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# Safety outcomes of female sterilization by salpingectomy and tubal occlusion<sup>☆,☆☆,★</sup>

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## Abstract

**Objective:** Compare immediate and short-term complications and surgical times among women having laparoscopic salpingectomy or tubal occlusion for female sterilization.

**Study design:** We used billing data to identify women having laparoscopic sterilization at our training institution between July 1, 2011, and June 30, 2015. We performed a retrospective chart review to extract demographic information, surgical times and complications within 30 days, including unscheduled clinic or emergency room visits. We categorized complications as immediate (prior to discharge) and short-term (within 30 days after the procedure). Surgeries including additional procedures other than IUD removal were considered mixed operations. Mixed operations and unilateral sterilization procedures were only included in safety evaluations.

**Results:** The 149 procedures included 81 salpingectomies (including 18 mixed operations and 2 unilateral salpingectomies) and 68 tubal occlusions (including 8 mixed operations). All procedures involved Obstetrics and Gynecology residents. Salpingectomy and occlusion procedures had similar immediate (2.5% vs. 2.9%,  $p=1.0$ ) and short-term (4.9% vs. 14.7%,  $p=.051$ ) complication rates. Surgical time averaged 6 min longer for salpingectomies than occlusion procedures (44 vs. 38 min, respectively,  $p=.018$ ). Average surgical times were shorter with more experienced (3rd/4th year) residents than less experienced (1st/2nd year) residents for both salpingectomy (32±18 min vs. 46±13 min, respectively,  $p=.124$ ) and occlusion procedures (32±13 min vs. 41±12 min, respectively,  $p=.026$ ).

**Conclusion:** Salpingectomy for female sterilization takes slightly longer to complete than tubal occlusion procedures without evidence that it increases complications.

**Implications statement:** Laparoscopic salpingectomy is a safe alternative to tubal occlusion with only a small increase in surgical time. Because salpingectomy offers higher efficacy and more ovarian cancer protection than occlusion procedures, salpingectomy should be an option offered to women seeking laparoscopic sterilization.

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*Key words:* Salpingectomy; Laparoscopic; Sterilization; Surgical time

## Introduction

In the United States, approximately 38% of women use surgical sterilization as their means of birth control [1]. Methods of female sterilization include tubal occlusion, partial salpingectomy or transcervical sterilization. The most commonly used methods of sterilization in the United States

are silastic rings, Filshie clips, or bipolar cautery [2]. The US Collaborative Review of Sterilization (CREST) study, a prospective analysis of outcomes with postpartum partial salpingectomy and laparoscopic occlusion procedures, included procedures performed from 1978 to 1987 at a time when surgical technology was not far advanced and the goal was to do procedures as quickly as possible given the relatively poor visualization and the lack of sophisticated instruments [3]. Thus, surgeons rarely performed methods that would be 100% effective, like salpingectomy.

Recent attention has focused on salpingectomy for sterilization based on studies suggesting a reduction in ovarian serous adenocarcinoma risk [4] and because it offers 100% efficacy [5]. Female occlusive sterilization procedures are estimated to reduce a woman's lifetime risk of ovarian cancer by 24–34% [6,7]. However, a recent meta-analysis

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demonstrated that women who had undergone salpingectomy had an overall 49% reduction in ovarian carcinoma risk [8].

Despite a large study from British Columbia, Canada showing no increased risks for salpingectomy compared to occlusive procedures, salpingectomy has still not been widely adopted as a primary method of sterilization [9]. The only difference in outcome between salpingectomy and occlusion appears to be 10 min in operating time. The British Columbia experience is the only published comparison of outcomes using modern surgical laparoscopic techniques. To better understand these differences in a teaching institution and to provide more comparative data, we reviewed our institutional experience to evaluate complication rates and surgical times in women choosing laparoscopic salpingectomy or tubal occlusion for sterilization.

## 2. Materials and methods

We performed a retrospective cohort study among a population of women who underwent laparoscopic surgical sterilization at UC Davis Medical Center from July 2011 to June 2015. We used billing codes to identify patient's medical record numbers. We obtained institutional review board approval prior to study initiation.

At our institution, we typically use electrothermal bipolar tissue sealing instruments when performing laparoscopic salpingectomy for sterilization, usually with three abdominal ports. Tubal occlusion methods are typically performed with only two abdominal ports with the device used being up to the provider doing the case.

Two authors (J.W. and F.S.) reviewed all charts to obtain demographic information (ethnicity, age, gravity & parity, insurance type), procedure(s) performed, presence or absence of medical and surgical comorbidities, lowest level resident involved in case, surgical times, and complications. We defined sterilizations performed in addition to another procedure as "mixed" procedures except those that included IUD removal.

We defined surgical time as the time from incision to closure and excluded mixed and unilateral procedures from surgical times analyses. We defined complications as immediate (during the procedure or prior to leaving the hospital) and short-term (within 30 days). Immediate complications included hemorrhage, return to the OR, unexpected ICU admission, admission after outpatient procedure or "other." Short-term complications included infection (intra-uterine, incisional, sepsis, other), post-operative pain requiring additional visits, calls or pain medications, readmission to the hospital or "other." We included complications from mixed and unilateral procedures; we assessed any complication following a mixed procedure as related to the sterilization unless the complication was clearly linked to the other procedure as determined by all three authors.

We used surgical complications (both immediate and short-term) as our primary outcomes and surgical times as the secondary outcome. We compared demographics using Leven's test for equality of variances, *t*-tests and chi-squared tests, as appropriate. We analyzed complication rates and variation in surgical times using Fischer's exact test. We compared surgical times overall and by resident years, divided as lower level residents (years 1 and 2) and upper level residents (years 3 and 4). We assessed the correlation of surgical times and BMI using Pearson correlation (*r*) in which a value close to +1 or -1 suggests strong correlation and a value close to zero implies a lack of correlation. Statistical analysis was performed using SPSS (IBM, Armonk, NY, USA) with a  $p \leq .05$  considered significant.

## 3. Results

We identified 150 charts and all were available for analysis. Procedures included 81 salpingectomies (including 18 mixed and two unilateral procedures) and 68 occlusion procedures (including 8 mixed procedures). We excluded one additional procedure involving both methods of sterilization (one side salpingectomy, one side occlusion). Patient characteristics for the 149 women in this analysis are presented in Table 1. Among the women having an occlusion procedure, 13 (19.1%), 22 (32.4%) and 32 (47.1%) women had Falope ring placement, bipolar cautery and Filshie clip placement, respectively. One woman in the occlusion group, with intention to perform bilateral Falope ring placement, had one tube occluded with bipolar cautery due to peritubal adhesions preventing ring placement.

One immediate complication occurred in each group, both secondary to anesthesia issues (one case of laryngospasm in the salpingectomy group requiring an overnight ICU admission, one case of angioedema secondary to an anesthesia medication requiring overnight inpatient management).

Short-term were not more frequent in women having a salpingectomy (4/81, 4.9%) than occlusion (10/68, 14.7%) sterilization procedures ( $p = .051$ ). The short-term complications for salpingectomy included one case of incisional infection requiring oral antibiotics and three cases of increased pain requiring additional visits or calls. The short-term complications for tubal occlusion included four cases of incisional infections requiring oral antibiotics and six cases of increased pain requiring additional visits or calls.

Average surgical times were 6 min longer for salpingectomy compared to occlusion methods ( $44 \pm 13$  min versus  $38 \pm 15$  min, respectively,  $p = .018$ ). Increasing BMI did not correlate with surgical times in women having salpingectomy ( $r = .27$ ) or occlusion ( $r = .06$ ) procedures. Table 2 demonstrates that salpingectomy procedures took slightly longer within each resident level, averaging 5 min faster for lower level residents and 8 min faster for upper level residents. Among women

Table 1

Demographics and pertinent medical history of women choosing salpingectomy or tubal occlusion procedures for sterilization from July 2011 to June 2015.

	Salpingectomy <i>n</i> =81	Occlusion <i>n</i> =68	p-value*
Age (years)	35.6±5.5	36.2±5.3	.58
BMI	29.6±6.5	28.8±5.8	.43
BMI≥30 kg/m <sup>2</sup> (obese)	33 (40.7%)	24 (35.3%)	
Race/Ethnicity			.03
White	46 (58.2%)	31 (45.6%)	
Hispanic	8 (9.9%)	18 (26.5%)	
African American	9 (11.1%)	8 (11.8%)	
Asian	6 (7.4%)	6 (8.8%)	
Native Hawaiian or Pacific Islander	2 (2.5%)	2 (3.0%)	
American Indian or Alaska Native	0	2 (2.9%)	
Declined or missing	3 (3.7%)	1 (1.5%)	
Gravidity			.95
0	3 (3.7%)	4 (5.9%)	
1	8 (9.9%)	11 (16.2%)	
2	23 (28.4%)	14 (20.6%)	
3	13 (16.0%)	18 (26.5%)	
4	16 (19.8%)	8 (11.8%)	
5 or more	18 (22.2%)	13 (19.3%)	
Parity			.69
0	1 (1.2%)	4 (5.9%)	
1	12 (14.8%)	16 (23.5%)	
2	38 (46.9%)	25 (36.8%)	
3	14 (17.3%)	14 (20.6%)	
4 or more	13 (16.0%)	8 (11.7%)	
Insurance			.23
Private	67 (82.7%)	60 (88.2%)	
State (medical assistance)	11 (13.6%)	8 (11.8%)	
Federal	3 (3.7%)	0	
Current every day smoker	6 (7.4%)	9 (13.2%)	.28
Significant gynecologic history			
Endometriosis	0	3 (4.4%)	.10
Pelvic infection	1 (1.2%)	2 (2.9%)	.59
Prior abdominal surgery <sup>†</sup>	22 (27.2%)	19 (27.9%)	1.00
Active medical conditions			
Diabetes	5 (6.2%)	0	
Hypertension	3 (3.7%)	5 (7.4%)	
SLE	1 (1.2%)	1 (1.5%)	
Organ transplant	0	1 (1.5%)	
Seizure disorder	0	1 (1.5%)	
Multiple sclerosis	0	1 (1.5%)	
HIV	1 (1.2%)	0	
Graves' disease	1 (1.2%)	0	
Crohn's disease	1 (1.2%)	0	

Data are presented as n (%) or mean ± S.D.

SLE, systemic lupus erythematosus.

\* *P* values were determined using a *t* test for age and chi-square for all other variables.

† Two or more laparoscopic procedures or any laparotomy.

undergoing tubal occlusion, surgical times did not differ by method used [Falope ring placement 35±8 min; bipolar cauterly 41±13 min; Filshie clip placement 37±17 min (*p*=.41)].

#### 4. Discussion

We found no evidence of increased immediate or short-term complication rates with laparoscopic salpingect-

omy as compared to tubal occlusion for female sterilization over a four-year period. We found a higher, although not significant, short-term complication rate for tubal occlusion methods compared to salpingectomy (14.7% vs. 4.9%, *p*=.051), primarily related to increased complaints related to pain with occlusion resulting in additional visits, phone calls, or requests for refills on narcotic medications. The immediate complications (one in each group) resulted from anesthetic issues.

Table 2  
Surgical times for salpingectomy and tubal occlusion procedures for sterilization based gynecology/gynecology resident year.

	Number	Average (minutes)	p value
Salpingectomy			.12
Lower level	41	46±13	
Upper level	22	40±18	
Occlusion			.03
Lower level	40	41±12	
Upper level	20	32±13	

Lower level residents = years 1 and 2; upper level residents = years 3 and 4.

Surgical times were slightly longer for salpingectomy than for tubal occlusion methods, supporting the findings of McAlpine and colleagues [9]. We expected before performing our analysis that salpingectomy would take slightly longer to complete than tubal occlusion and that this difference would decrease with advancing surgical experience. However, we only found a statistically significant difference in procedure time related to resident experience for occlusion procedures and not for salpingectomy. Perhaps this finding implies that salpingectomy generally involves steps that are less dependent on learner experience as compared to occlusion procedures. The overall number of patients who had significant risk factors that may increase surgical time (obesity, significant surgical history, history of PID or endometriosis) was small and limited any statistical comparisons to control for these factors. BMI and surgical times had only a slightly positive correlation, implying that surgical times were dependent on other factors.

Our study corroborates the findings of McAlpine and colleagues [9] from British Columbia and shows that their findings are generalizable. Limitations of our study include the limits of retrospective data collection and that women may have gone to other healthcare providers with complications. Additionally, the relatively small sample size limits the power to compare serious complication rates.

We believe the benefits of salpingectomy outweigh the drawback of minimally increased operating times as compared

to occlusion procedures. In addition to eliminating the potential for sterilization failure (intrauterine or extrauterine pregnancy) with bilateral salpingectomy, future surgery for tubal torsion or hydrosalpinx is also eliminated. The American College of Obstetrics and Gynecology recently advocated for opportunistic salpingectomy at hysterectomy or laparoscopic sterilization [10]. Our data supports that doing so at the time of sterilization adds minimal time with no evidence of increased morbidity.

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