ovine OR monkey OR monkeys OR trout OR marmoset* OR canine OR dog OR dogs OR feline OR cat OR cats OR zebrafish) AND PUBYEAR > 2009 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE , "English"))
Web of Science Core Collection	(TS=(salpingectom* OR salpingo-oophorectom* OR (tubal NEAR/3 excision*) OR tubectom* OR ((tube* or tubal) NEAR/3 remov*)) AND TS=(prophyla* OR opportunistic OR ((prevent* or elective or optional) NEAR/3 (surg* or procedure*)))) NOT TI=(hysterectom* OR gynecolog* OR gynaecolog* OR urogynecologic* OR urogynaecologic* OR uro-gynecologic* OR uro-gynaecologic* OR cesarean OR caesarean OR c-section* OR veterinary OR rabbit OR rabbits OR animal OR animals OR mouse OR mice OR rodent OR rodents OR rat OR rats OR murine OR hamster* OR pig OR pigs OR piglets OR swine OR porcine OR horse* OR equine OR cow OR cows OR cattle OR bovine OR goat OR goats OR sheep OR lambs OR ovine OR monkey OR monkeys OR trout OR marmoset* OR canine OR dog OR dogs OR feline OR cat OR cats OR zebrafish) Refined by Publication Years: 2010–2024/Languages: English
Google Scholar	opportunistic salpingectomy

Database	**2021 Results**	**2024 Results**
MEDLINE	439	542
Embase	856	1105
Cochrane Library	142	217
Scopus	684	1216
Web of Science Core Collection	762	897
Google Scholar	200	n/a
Total	2883	3977

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