Original Article

Feasibility of Risk Reducing Salpingo-oophorectomy at the Time of Abdominal Surgery for Correction of Pelvic Organ Prolapse and Urinary Incontinence

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Abstract

Objective: The objective of this study is to assess the perioperative outcomes when prophylactic bilateral salpingo-oophorectomy (BSO) is performed concomitantly with surgery to repair pelvic organ prolapse (POP) or stress urinary incontinence (SUI).
Materials and Methods: This is a retrospective case–control study of patients who underwent abdominal surgery for the correction of POP and/or SUI with or without concomitant BSO at a tertiary care center. The primary outcome measures were postsurgery length of hospitalization, estimated blood loss, and 30-day readmission rate. The secondary outcome measure was detection of ovarian cancer precursor lesions.
Results: We identified 734 patients who had surgery for POP and/or SUI. The control group contained 385 patients, and the BSO group contained 349 patients. There was no difference between the control and BSO groups in the postsurgery length of stay (LOS) (35.2 h vs. 34.1 h; $P = 0.49$), and all-cause 30-day readmission rate (14.2% vs. 11.6%; $P = 0.3085$). However, there was decreased blood loss (40.8 ml vs. 67.2 ml, $P < 0.0001$) in the BSO group compared to the control group. Sub-analysis of primary outcomes in postmenopausal women (age > 55) showed decreased postsurgery LOS (33.4 h vs. 37.4 h; $P = 0.0208$) and decreased blood loss (35.9 ml vs. 82.7 ml; $P < 0.0001$) in the BSO group compared to control.
Conclusion: Secondary to the lack of additional complications, we recommend surgeons give more consideration to finding appropriate candidates for a risk reducing BSO at time of abdominal surgery to repair POP or SUI.

Keywords: Ovarian cancer prevention, pelvic organ prolapse, risk reducing oophorectomy, stress urinary incontinence, surgery to reduce the risk of ovarian cancer

Introduction

While ovarian cancer is the seventh most common cancer amongst women in the world, it ranks as the fifth leading cause of cancer-related death in women nationally.[1,2] Only 15% of ovarian cancer patients are diagnosed at an early stage, resulting in a relative 5-year survival rate of 46.5%, which has not significantly changed since 1995.[3]

Despite much interest in developing a screening test for early-stage ovarian cancer, there is currently no test that has showed improvement in survival, even in women considered at high-risk due to genetic mutations such as BRCA1/2.[4-6] Therefore, in both population-risk and high-risk women, screening is not recommended due to the

Article History:
Submitted: 17 March 2020
Revised: 10 June 2020
Accepted: 11 August 2020
Published: 30 January 2021

Access this article online

Quick Response Code:

Website: www.e-gmit.com

DOI: 10.4103/GMIT.GMIT_21_20

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How to cite this article: Azadi A, Bradley JA, Marchand GJ, Lorenz DJ, Doering D, Ostergard DR. Feasibility of risk reducing salpingo-oophorectomy at the time of abdominal surgery for correction of pelvic organ prolapse and urinary incontinence. Gynecol Minim Invasive Ther 2021;10:10-8.

high rates of unnecessary procedures.[7-9] However, some prevention strategies such as salpingectomy and bilateral salpingo-oophorectomy (BSO), have resulted in significant reductions in the risk of developing ovarian cancer.[10]

Initial studies showed that prophylactic BSO in BRCA1/2 carriers would reduce the risk of developing ovarian cancer by 50%–96%, so it is recommended by most clinicians that women who have known BRCA1/2 mutations should receive prophylactic BSO after the completion of desire for pregnancy.[11-13] However, due to the many negative health effects on the cardiovascular and musculoskeletal systems of surgically-induced menopause, there is no consensus on which other high-risk groups of women should receive prophylactic oophorectomy and/or salpingectomy.[14] Clinical and molecular data in the past decade have revealed that specific subtypes of ovarian cancer and precancerous lesions originate from epithelial cells in the fallopian tube. Specifically, the Fallopian tube is the site of origin for the majority of high-grade serous carcinomas, which represents 70% of invasive ovarian carcinomas.[15] Within the past decade, medical societies in Canada and the US have recommended premenopausal women receive prophylactic salpingectomy at the time of hysterectomy or instead of tubal ligation for ovarian cancer prophylaxis, although the long-term health effects of this approach have not been investigated.[16-18] Recently, there has been discussion in the literature about performing ovarian cancer prophylactic procedures at the time of surgery to correct pelvic organ prolapse (POP) and stress urinary incontinence (SUI), although no data currently exist to support this viewpoint.[19,20]

POP and cancer are the most common indications for a hysterectomy in women older than 55 years old.[21] Recent estimates show that up to the age of 80, the lifetime risk of requiring surgery for POP or SUI is 20%, highlighting the vast impact that this disorder will have on public health in the future.[22,23] Approximately 75% of women who develop POP are postmenopausal. In the Women's Health Initiative study, investigators showed that in postmenopausal women older than 60 who still had a uterus, 41.1% of them had POP on physical examination.[24] It is our belief that women who present for surgical correction of POP or SUI, especially those who are postmenopausal, represent a unique population ideal for prophylactic BSO. In addition to ovarian cancer prophylaxis, recent evidence suggests the removal of the ovaries in postmenopausal patients has a protective effect against developing breast cancer, the mechanism of which is thought to be due to the decreased levels of androgens found in the circulation.[25,26] The purpose of this study is to determine the perioperative outcomes of performing BSO concomitantly with abdominal surgery for POP or SUI.

Materials and Methods

This is a retrospective case–control study of patients who underwent abdominal surgery for correction of POP and/or urinary incontinence by the author AA from February 1, 2014 to September 15, 2017 at a major tertiary center in Kentucky, USA. Cases include patients who had one or more of the following procedures performed: Abdominal hysterectomy, laparoscopic or robotic-assisted hysterectomy, vaginal hysterectomy, salpingectomy, oophorectomy, Burch colposuspension, sacralcolpopexy, and uterosacral ligament suspension. This study was reviewed at the November 2019 IRB Meeting of the Marchand Institute and was found to be exempt. The reason the work was found to be exempt was stated as "retrospective analysis."

Patients were then sorted into either a group who received BSO at the time of surgery versus a control group whose ovaries and Fallopian tubes were preserved during surgery. The exclusion criteria included patients who had a prior oophorectomy at the time of surgery. The following patient characteristics were collected for comparison between the control and BSO groups: age, weight, height, body mass index (BMI), parity, gravidity, history of tobacco use, history of alcohol use, estimated blood loss, total length of stay (LOS) in hours, postsurgery LOS in hours, readmission rate within 30 days (including surgical and medical causes such as UTIs, postoperative pain, and urinary retention,) indication for surgery, if the patient was taking hormone replacement therapy (HRT) at time of surgery, type of prolapse, and stage of prolapse. Due to the possibility that an unequal proportion of surgeries performed on patients in the BSO and control groups may not have had surgical access to the ovaries, we performed an additional subanalysis of the baseline patient characteristics and primary end points (total LOS, postsurgery LOS, readmission rate within 30 days, and estimated blood loss) in which we only selected patients whose ovaries were grossly commented on in the operative report. Pathology reports were reviewed for every surgical specimen submitted for histological analysis, and pathological characteristics of the ovaries, Fallopian tubes, uterus, and cervix were systematically analyzed.

Data are reported as arithmetic means of individual data points with corresponding 95% confidence intervals (CIs). Continuous variables were analyzed by the unpaired two-sample *t*-test. For categorical variables, the Chi-square test or Fisher's exact test (when $n < 10$) was used to compare between the two groups. The Wilcoxon rank-sum test was used to analyze the differences in stages of prolapse between the control and BSO group. Graphs were generated, and statistical analyses were performed using GraphPad Prism 7.0. (San Diego, California, USA) Differences were accepted as statistically significant when $P < 0.05$.

Results

A total of 951 cases were initially identified for further screening. Upon further chart review, 217 cases were removed from analysis due to meeting exclusion criteria as previously described. This left 734 cases which were sorted into two groups: 385 patients were placed into the control group, and 349 patients were placed into the BSO group. Table 1 compares the baseline characteristics of patients in our study. The mean age of the control group was 57.1 years (range 25–90; 95% CI = 55.5–58.7), compared to a higher age of 60.2 years (range 33–77; 95% CI = 59.4–61.1; $P = 0.0008$) in the BSO group. In order to assess the number of women who were postmenopausal in each group, we created a subgroup of patients within the control and BSO groups who were ≥55 years old who we arbitrarily labeled as postmenopausal for supplemental analysis of our primary endpoints (readmission rate, LOS, postsurgery LOS, and estimated blood loss). In postmenopausal women, the control group was comprised of 194 women (50.4%), and the BSO group consisted of 255 women (73.1%), which was significant at $P < 0.0001$. There were no significant differences between the control and BSO groups when comparing mean values of BMI, gravidity, parity, alcohol use, and use of HRT at the time of surgery.

Table 1: Patient demographics

Variable	Value		
	Control group; *n*=385	BSO group; *n*=349	*P*
Age (years)			
Mean	57.1	60.2	0.001
95% CI	55.5-58.7	59.4-61.1	
Range	25-90	33-77	
Age ≥55 years, *n* (%)	194 (50.4)	255 (73.1)	<0.0001
BMI			
Mean	29.1	28.9	0.737
95% CI	28.5-29.7	28.3-29.5	
Range	16.6-50.7	16.7-52.3	
Smoking status, *n* (%)			
Current	68 (17.7)	43 (12.3)	0.001
Quit	91 (23.6)	112 (32.1)	
Never	226 (58.7)	194 (55.6)	
Alcohol use			
No	229 (59.5)	203 (58.2)	0.718
Yes	156 (58.7)	146 (41.8)	
Gravidity			
Mean	3.3	3.1	0.141
95% CI	3.1-3.5	2.9-3.3	
Range	0-27	0-14	
Parity			
Mean	2.7	2.6	0.354
95% CI	2.6-2.9	2.5-2.8	
Range	0-10	0-10	
HRT, *n* (%)	18 (4.7)	24 (6.8)	0.120

BMI: Body mass index, HRT: Hormone replacement therapy, CI: Confidence interval

To further characterize our patient population, we assessed the indications for surgery in Table 2. Overall, 446 (60.8%) patients in our study had SUI and 696 (94.8%) had POP, whereas 426 (58%) patients experienced both SUI and POP. When performing between group comparisons, there was no difference in the number of patients who experienced SUI, incomplete bladder emptying, and overactive bladder, but slightly fewer patients had POP in the control group compared to the BSO group (92.7% vs. 97.1%; $P = 0.0071$).

To characterize the severity of prolapse in our patients, as listed in Table 3, we examined operative reports and admission notes for the stage of prolapse as determined by the POP quantification system.[27] Overall, there was a difference between the control and BSO group in the stage of prolapse that patients presented to surgery with as determined by the Wilcoxan rank sum test ($P = 006$). Although there was a similar percentage of patients who presented with stage one and two prolapse between the two groups, there were fewer patients in the control group with stage three prolapse (121 [31.4%] vs. 156 [45.5%]), and a higher number with stage four prolapse (98 [25.5%] vs. 42 [12.2%]). No prolapse was noted in 134 (18.3%) patients. We also quantified the type of prolapse that patients experienced at the time of surgery in Table 3. In our cohort, a cystocele was present in 447 (60.9%) patients, uterovaginal prolapse was present in 511 (69.6%) patients, a rectocele was present in 233 (31.7%) patients, and vaginal vault prolapse was present in 154 (21%) of the patients. Different types of

Table 2: Indications for surgery

Variable	Value			
	All patients; *n*=734, *n* (%)	Control group; *n*=385, *n* (%)	BSO group; *n*=349, *n* (%)	*P*
SUI	446 (60.8)	235 (61.0)	211 (60.5)	0.877
POP	696 (94.8)	357 (92.7)	339 (97.1)	0.007
SUI + POP	426 (58.0)	220 (57.1)	206 (59.0)	0.606
Incomplete bladder emptying	113 (15.4)	50 (13.0)	63 (18.1)	0.058
Overactive bladder	80 (10.9)	46 (11.9)	34 (9.7)	0.338

BSO: Bilateral salpingo-oophorectomy, SUI: Stress urinary incontinence, POP: Pelvic organ prolapse

Table 3: Prolapse characteristics of women

Type of prolapse	Value, *n* (%)			
	All patients; *n*=734, *n* (%)	Control group; *n*=385, *n* (%)	BSO group; *n*=349, *n* (%)	*P*
Prolapse stage				
1	2 (0.2)	2 (0.5)	0 (0)	0.006
2	181 (24.7)	92 (23.9)	89 (25.9)	
3	277 (37.7)	121 (31.4)	156 (45.5)	
4	140 (19.1)	98 (25.5)	42 (12.2)	
Unspecified	134 (18.3)	72 (18.7)	62 (17.8)	
Type of prolapse				
Cystocele	447 (60.9)	207 (53.8)	240 (68.8)	0.016
Uterovaginal	511 (69.6)	238 (61.8)	272 (78.2)	< 0.0001
Rectocele	233 (31.7)	128 (33.2)	105 (30.1)	0.358
Vaginal vault	154 (21.0)	106 (27.5)	48 (13.8)	< 0.001
Perineocele	5 (0.7)	3 (0.8)	2 (0.6)	>0.999
Enterocele	7 (1.0)	6 (1.6)	1 (0.3)	0.126
Unspecified	37 (5.0)	28 (7.3)	9 (2.6)	0.004

BSO: Bilateral salpingo-oophorectomy

prolapse can often occur at the same time. One study reports the prevalence of two or more types of prolapse at 20%. We assessed the rates of concurrent types of prolapse to provide further information about baseline characteristics of the patients in our cohort [Appendix 1].

To characterize the pathological characteristics of tissues removed during surgery, pathology reports were examined. All organ pathologies were noted for the cervix, myometrium, endometrium, Fallopian tubes, and ovaries in Table 4. Of the 734 patients in our study, cervical pathology was not commented on in 218 of the cases (29.7%). Chronic cervicitis was noted in 469 (63.9%) patients, low-grade squamous intraepithelial lesions were noted in 2 (0.3%) patients, high-grade squamous intraepithelial lesions were noted in 3 (0.4%) patients, and endocervical adenocarcinoma was present in 1 (0.1%) of patients. There was a high proportion of patients who had leiomyomas (n = 210, 28.6%) and adenomyosis (n = 180, 24.5%). The majority (n = 186, 88.6%) of patients who had leiomyomas had intramural leiomyomas [Appendix 2]. Within the endometrium, 58 (7.9%) patients had hyperplastic polyps, and 11 (1.5%) patients had simple or complex hyperplasia.

Next, we examined the pathology reports of women in the BSO group to determine the pathological characteristics of the Fallopian tubes and ovaries, as shown in Table 5. Of the 349 patients in the BSO group, 115 (33%) had benign paratubal cysts, and 12 (3.4%) had hydrosalpinx. Benign ovarian inclusion cysts were found in 72 (20.6%) of patients and 31 (8.9%) had serous cystadenomas. Sertoli-leydig tumors, adult granulosa cell tumors, and mature cystic teratomas were found in 6 (1.8%) of patients. Only one patient was diagnosed with ovarian serous adenocarcinoma.

To evaluate the perioperative outcomes of performing BSO concomitantly with other procedures for POP or SUI, we calculated the mean postsurgery LOS, estimated blood loss, and 30-day readmission rate for patients in our cohort [Table 6] as well as performed a subanalysis for all women of age ≥55 years [Appendix 3]. For all patients, there was no difference in the mean overall LOS (39.1 h vs. 36.5 h), postsurgery LOS (35.2 h vs. 34.1 h), and all-cause 30-day readmission rates (14.2% vs. 11.6%, respectively, P = 0.3085) between the control and BSO group respectively. There was decreased blood loss in the BSO group compared to control (40.8 ml vs. 67.2; $P < 0.0001$). As seen in the subanalysis of women of age ≥ 55 years in Appendix 3, there was no difference in all-cause 30-day readmission rate (10.3% vs. 9.8%; P = 0.8598) or overall LOS (37.4 h vs. 35.6 h) between the control and BSO group. Interestingly though, postmenopausal women in the BSO group had decreased postsurgery LOS (33.4 h vs. 37.4 h; P = 0.0208) and decreased blood loss (35.9 ml vs. 82.7 ml; $P < 0.0001$) compared to the control group. There was no injury to bladder or ureters noted.

In addition, to further strengthen our confidence that the types of procedures performed in the control and BSO groups were homogenous with each other and that the surgeon had access to the ovaries without performing additional dissection, we performed an additional subanalysis of patients from the control and BSO groups in which the gross appearance of the ovaries had been commented on in the operative report. For this group, we re-analyzed the baseline patient characteristics and primary endpoints and found no significant differences between the control and BSO group [Appendixes 4 and 5] that had not been noted before in Tables 1 and 6.

Table 4: Organ pathology of all patients (*n*=734)

Variable	Value, *n* (%)
Cervix	
Chronic cervicitis	469 (63.9)
Benign endocervical polyps	19 (2.6)
Nabothian cysts	11 (1.5)
Low-grade squamous intraepithelial lesion	2 (0.3)
High-grade squamous intraepithelial lesion	3 (0.4)
Endocervical adenocarcinoma	1 (0.1)
Unremarkable	29 (3.9)
Not specified	218 (29.7)
Myometrium	
Leiomyoma	210 (28.6)
Adenomyosis	180 (24.5)
Unremarkable	186 (25.3)
No tissue sent	213 (29.0)
Endometrium	
Basal endometrium	138 (18.8)
Secretory phase	25 (3.4)
Proliferative phase	101 (13.8)
Atrophic polyps	37 (5.0)
Hyperplastic polyps	58 (7.9)
Atrophic	215 (29.2)
Simple hyperplasia	6 (0.8)
Complex hyperplasia	5 (0.7)
Endometrioid adenocarcinoma	1 (0.1)
Not specified	211 (28.7)

Table 5: Fallopian tube and ovarian pathology in the bilateral salpingo-oophorectomy group (*n*=349)

Variable	Value, *n* (%)
Fallopian tubes	
Hydrosalpinx	12 (3.4)
Benign paratubal cysts	115 (33.0)
Unremarkable	210 (60.2)
Ovaries	
Benign inclusion cysts	72 (20.6)
Follicular cyst	17 (4.9)
Luteinized cyst	13 (3.7)
Serous cystadenoma	31 (8.9)
Serous cystadenofibroma	4 (1.1)
Serous adenofibroma	4 (1.1)
Mucinous adenofibroma	1 (0.3)
Endometriosis	4 (1.1)
Transitional cell adenofibroma	1 (0.3)
Sertoli-Leydig tumor	2 (0.6)
Adult granulosa cell tumor	2 (0.6)
Serous adenocarcinoma	1 (0.3)
Mature cystic teratoma	2 (0.6)
Unremarkable	188 (53.9)

Discussion

Compared to 2001, an increasing number of women are seeking care for pelvic floor disorders annually, and it is estimated that by 2050, 58.2 million women will have at least one pelvic floor disorder.[28] With the concomitant increase in the total number of pelvic floor procedures that will be performed, it is paramount that pelvic reconstructive surgeons provide comprehensive care for these patients, including consideration of prophylactic BSO for ovarian cancer prevention.[29]

Surgery is indicated for the treatment of POP in women who are bothered by their POP and have failed or declined nonsurgical treatments. There are various vaginal and abdominal surgical approaches for the treatment of POP. Important considerations for deciding the type and route of surgery include but not limited to the type and severity of prolapse, the nature of the symptoms (e.g., presence of urinary, bowel, or sexual dysfunction), the patient's general health and comorbidities, patient preference, and the surgeon's expertise.

In the present study, we assessed the safety of performing prophylactic BSO in women who present for surgical correction of POP and/or SUI, and we report the incidence of malignant and nonmalignant pathological conditions in our cohort of patients. Current data and models predict that population-risk women have a 1% risk of developing ovarian cancer by age 80, yet it remains the leading cause of death from cancer of the female reproductive tract.[30] There has been increasing interest in performing opportunistic salpingectomy (OS) for ovarian cancer prophylaxis and several studies have showed the efficacy and safety of performing this procedure at the time of hysterectomy, but all of the studies were performed in patient populations that were predominantly premenopausal women.[30-36] A recent histopathological study showed that even though no direct connection between the fallopian tube and ovary is thought to exist, microscopic fimbria are adherent to the ovary at the time of histopathological analysis.[37] Thus, many women who are having OS for ovarian cancer prophylaxis could still be at high risk of developing ovarian cancer from premalignant microscopic fimbria cells.

Due to the negative impact on overall health and mortality from performing BSO in premenopausal women, we agree that the best surgical option for ovarian cancer prophylaxis for premenopausal women would be OS.[38] However, given that 70% of invasive ovarian carcinomas arise from the fallopian tube and fimbriae tissue, we are concerned that OS may not be the most appropriate procedure for prophylaxis in postmenopausal patients when BSO could be performed without additional complications. A large population-based study in Sweden by Falconer *et al*. looked at the rate of ovarian cancer in postmenopausal women (mean age 63)

Table 6: Perioperative variables of surgical complications

Variable	Value		
	Control group; *n*=385, *n* (%)	BSO group; *n*=349, *n* (%)	*P*
30-day all cause readmission, *n* (%)	55 (14.2)	41 (11.6)	0.309
Postsurgery LOS (h), mean±SD	35.2±18.3	34.1±24.6	0.492
EBL (ml), mean±SD	67.2±77.6	40.8±46.2	<0.0001

BSO: Bilateral salpingo-oophorectomy, LOS: Length of stay, EBL: Estimated blood loss, SD: Standard deviation

who received hysterectomy with BSO compared to a control group that was premenopausal (mean age 36), however data on the length of hospitalization, readmission rate, and other indicators of complications from the procedure were not reported in that study.[39] Similar to our findings, a recent population-based study in Taiwan by Lai *et al*. showed that performing BSO with hysterectomy compared to hysterectomy alone in women >55 years old was associated with decreased LOS and decreased risk of developing surgical complications.[40] Unfortunately, that study did not report clinical variables such as BMI or exposure to HRT, which could have led to confounding results.

Although various groups have looked at the long-term effects of performing BSO in premenopausal women, there have been no studies that have evaluated the role of prophylactic BSO with pelvic surgery for benign urogynecological conditions.[41] A recent study that surveyed 117 pelvic surgeons examined concerns that surgeons had regarding performing OS. The authors found that the most common reason for not performing OS was that the procedure may increase blood loss.[30]

The primary aim of this study was to evaluate the safety of performing prophylactic BSO with procedures to repair POP and/or SUI by assessing perioperative variables. Our study showed no difference in LOS between the control and BSO groups. In fact, there was 40% less blood loss in the BSO group than in the control group. In addition, further analysis of postmenopausal women (≥55 years of age) in our cohort showed that the group receiving prophylactic BSO had reduced LOS after surgery and reduced blood loss compared to control, similar to the study by Lai *et al*.[40] Although we feel the decrease in postsurgery LOS and blood loss in the BSO group in postmenopausal women is negligible clinically, it does provide compelling evidence that performing prophylactic BSO in postmenopausal women is a safe procedure that clinicians should discuss with their patients when counseling patients on surgical options. This is the first study to examine the safety and effectiveness of performing prophylactic BSO in a cohort of patients in the US who present for a surgical approach to repair POP and/or SUI.

The secondary aim of this study was to demonstrate the feasibility of detecting premalignant and early-stage lesions by performing prophylactic BSO with routine procedures for repair of POP and SUI. Due to the low prevalence of ovarian cancer, our study was not powered to detect a large number of ovarian cancer cases. We feel that the prevalence of premalignant and malignant lesions in our cohort of patients is similar to other case series that have been published. The risk of incidental premalignant and malignant pathology in the uterus has been reported to be 0.2%–4.2%, and the majority of these cases occurred in postmenopausal women.[42-44] Consistent with these studies, we found that 1.6% of our patients had endometrial hyperplasia or endometrial cancer, all of who were ≥54 years of age.

Multiple papers have been published illustrating the different types of epithelial ovarian tumors and how they are thought to progress from benign precursor lesions to malignant tumors.[45] It is notable that in our study, which only had 349 patients in the salpingo-ophorectomy arm, we were able to detect benign inclusion cysts in 72 (20.6%) patients and serous cystadenomas in 31 (8.9%) patients, both of which mounting molecular evidence suggests are precursor lesions to low-grade serous tumors. Our study is the first study to show that in women presenting for pelvic surgery for repair of POP or SUI, performing prophylactic BSO has the additional benefit of detecting precursor lesions to ovarian cancer.

Conclusion

While no study has looked at the long-term health outcomes of performing BSO in postmenopausal women, our data provide clinicians with information that can be used to counsel patients about the safety of BSO at the time of surgery for POP as well as the prevalence of premalignant lesions that may be expected upon histopathology. We believe this should be taken into consideration, along with the current recommendations of the various societies regarding risk reducing oophorectomy. In the future, further studies that assess the long-term health effects of performing BSO in postmenopausal women are warranted, so that a more accurate assessment of long-term risks versus benefits can be established. In summary, we provide evidence that there is no increased harm or acute complications to the patient

by performing prophylactic BSO at the time of surgery for repair of POP and/or SUI. Based on these findings we would recommend physicians give more consideration to finding appropriate candidates for risk reducing BSO at time of abdominal surgery to repair POP and/or SUI.

Financial support and sponsorship

No funding from any was used to support this research.

Conflicts of interest

There are no conflicts of interest.

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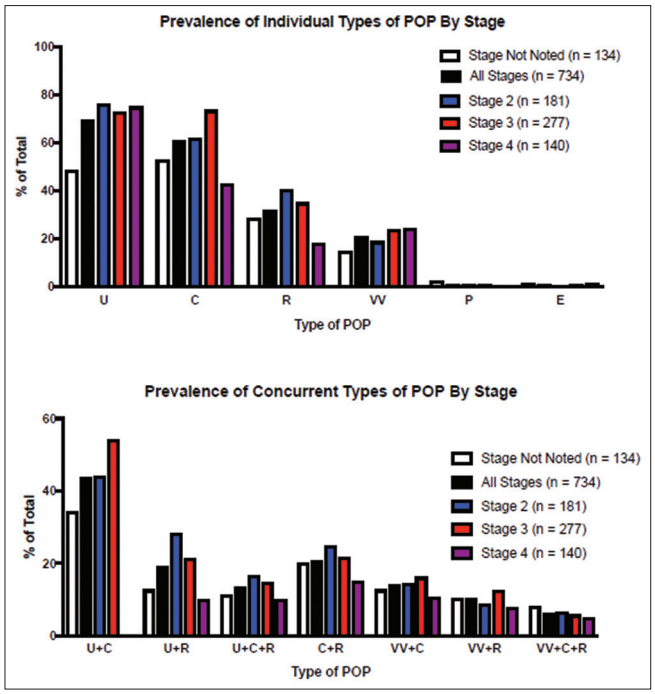
Appendixes



Appendix 1: Prevalence of Types of POP By Stage. U = uterovaginal, C = cycstocele, R = rectocele, VV = vaginal vault, P = perioneocele, E = enterocele

Appendix 2: Percentage of various subtypes of leiomyomas (*n*=210)

Leiomyoma Subtype	Value, n (%)
Intramural	186 (88.6)
Subserosal	31 (14.8)
Submucosal	28 (13.3)

Appendix 3: Quality measures of surgical complications in postmenopasue women

Variable	Value		
	Control Group n = 194	BSO Group n = 255	p-value
30-Day All-cause Readmission, n (%)	20 (10.3)	25 (9.8)	0.8598
Overal Length of Stay in Hours, Mean (StDev)	37.4 (22.0)	35.6 (14.8)	0.2966
Post-surgery Length of Stay in Hours, Mean (StDev)	37.4 (22.0)	33.4 (14.9)	0.0208
Estimated Blood Loss in ml, Mean (StDev)	82.7 (93.5)	35.9 (34.5)	<0.0001

Appendix 4: Demographics of patients with Noted ovarian appearance

Variable	Value		
	Control Group; N = 259	BSO Group; N = 333	p-value
Age at time of surgery (y)			
Mean	52.0	60.2	< 0.0001
95% CI	50.3 - 53.8	59.4 - 61.1	
Range	25 - 88	33 - 77	
BMI			
Mean	29.4	28.9	0.3094
95% CI	28.6 - 30.1	28.3 - 29.5	
Range	16.6 - 50.7	16.7 - 52.3	
Smoking Status, n (%)			
Current	50 (19.3)	42 (12.6)	0.001
Quit	52 (20.1)	108 (32.4)	
Never	157 (60.6)	183 (55.0)	
Alcohol Use, n (%)			
No	143 (55.2)	193 (58.0)	0.5035
Yes	116 (44.8)	140 (42.0)	
Gravidity			
Mean	3.3	3.1	0.1870
95% CI	3.0 - 3.6	2.9 - 3.3	
Range	0 - 27	0 - 14	
Parity			
Mean	2.7	2.6	0.7223
95% CI	2.5 - 2.9	2.5 - 2.8	
Range	0 - 10	0 - 10	
HRT, n (%)	8 (3.1)	24 (7.2)	0.0279

Appendix 5: Perioperative variables of surgical complications in patients with Noted ovarian appearance

Variable	Value		
	Control Group; N = 259	BSO Group; N = 333	p-value
Age at time of surgery (y)			
Mean	52.0	60.2	< 0.0001
95% CI	50.3 - 53.8	59.4 - 61.1	
Range	25 - 88	33 - 77	
BMI			
Mean	29.4	28.9	0.3094
95% CI	28.6 - 30.1	28.3 - 29.5	
Range	16.6 - 50.7	16.7 - 52.3	
Smoking Status, n (%)			
Current	50 (19.3)	42 (12.6)	0.001
Quit	52 (20.1)	108 (32.4)	
Never	157 (60.6)	183 (55.0)	
Alcohol Use, n (%)			
No	143 (55.2)	193 (58.0)	0.5035
Yes	116 (44.8)	140 (42.0)	
Gravidity			
Mean	3.3	3.1	0.1870
95% CI	3.0 - 3.6	2.9 - 3.3	
Range	0 - 27	0 - 14	
Parity			
Mean	2.7	2.6	0.7223
95% CI	2.5 - 2.9	2.5 - 2.8	
Range	0 - 10	0 - 10	
HRT, n (%)	8 (3.1)	24 (7.2)	0.0279