ONCOLOGY

Opportunistic salpingectomy: uptake, risks, and complications of a regional initiative for ovarian cancer prevention

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OBJECTIVE: The purpose of this study was to assess the uptake and perioperative safety of bilateral salpingectomy (BS) as an ovarian cancer risk-reduction strategy in low-risk women after a regional initiative that was aimed at general gynecologists in the province of British Columbia, Canada.

STUDY DESIGN: This population-based retrospective cohort study evaluated 43,931 women in British Columbia from 2008-2011 who underwent hysterectomy that was performed with and without BS or bilateral salpingo-oophorectomy or who underwent surgical sterilization by means of BS or tubal ligation. Parameters that were examined include patient age, operating time, surgical approach, indication, length of hospital stay, and perioperative complications.

RESULTS: There was an increase in the uptake of hysterectomy with BS (5-35%; $P < .001$) and BS for sterilization (0.5-33%; $P < .001$) over the study period, particularly in women <50 years old. Minimal additional surgical time is required for hysterectomy with BS (16 minutes; $P < .001$) and BS for sterilization (10 minutes; $P < .001$) compared with hysterectomy alone or tubal ligation, respectively. No significant differences were observed in the risks of hospital readmission or blood transfusions in women who underwent hysterectomy with BS (adjusted odds ratio [aOR], 0.91; 95% confidence interval [CI], 0.75—1.10; and aOR, 0.86; 95% CI, 0.67—1.10, respectively) or BS for sterilization (aOR, 0.8; 95% CI, 0.56—1.21; and aOR, 0.75; 95% CI, 0.32—1.73, respectively). From 2008-2011 the proportion of hysterectomies with BS performed by open laparotomy decreased from 77-44% with uptake in laparoscopic, vaginal, and combined procedures ($P < .001$).

CONCLUSION: After our 2010 educational initiative, there has been a shift in surgical paradigm in our province. This cancer prevention approach does not increase the risk of operative/perioperative complications and appears both feasible and safe.

Key words: educational campaign, ovarian cancer, prevention, safety, salpingectomy

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In the developed world, ovarian cancer accounts for more deaths than any other cancer of the female reproductive tract. Each year >225,000 ★EDITORS' CHOICE★ women will experience ovarian cancer, and 140,000 women will die of the disease.[1] There are no effective screening tests,[2-6] and, in the past 30 years, advances in treatment have yielded marginal differences in overall survival.[7,8]

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Epithelial ovarian cancer is recognized now to encompass 5 distinct diseases that differ in histologic appearance, clinical presentation, response to therapy, likelihood of recurrence, molecular aberrations, and site of origin.[9,10] High-grade serous cancer is the most common histologic subtype; the belief is that most of these cancers originate in the distal fallopian tube.[11-18] In addition, the fallopian tube likely plays a permissive role in the development of the next 2 most common subtypes, endometriosis-associated clear cell and endometrioid ovarian cancers, which serve as conduits for the passage of ectopic endometrium and infectious/inflammatory agents[19-22] (Video 1). The importance of the role of the fallopian tube in ovarian cancer is further evident in studies that demonstrate lower rates of ovarian cancer in women who have had their fallopian tubes disrupted by tubal ligation.[23-25]

These observations prompted our gynecologic tumor group in British Columbia (BC) to initiate a province-wide ovarian cancer prevention initiative. We hypothesized that removal of the fallopian tubes (bilateral salpingectomy [BS]), even in the general population of women who are at baseline risk for the development of ovarian cancer, would reduce the incidence of ovarian cancer and change the histologic distribution of epithelial ovarian cancer in years to come. Further, we believed that this procedure was well within the surgical repertoire of gynecologic surgeons and that access to the fallopian tubes was feasible during other routine gynecologic procedures such as hysterectomy or sterilization. Finally, experience with BS over the past 5-10 years gave us confidence that the surgical removal of the tubes would not result in the negative consequences of oophorectomy.[26-28] In September 2010, we sent an informational and instructional DVD (Videos 1-5) that was directed at all obstetricians and gynecologic surgeons in BC and that outlined the role of the fallopian tube in ovarian cancer and explained the association of high-grade serous cancer with inherited *BRCA1/2* mutations. We made 3 recommendations: (1) consideration of surgical removal of the fallopian tubes at the time of hysterectomy, even when ovaries were being preserved, (2) consideration of excisional BS for permanent sterilization in place of tubal ligation, and (3) referral of all patients with high-grade serous cancer for hereditary cancer counselling and genetic testing for *BRCA1/2* mutations. The first 2 interventions were aimed at women who were in the general population who are at low risk for the development of ovarian cancer (ie, risk of approximately 1.5-2% over her lifetime). The third recommendation strived to identify women who were at high risk for the development of ovarian cancer (ie, risk of up to 50% over her lifetime), because identification of the incident case with a *BRCA1/2* mutation in a family enables other family members to be tested and risk-reducing strategies (chemical, surgical) to be initiated. In combination, these recommendations were projected to reduce ovarian cancer rates in the province of BC by 40% over the next 20 years.

Herein, we present the provincial statistics on the uptake of salpingectomy procedures in low-risk women across the province of BC before and after the 2010 campaign. We determine the additional operating room (OR) time that is required, address surgical approach and regional variation, and determine whether there are operative or perioperative complications that might be attributed to the performance of salpingectomy alone or in addition to other procedures.

Materials and Methods

Database and requested parameters

This large retrospective cohort study was conducted with the use of data from the Canadian Institute of Health Information Discharge Abstract Database that captures demographic, administrative, and clinical information for all hospital discharges (inpatient and day surgeries) in Canada. Previous studies that validated the Discharge Abstract Database have reported a high degree of accuracy in the procedure codes and primary diagnosis codes.[29] Ethics approval was obtained from the University of British Columbia Clinical Research Ethics Board. All women who underwent any or any combination of salpingectomy, hysterectomy, oophorectomy, fimbriectomy, or tubal ligation in the Canadian province of BC from Jan. 1, 2008 (before campaign initiation), to Dec. 31, 2011 (after the campaign and most recent complete calendar year data that were available at the time of our request), were included in this study. Patients who were <15 years old and patients who were not coded as being of female sex were excluded. Canadian Classification for Health Intervention codes were used to identify patients who underwent the surgical procedures of interest. A diagnosis code, *International Classification of Diseases,* 10th edition (ICD-10)-CA Z30.2, indicated that the encounter was for sterilization purposes specifically. The Discharge Abstract Database provided information on operating time (time from first skin incision until completed skin closure), surgical approach (vaginal, laparoscopic, combined vaginal and laparoscopic, open), surgical indication, and length of hospital stay (LOS). Data were also gathered for patients who required blood transfusion and/or readmission to hospital, which reflected possible surgical complications. Parameters that were chosen for this study are of interest from an educational/knowledge translation perspective and were selected based on a provincial and cross-Canada survey of practicing gynecologists who identified concerns that were associated with the recommended change in surgical practice.[30,31] This study will inform which patient groups are appropriate candidates for the preventative surgery and which surgical practices are feasible across health authorities of varying resources. All statistical analyses were performed with Stata software (version 12; StataCorp, College Station, TX).

Procedural uptake

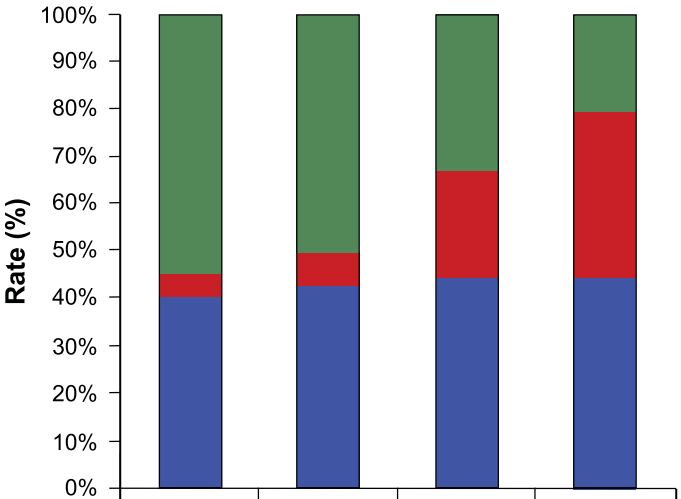
The rates of salpingectomy between 2008-2011, which include the number of hysterectomies that were performed with and without BS or salpingo-oophorectomy and the number of sterilizations that were performed with BS or tubal ligation, were examined as measures of the baseline rates for the surgical procedures before the 2010 educational campaign and the uptake of the recommended change in practice after the campaign. χ^2 analysis was

performed to indicate whether there were significant differences in the rate of procedures across the 4-year time period.

Operative/perioperative measures

To investigate whether BS was associated with a higher risk of complications, data for women who underwent hysterectomy were divided into 3 categories that were based on surgical procedures received: (1) hysterectomy alone (the reference group, because these women were expected to be at lowest risk for complications), (2) hysterectomy with BS but no oophorectomy, and (3) hysterectomy with bilateral salpingo-oophorectomy (BSO). Comparisons were also made between the cohorts of women who had a diagnosis code that indicated that the encounter was for sterilization purposes and who underwent either (1) tubal ligation (the reference group, because this was standard practice for sterilization) or (2) isolated BS (defined as BS without accompanying hysterectomy or oophorectomy). Because the continuous variables were distributed normally, data were presented as means with standard deviations. Differences in the age of patients, OR time, LOS, hospital readmission, and the rate of blood transfusion were analyzed by χ^2 tests for categoric variables and independent samples *t* tests for continuous variables. We ran logistic regressions, controlling for patient age as a potential confounder and cesarean section within that hospital stay among women who underwent tubal ligation and salpingectomy (because these procedures frequently occurred in the same hospital stay and both influence the rate of complications). We obtained aORs for the risk of hospital readmission and blood transfusion. All of these parameters were also compared for each year of the study period in cohorts of women who underwent hysterectomy with BS or isolated BS that was performed by different surgical approaches that included open procedure (the reference category), laparoscopic, vaginally, or using a combined (laparoscopic and vaginal) approach and among women who underwent isolated BS by open procedure (the reference category), laparoscopic, or vaginal approach.

FIGURE 1
Specific procedures that were performed from 2008-2011 in British Columbia



	2008	2009	2010	2011
Hysterectomy alone	55% (n = 2950)	50% (n = 2610)	33% (n = 1762)	21% (n = 1040)
Hysterectomy with bilateral salpingectomy	5% (n = 267)	7% (n = 378)	23% (n = 1240)	35% (n = 1785)
Hysterectomy with bilateral salpingo-oophorectomy	40% (n = 2147)	42% (n = 2197)	44% (n = 2341)	44% (n = 2219)

Proportion of women who underwent hysterectomy alone (*green*), hysterectomy with bilateral salpingectomy (*red*), and hysterectomy with bilateral salpingo-oophorectomy (*blue*).

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Regional variation

There are 16 Health Service Delivery Areas (HSDAs) in BC that are based on geography and population distribution. We were interested to see whether the educational campaign had influenced all regions equally or whether there might be isolated areas where knowledge translation had failed. We investigated the regional variation in the rates of hysterectomy alone or in combination with BS or BSO and the rates of isolated salpingectomy across HSDAs as well as regional differences in surgical approach for these procedures.

RESULTS

Procedural uptake

There were 43,973 women who underwent ≥1 of our requested surgical procedures. Of these women, 4 were dropped because they were not coded as female, and 38 were dropped because they were <15 years old, which left us with a total study population of 43,931 women. In our sample, there were no missing data on primary procedure, primary diagnostic code, or age. Women for whom data on OR time were missing were excluded from the descriptive analysis of mean OR time. In this study population 21,003 women underwent hysterectomy; 21,411 women underwent BS; 13,719 women underwent tubal ligation, and 15,285 women underwent oophorectomy. Although procedures were not mutually exclusive, women were only included in 1 group based on the procedures that they had received (eg, a woman who underwent a hysterectomy with salpingectomy is included only in the group of women who underwent hysterectomy with salpingectomy and not

also included in the hysterectomy group and salpingectomy group). Women in our sample had a mean age of 44.7 years.

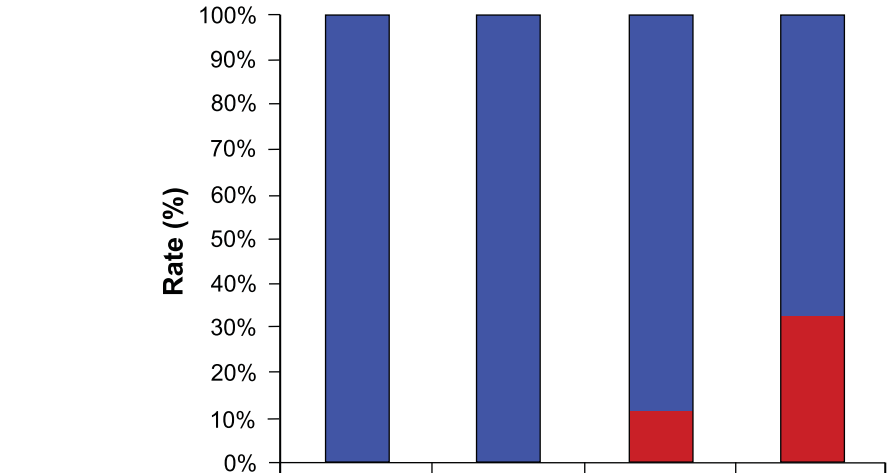
The share of hysterectomies that were performed with salpingectomy increased significantly between 2008 and 2011 ($P < .001$; Figure 1). Although only 45% of hysterectomies included removal of the fallopian tubes (BS or BSO) in 2008, this number had increased to 79% in 2011, which represented a statistically significant increase in the number of hysterectomies with salpingectomies across our study period ($P < .001$).

The rate of hysterectomy with BS (without oophorectomy) increased from 5% of all hysterectomy procedures in 2008 to 35% in 2011 ($P < .001$). The greatest change was observed after the September 2010 campaign; 80.7% of all hysterectomies with salpingectomy that were performed in 2010 were performed between Sept. 1 and Dec. 31, 2010. The numbers of radical hysterectomies were relatively stable over the time period (mean, 73) but radical hysterectomies with BS (and ovarian preservation) increased from 9% before the campaign to 24% after the campaign.

Figure 2 shows the share of patients who underwent tubal ligation or isolated salpingectomy who had a diagnosis code that indicated that the encounter was for sterilization. Although very few isolated BSs (0.5%) were being performed for those with a diagnosis of sterilization in 2008 and 2009, by 2011, 33.3% of sterilizations were done with the use of isolated BS, which represented a statistically significant increase in the use of salpingectomy for sterilization ($P < .001$). Again a remarkable difference was observed after the September 2010 campaign because 98.1% of all salpingectomies for sterilization that were done in 2010 were done after the September campaign.

The number of hysterectomies with BS that were performed with a diagnosis code that indicated prophylactic (risk-reducing) surgery (ICD-10-CA Z40.0, Z40.8, or Z40.9) in years 2008-2011 were 1, 1, 106, and 152, respectively (a statistically significant increase over time; $P < .001$) and isolated BS carried out with a prophylactic code also increased 1, 0, 52, and 97, respectively, across the 4 study years ($P < .001$). In contrast, the corresponding numbers of prophylactic BSOs over the study period did not change at 64, 54, 64, and 72 over the 4 years ($P = .320$). The breakdown of these procedures by patient age is illustrated in Table 1 and Figure 3. The number of women who had a hysterectomy with BS increased in all age groups, particularly in women who were <50 years old (Figure 3, B; $P < .001$); this age cohort also had an increased number of isolated salpingectomies in 2011 compared with 2008 ($P < .001$; Figure 3, D). The number of women who underwent fimbriectomy only (without hysterectomy, oophorectomy, or salpingectomy) also increased over the study period ($P = .019$); this procedure was most commonly performed in women who were <40 years old (Figure 3, E).

FIGURE 2
Procedures with a diagnosis code that indicated the encounter was for sterilization that were performed from 2008-2011 in British Columbia



	2008	2009	2010	2011
Tubal ligation	99.6% (n = 3931)	99.7% (n = 3846)	88.6% (n = 3304)	66.7% (n = 2236)
Salpingectomy as sterilization	0.4% (n = 17)	0.3% (n = 11)	11.4% (n = 426)	33.3% (n = 1115)

Proportion of women who underwent isolated bilateral salpingectomy (*red*) or tubal ligation (*blue*).

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Operative/perioperative measures

Mean OR time was significantly longer in the hysterectomy with BS group ($P < .001$) and the hysterectomy with BSO group ($P < .001$) and compared with hysterectomy alone (Table 2); however, the differences were only 16.3 minutes and 22.4 minutes on average for each group, respectively. Table 2 also shows that LOS among those women who were discharged home after hysterectomy alone (mean LOS, 2.52 days) was slightly longer than among those who underwent hysterectomy with BS (mean LOS, 2.37 days; $P = .010$). There were no significant differences in rates of blood transfusion across the 3 groups of hysterectomy patients; approximately 2.5% of patients received a blood transfusion in all groups. There were significant differences across the groups in rates of hospital readmission; patients who had a hysterectomy with BSO had a higher rate of readmission to the hospital (5.7% compared with 4.5% for hysterectomy alone; $P < .001$), but this was not observed for hysterectomy with BS ($P = .632$, no difference from hysterectomy alone).

Mean OR time for sterilization by BS was longer by 10.2 minutes than tubal ligation (mean, 61.0 vs 71.2 minutes; $P < .001$). There were no statistically significant differences in LOS among patients who underwent salpingectomy for sterilization (mean LOS, 1.23 days) as compared with tubal ligation (mean LOS, 1.23 days; $P = .117$). Although both procedures are typically outpatient procedures, both groups contained women who stayed for postpartum care after live birth (41.1% of women in the tubal ligation group and 37.2% of women in the salpingectomy for sterilization group). The mean LOS decreases to 0.11 and 0.10 days when women in the postpartum period are removed from the tubal ligation and salpingectomy for sterilization groups, respectively (Table 2).

We wanted to examine differences in crude odds ratios to determine whether there were crude differences in complication rates among patients who undergo salpingectomy to ascertain any high-level difference in safety profiles among the procedures. However, the age group of women differed significantly (as expected) and women who underwent tubal ligation and isolated salpingectomy were much more likely to have just undergone delivery by cesarean section. Thus, we calculated age-adjusted odds ratios (aORs) for the hysterectomy groups and controlled for cesarean delivery in the tubal ligation and isolated salpingectomy groups to examine the risk of readmission to the hospital and blood transfusion (Table 2). Women who had a hysterectomy with BS were at no increased risk for readmission to the hospital or blood transfusion compared with those who had a hysterectomy alone (aOR, 0.91; 95% confidence interval [CI], 0.75−1.10 and aOR, 0.86; 95% CI, 0.67−1.10 for readmission and blood transfusion, respectively). With respect to women whose encounter was for sterilization purposes, women who underwent a BS were not at increased risk for either readmission or blood transfusion (aOR, 0.83; 95% CI, 0.56−1.23 and aOR, 0.77; 95% CI, 0.56−1.23, respectively).

Figure 4 shows the total number of hysterectomies with BS and the total number of isolated BSs that were performed by different surgical approaches across the study years. The proportion of hysterectomies with BS that were performed by open procedure decreased significantly from 77% in 2008 to 44% in 2011 ($P < .001$; Figure 4, A). For isolated salpingectomies, although the total number of these procedures increased dramatically from 2008-2011, there was no significant difference in surgical approach across time ($P = .127$; Figure 4, B).

Table 3 shows the differences in patient age, OR time, LOS and readmission, blood transfusion rates, and aORs for hysterectomies with BS, and isolated salpingectomies by surgical approach. OR time was significantly longer for laparoscopic approach and the

TABLE 1
Number of procedures each year by patient age

Procedure by age range, y	No. of women by year			
	2008	2009	2010	2011
Hysterectomy alone	2950	2610	1762	1040
15-39	683	622	400	198
40-44	677	542	378	188
45-49	700	595	358	143
50-54	275	228	159	97
≥55	615	623	467	414
Hysterectomy with bilateral salpingectomy	267	378	1241	1785
15-39	96	116	307	494
40-44	79	108	355	479
45-49	67	114	392	515
50-54	18	29	113	187
≥55	7	11	74	110
Hysterectomy with bilateral salpingo-oophorectomy	2147	2197	2341	2119
15-39	173	193	208	176
40-44	232	239	229	156
45-49	435	437	455	363
50-54	422	375	447	389
≥55	885	953	1002	1035
Isolated salpingectomy	124	154	734	1492
15-39	60	68	435	934
40-44	17	34	161	350
45-49	31	33	87	132
50-54	6	10	37	49
≥55	10	9	14	27
Fimbriectomy	238	246	296	288
15-39	167	168	196	201
40-44	37	29	53	33
45-49	19	20	22	34
50-54	5	15	13	10
≥55	10	14	12	10

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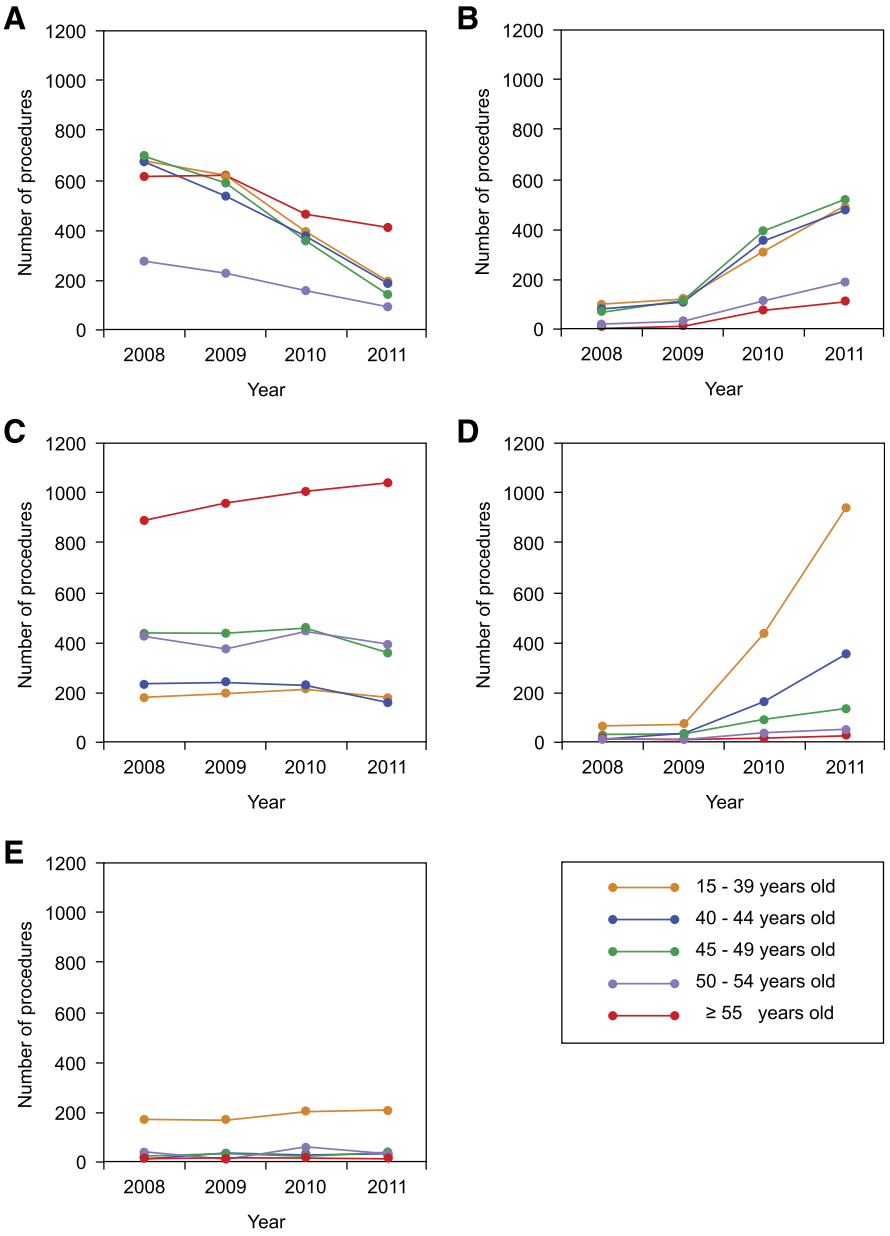
FIGURE 3
Number of women in British Columbia who underwent a procedure from 2008-2011 distributed according to patient age at the time of the surgery



A, Hysterectomy alone (n = 8362 women); **B**, hysterectomy with bilateral salpingectomy (n = 3670 women); **C**, hysterectomy with bilateral salpingo-oophorectomy (n = 8904 women); **D**, isolated salpingectomy (n = 2504 women); **E**, fimbriectomy (n = 1068 women). 15-39 years old, *orange*; 40-44 years old, *blue*; 45-49 years old, *green*; 50-54 years old, *purple*; ≥55 years old, *red*.

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combined approach than for open procedure (mean OR time, 168.1 and 155.3 minutes vs 124.7 minutes, respectively; all $P < .001$) and significantly shorter for the vaginal approach (mean OR time, 112.3 minutes; $P < .001$). Rates of readmission for hysterectomy with BS were lowest in those women who had a vaginal approach (2.4%; aOR, 0.51; 95% CI, 0.37–0.70), and combined modality also conferred a reduced risk of readmission (aOR, 0.71; 95% CI, 0.59–0.86).

Similarly, a laparoscopic approach for BS yielded shorter OR times ($P < .001$); however, all OR times for BS appear longer than expected because other procedures (eg, ablation of endometriosis, intrauterine device retrieval) may have been performed at the same time. When restricting the data to women who received no other procedures, the mean OR time was 95.4, 63.2, and 58.5 minutes, respectively, for the open procedure, laparoscopic and vaginal procedures. LOS was significantly shorter among those women who underwent laparoscopic salpingectomy compared with the open procedure (0.33 vs 3.34 days, respectively; $P < .001$). These numbers were influenced by concurrent deliveries and postpartum stays because 70.4% of the women who underwent open procedure salpingectomy were recovering after delivery vs 2.2% of the women who underwent a laparoscopic procedure. Readmission rates were significantly lower with the laparoscopic or vaginal approach; however, the number of vaginal procedures was very small, and these numbers should be interpreted with caution (Table 3).

Regional variation

Across the 16 HSDAs, there was significant variation in the proportion of hysterectomies that included only BS and no oophorectomy. The share of hysterectomies with BS across the 2008 and 2011 study period varied from a high of 25% in 1 HSDA to a low of 1% in another HSDA. By 2011, this had changed to a high of 49% and a low of 3%. Also, the HSDA that performed only 3% of hysterectomies with salpingectomy in 2011 was an outlier with the next lowest HSDA that performed 18% of hysterectomies with salpingectomy and no oophorectomy by 2011.

There was also considerable variation in surgical approach across HSDAs. There was 1 HSDA that performed 100% of their hysterectomies with BS by open procedure through the full study period. Among the other HSDAs, the rate of the laparoscopic approach varied from a low of 1% in several HSDAs to a high of 36% in 1 HSDA; the rate of the vaginal approach varied from a low of 5% to a

high of 43%, and the rate of the combined approach varied from a low of 5% to a high of 55%. By 2011 laparoscopic and combined approaches had increased in many HSDAs (by 2011 the new highs were 49% and 58% for these approaches, respectively).

COMMENT

Given the strength and the volume of literature that support the important role of the fallopian tube in ovarian cancer, our provincial team of gynecologic oncology surgeons have been performing BS at the time of hysterectomy for many years. This preference has been imparted to our residents and Fellows in BC before expanding our message through the more formal campaign in September 2010. This precampaign practice likely explains the much higher 2008 baseline rate of these procedures in BC (approximately 5% hysterectomy with BS) compared with the rest of Canada (<2%) that was recorded in the recent Canadian Partnership Against Cancer report by Sandoval et al.[32] Even with this higher baseline rate of procedures, uptake in BC over the ensuing 4 years was marked: hysterectomy with BS increased from 5-35% and salpingectomies for sterilization increased from 0.5-33% in the study period.

Hysterectomy with BS (and ovarian preservation) was performed across all age brackets including perimenopausal women, which reflected awareness of the long-term health repercussions of surgical removal of the ovaries.[26-28] Although there are subtle age differences in women who undergo isolated salpingectomy compared with tubal ligation (and differences in age according to surgical approach for BS), it is apparent that a wide range of ages for this procedure can be considered appropriate.

There remains, at the end of the calendar year of 2011, 21% of hysterectomies with which neither BS nor BSO were performed and 67% of surgical sterilizations in which tubes are left in situ. Rare challenging cases might necessitate abandoning the pursuit of the tubes, but in most cases, this "extra" surgical step is achievable. We have shown that the surgical time that is

TABLE 2
Operative/perioperative measures of risk of opportunistic salpingectomy

Variable	Hysterectomy only (n = 8362)	Hysterectomy with bilateral salpingectomy (n = 3670)	*P* value[a]	Hysterectomy with bilateral salpingo-oophorectomy (n = 8904)	*P* value[a]	Tubal ligation (n = 13719)	Salpingectomy for sterilization (n = 1569)	*P* value[a]
Age, y[b]	48.6 ± 12.7	43.5 ± 7.6	< .001	54.2 ± 11.9	< .001	34.8 ± 5.7	36.0 ± 5.4	< .001
Operating room time, min[b]	117.3 ± 47.7	133.6 ± 50.1	< .001	139.7 ± 54.2	< .001	61.0 ± 25.1	71.2 ± 23.5	< .001
Missing data on operating room time	2967	279	—	2173	—	4965	221	—
Length of hospital stay, d[b]	2.52 ± 3.0	2.37 ± 1.9	.010	2.93 ± 4.3	< .001	1.31 ± 3.1	1.23 ± 4.5	.117
Readmission, n (%)	379 (4.5)	159 (4.3)	.632	506 (5.7)	.001	309 (2.3)	28 (1.8)	.233
Readmission, adjusted odds ratio[c]	1.00 (Reference)	0.91 (0.75, 1.10)	.347	1.34 (1.16, 1.53)	< .001	1.00 (Reference)	0.83 (0.56, 1.23)	.547
Blood transfusion, n (%)	219 (2.6)	89 (2.4)	.54	225 (2.5)	.704	74 (0.5)	6 (0.4)	.415
Blood transfusion, adjusted odds ratio[c]	1.00 (Reference)	0.86 (0.67, 1.10)	.183	1.09 (0.90, 1.33)	.353	1.00 (Reference)	0.77 (0.56, 1.23)	.36

There were 67 women who underwent hysterectomy with oophorectomy who are not included in this Table.

[a] Compared with the reference hysterectomy-alone procedure for hysterectomy with bilateral salpingectomy or bilateral salpingo-oophorectomy and as compared with the reference tubal ligation for a salpingectomy procedure; [b] Data are given as mean ± SD; [c] Odds ratios for hospital readmission and blood transfusion were adjusted for patient age. Regressions that compared salpingectomy with tubal ligation also were controlled for delivery by cesarean section during the hospitalization stay.

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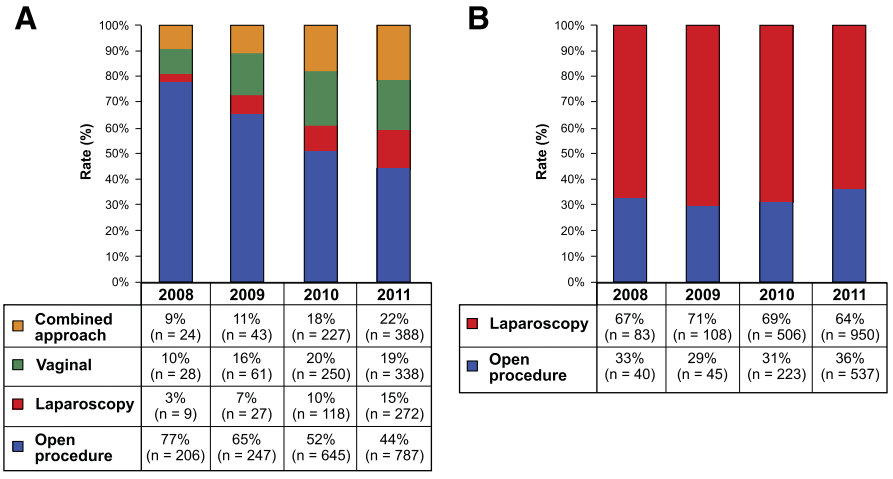
FIGURE 4
Hysterectomies with BS and isolated BS by surgical approach from 2008-2011 in British Columbia



	2008	2009	2010	2011
Combined approach	9% (n = 24)	11% (n = 43)	18% (n = 227)	22% (n = 388)
Vaginal	10% (n = 28)	16% (n = 61)	20% (n = 250)	19% (n = 338)
Laparoscopy	3% (n = 9)	7% (n = 27)	10% (n = 118)	15% (n = 272)
Open procedure	77% (n = 206)	65% (n = 247)	52% (n = 645)	44% (n = 787)

	2008	2009	2010	2011
Laparoscopy	67% (n = 83)	71% (n = 108)	69% (n = 506)	64% (n = 950)
Open procedure	33% (n = 40)	29% (n = 45)	31% (n = 223)	36% (n = 537)

A, Hysterectomy with bilateral salpingectomy (n = 3670 women) and **B**, isolated bilateral salpingectomy (n = 2504 women) according to surgical approach (open procedure, *blue*; laparoscopy, *red*; vaginal, *green*; combined approach, *orange*). For hysterectomies with bilateral salpingectomy, the number of procedures that were performed by open laparotomy decreased significantly over the 4-year study period; there was a corresponding increase in laparoscopic, vaginal, and combined procedures ($P < .001$ for all). For isolated bilateral salpingectomies, although the total number of procedures that were performed increased from 2008-2011, there was no significant difference in surgical approach across time ($P = .127$).

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required for BS in addition to hysterectomy across all surgical approaches is, on average, 16 minutes and for BS instead of tubal ligation is, on average, 10 minutes; this represents 13% and 16% of total procedural time, respectively.

There were no increased risks in terms of LOS, hospital readmissions, or blood transfusions with hysterectomy and BS compared with hysterectomy alone in approximately 21,000 procedures that were reviewed. Isolated salpingectomy did not increase LOS or the likelihood of readmission or blood transfusion. This is a salient and highly relevant result because both of these complications were voiced as surgical concerns by gynecologic surgeons at the time of the campaign announcement,[31] particularly in the peripartum setting with vascular engorgement of the pelvic structures.

For hysterectomy with BS, the vaginal approach was the fastest and was associated with the lowest risk of readmission (lower risk observed with combined approach as well). Mean OR time for isolated salpingectomy that was performed by open vs laparoscopic approach was statistically different, but within 1.5 minutes of each other (laparoscopy took longer). Readmission rates were significantly lower with both laparoscopic and vaginal approaches to isolated BS.

Variation exists across HSDAs in BC, both in procedures performed and in surgical approach. Further investigations would be needed to elucidate the reasons behind these differences, but we hypothesize that, because some HSDAs have a single or few practicing surgeons, they may be limited by the equipment in their center, their training (exposure to laparoscopy), or a lack of a surgical assistance. The volume of surgical cases in many of the "outlier" HSDAs is low (range of total number of hysterectomies over 4-year study period between HSDAs, 262−3774 cases) and of minimal impact to overall provincial numbers. Importantly, however, our data reflect that each year across all HSDAs gynecologic surgeons are performing more salpingectomies, and increasingly, these are by the laparoscopic approach.

Given the aforementioned safety data, the simplicity of the surgical procedure, and the short additional surgical time required, we believe the practice of BS should be considered by any surgical specialist who has access to the fallopian tubes in an appropriately consented individual. We have conducted educational sessions with our general surgery colleagues in BC and in other health regions and have initiated ovarian cancer prevention campaigns. Educational initiatives are being directed to both gynecologic and general surgery groups.

Limitations of this study include its retrospective nature, the risk of imprecision given its dependence on database accuracy in surgeon and administrative coding, and the potential for bias in the data that are requested, included, and omitted.

The data herein, which represent procedures in almost 44,000 women in BC over a 4-year time period before and after an educational ovarian cancer prevention campaign that was aimed at individuals who were at low risk for the development of ovarian cancer demonstrates that the performance of BS either concurrent with another gynecologic procedure (eg, hysterectomy) or for specific gynecologic indications of sterilization or risk reduction is feasible and safe. The safety of BS with hysterectomy recently has also been heralded by Morelli et al,[33] who compared perioperative and postoperative complications, ovarian sonographic characteristics, and hormone levels in women who underwent total laparoscopic hysterectomy with BS vs total laparoscopic hysterectomy alone. This well-designed but nonrandomized trial (n = 79 women in each arm) showed no negative effects with the addition of BS. In our regional population of women who undergo BS, we are also assessing ovarian hormone levels before and after the procedure to ensure that there are no changes.

The true measure of success of this campaign, which is impossible to gauge at this early time point, is whether this change in the surgical paradigm will decrease the rate of ovarian cancer in BC. No previous large-scale population-wide

TABLE 3
Operative/perioperative measures of risk of opportunistic salpingectomy by surgical approach

Variable	Open procedure	Laparoscopic	*P* value[a]	Vaginal	*P* value[a]	Combined vaginal and laparoscopic	*P* value[a]
Hysterectomy with bilateral salpingectomy, n	1885	426		677		682	
Age, y[b]	43.1 ± 6.4	42.4 ± 6.1	.042	46.5 ± 10.6	< .001	42.4 ± 7.1	.015
Operating room time, min[b]	124.7 ± 42.7	168.1 ± 59.9	< .001	112.3 ± 43.7	< .001	155.3 ± 47.8	< .001
Missing data on operating room time, n	211	12	—	31	—	26	—
Length of hospital stay, d[b]	2.94 ± 1.7	1.58 ± 2.8	< .001	2.03 ± 1.9	< .001	1.60 ± 0.8	< .001
Readmission, n (%)	89 (4.7)	21 (4.9)	.847	16 (2.4)	.009	35 (5.1)	.739
Readmission, adjusted odds ratio[c]	1.00 (Reference)	0.86 (0.65, 1.13)	.232	0.51 (0.37, 0.70)	< .001	0.71 (0.59, 0.86)	.001
Blood transfusion, n (%)[d]	67 (3.6)	4 (0.9)	.005	3 (1.3)	.004	10 (1.5)	.007
Isolated salpingectomy	845	1647		12	0		
Age, y[b]	37.2 ± 8.7	38.8 ± 7.3	< .001	42.8 ± 11.3	.027	—	—
Operating room time, min[b]	98.6 ± 52.9	84.5 ± 41.7	< .001	106.2 ± 70.0	.656	—	—
Missing data on operating room time	233	130	—	2	—	—	—
Length of hospital stay, d[b]	3.34 ± 6.5	0.33 ± 0.97	< .001	1.75 ± 2.45	.375	—	—
Readmission, n (%)	38 (4.5)	36 (2.2)	.001	0	.452	—	—
Readmission, adjusted odds ratio[c]	1.00 (Reference)	0.62 (0.54, 0.71)	< .001	0.50 (0.38, 0.65)	< .001	—	—
Blood transfusion, n (%)[d]	18 (2.1)	3 (0.2)	< .001	0	.609	—	—

[a] Compared with the reference open procedure; [b] Data are given as mean ± SD; [c] Odds ratio for hospital readmission was adjusted for patient age and for cesarean section among women who underwent isolated salpingectomy; [d] Number of blood transfusions in these groups were too small for analysis by logistic regression.

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interventions of this kind have been implemented that could serve as a reference. We are encouraged by a large population-based series (published since our campaign, 24,000 women included) that demonstrated a decreased risk in all epithelial ovarian cancers in women who had undergone tubal ligation.[23] The protective effect of tubal ligation was greatest within the endometriosis-associated ovarian cancers; specifically, clear cell (odds ratio, 0.53; 95% CI, 0.4−0.67) and endometrioid (odds ratio, 0.48; 95% CI, 0.4−0.59)[23] ovarian carcinomas reflected the permissive role of the fallopian tube as a conduit. In addition, Lessard-Anderson et al[34] recently presented data from approximately 600 women that revealed a protective effect of tubal ligations (aOR, 0.56; 95% CI, 0.28−1.11) and particularly excisional sterilizations (aOR, 0.36; 95% CI, 0.13−1.0) compared with no tubal ligation/excisional procedures on ovarian cancer rates in low-risk populations. Their report encompassed >50 years of procedure data that demonstrated that patience is needed to observe the effect of any surgical intervention that may be performed ≥30 years before the predicted age of the development of ovarian cancer in the general population.

In BC, we have initiated population- and cohort-based approaches to the measurement of changes in ovarian cancer rates and histologic distribution. Based on age-specific rates of ovarian cancer in the general population and the age at which most salpingectomy procedures are being performed (mean, 43.5 years old for hysterectomy with BS; mean, 36 years old for isolated salpingectomy), we predict that it will be at least 15 years before a difference can be discerned. Fundamental for this initiative to continue, we are reassured that this surgical intervention is safe and achievable. ■

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