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Patterns of Specialty-Based Referral and Perioperative Outcomes for Women With Endometrial Cancer Undergoing Hysterectomy

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Abstract

Objective—To examine patterns of referral to gynecologic oncologists and perioperative outcomes based on surgeon specialty for women with endometrial cancer and hyperplasia.

Methods—The National Surgical Quality Improvement Program database was used to perform a retrospective cohort study of women with endometrial cancer and hyperplasia who underwent hysterectomy from 2014 to 2015. Patients were stratified based on treatment by a gynecologic oncologist or other provider. Patterns of referral to a gynecologic oncologist was the primary outcome while mode of hysterectomy and complications were secondary outcomes.

Results—A total of 6510 women were identified. Gynecologic oncologists performed 90.9% (95% CI, 90.1–91.7%) of the hysterectomies for endometrial cancer, 66.8% (95% CI, 63.1–70.4%) for complex atypical endometrial hyperplasia and 49.3% (95% CI, 44.7–53.8%) for endometrial hyperplasia without atypia. Older women and those with a higher American Society of Anesthesiology score were more likely to be treated by an oncologist. A minimally invasive hysterectomy was performed in 73.6% (95% CI, 72.1–75.1%) of women with endometrial cancer operated on by gynecologic oncologists compared to 73.8% (95% CI, 68.8–78.2%) of those treated by other physicians (OR=0.99; 95% CI, 0.80–1.23) while lymphadenectomy was performed in 56.3% of women treated by gynecologic oncologists vs. 34.8% of those treated by

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other specialists (OR=2.42; 95% CI, 1.99–2.94). Severe complications were uncommon and there was no difference in complication rates based on specialty, 2.6%, (95% CI, 2.2–3.1%) vs. 2.0% (95% CI, 0.8–3.3%).

Conclusion—Gynecologic oncologists provide care for the majority of women with endometrial cancer who undergo hysterectomy in the United States and are also involved in the care of a large percentage of women with endometrial hyperplasia.

Introduction

Over the last decade the treatment of endometrial cancer has grown increasingly complex. For women who undergo hysterectomy, minimally invasive procedures, including both robotic-assisted and laparoscopic techniques, are now commonly used.^{1,2} Likewise, the role of lymphadenectomy has evolved and is now frequently omitted or more limited nodal sampling performed using sentinel node biopsy.^{3,4} The role of adjuvant therapy for early-stage disease also remains an area of active debate.^{5,6}

Given the complexities of surgical oncologic care, recommendations have been made to concentrate care to specialist surgeons for many high-risk cancer operations.^{7–10} These recommendations most commonly advocate referral to high-volume surgeons or to surgical sub-specialists with advanced training for particular procedures or disease sites.^{7,11} For endometrial cancer, several reports have suggested that outcomes are improved when women are treated by gynecologic oncologists.^{12–14} In 2005, the American College of Obstetricians and Gynecologists and the Society of Gynecologic Oncology released a statement recommending that women with endometrial cancer be treated by gynecologic oncologists.¹⁵ The role of gynecologic oncologists in the treatment of endometrial cancer was reaffirmed in 2015.¹⁶

Despite these recommendations, little is known about contemporary referral patterns for women with endometrial cancer. We performed a population-based analysis to examine the patterns of care for women with endometrial cancer and its precursor lesion, endometrial hyperplasia. Specifically, we examined treatment and outcomes for women with endometrial cancer and hyperplasia treated by gynecologic oncologists compared to other providers.

Materials and Methods

We performed a retrospective cohort study using the American College of Surgeons' National Surgical Quality Improvement Program (NSQIP) database to examine specialty-based referral for women with endometrial cancer.¹⁷ NSQIP is a nationwide database that collects information on surgical procedures performed at hospitals across the U.S. The database was developed to improve quality and now collects data on over 150 variables from over 600 hospitals.¹⁸ NSQIP collects data from the hospital admission for the procedure until 30 days after surgery. NSQIP captures preoperative conditions and risk factors, intraoperative events, and postoperative outcomes and complications. Data is abstracted using a defined sampling schema by trained registrars. The data are regularly audited to ensure quality.

In 2014, NSQIP began collecting more detailed information on the perioperative characteristics of women undergoing hysterectomy (Procedure Targeted Hysterectomy Participant Use File) at a subset of participating sites. This data includes the specialty of the operating physician. The Targeted Hysterectomy file includes 91 participating hospitals in 2014 and 109 sites in 2015.¹⁸ This study was a secondary analysis of the the Procedure Targeted Hysterectomy Participant Use File. All data was de-identified and the study was deemed exempt by the Columbia University Institutional Review Board.

Women who underwent hysterectomy for endometrial cancer or endometrial hyperplasia linked in both the main NSQIP and Procedure Targeted Hysterectomy Participant Use Files from from 2014 to 2015 were included in the analysis. Endometrial cancer included malignancies of any part of the uterus (Appendix 1, available online at <http://links.lww.com/xxx>). Endometrial hyperplasia was classified as endometrial hyperplasia without atypia or endometrial intraepithelial neoplasia/atypical endometrial hyperplasia.

Hysterectomy was classified as either abdominal, minimally invasive, including laparoscopic and robotic-assisted, or vaginal. For women with cancer, performance of lymphadenectomy was recorded if any of the primary CPT codes for hysterectomy also included lymphadenectomy or if any secondary lymphadenectomy codes were listed.

Age at the time of surgery was classified as <50, 50–59, 60–69, or ≥70 years while race was categorized as white, black, other, or unknown. Body mass index (BMI) was estimated as the weight in kilograms divided by height in square meters and grouped as normal (<25 kg/m²), overweight (25–29.9 kg/m²), obese (>30 kg/m²) or unknown. Preoperative functional status was estimated using the American Society of Anesthesiology (ASA) classification score as 1, 2, 3, 4, or unknown. For women with endometrial cancer, tumor stage was classified as stage IA, IB, INOS, II, III, IV or not otherwise specified (NOS).

The primary outcome of the analysis was the specialty of the primary surgeon. Within NSQIP, the subspecialty of the operating surgeon is captured. The physician specialty is recorded as gynecologic oncologist, obstetrician-gynecologist, reproductive endocrinologist, urogynecologist, maternal fetal medicine specialist, and other. We compared gynecologic oncologists to any other specialty.

Secondary outcomes of the study included the choice of the surgical procedure and outcomes. As described above, the route of surgery was classified as abdominal, minimally invasive, or vaginal for each pathologic group. Performance of lymphadenectomy for endometrial cancer was categorized as yes or no. Perioperative complications were examined and defined as the occurrence of a Clavian class IV complication using a previously described classification system that included the occurrence of septic shock, cardiac arrest, myocardial infarction, pulmonary embolism, need for greater than 48 hours of ventilation, and unplanned re-intubation.^{19–22} Within the cohort, perioperative mortality was rare (0.32%) and was therefore not examined as an outcome.

Frequency distributions between categorical variables were compared using χ^2 tests. To examine factors associated with receipt of treatment by gynecologic oncologist, we fit multivariable logistic regression models adjusting for year, age, race, BMI, ASA

classification score for women with endometrial hyperplasia, and further adjusted for stage for women with cancer. To examine the association between specialty of the primary surgeon and the route of surgery, we fit separate unadjusted logistic regression models for abdominal, minimally invasive, and vaginal hysterectomy. We also fit unadjusted logistic regression models to examine the association between specialty and lymphadenectomy and perioperative complications. All analyses were conducted using SAS version 9.4 (SAS Institute Inc, Cary, North Carolina). All hypothesis testing was two-sided and a *P*-value of <0.05 was considered statistically significant.

Results

A total of 6510 women were identified. Among the 5408 women with endometrial cancer, gynecologic oncologists performed 90.9% (95% CI, 90.1–91.7%) of the hysterectomies (Table 1). Gynecologic oncologists performed 66.8% (95% CI, 63.1–70.4%) of the procedures for complex atypical endometrial hyperplasia and 49.3% (95% CI, 44.7–53.8%) of the operations for endometrial hyperplasia without atypia (Table 2). The involvement of gynecologic oncologists in hysterectomies for endometrial cancer remained relatively stable over time from 88.2% in the first quarter of 2014 to 90.2% in the fourth quarter of 2015 (*P*=0.51) (Figure 1). While there was more quarter-to-quarter variation for endometrial hyperplasia without (*P*=0.26) and with atypia (*P*=0.65), no clear trend in treatment by gynecologic oncologists was observed.

Among women with endometrial cancer, older women (≥ 70 vs. <50 , OR=1.43; 95% CI, 1.02–2.01) and those with higher ASA scores (3 vs. 1, OR=3.27; 95% CI, 1.82–5.88) were more likely to receive treatment by a gynecologic oncologist (Table 1). In contrast, non-white, non-black women (vs. white women, OR=0.57; 95% CI, 0.37–0.87) and obese women (vs. normal weight, OR=0.73; 95% CI, 0.54–0.99) were less likely to have care by a gynecologic oncologist. The only association between stage and specialty of the treating physician was an association between women with a stage recorded as not otherwise specified and care by a non-oncologist (OR=0.48; 95% CI, 0.33–0.71). When the cohort was limited to women with stage I neoplasms, race and ASA class remained associated with provider specialty.

For women with endometrial hyperplasia without atypia, advanced age and higher ASA class were associated with care by a gynecologic oncologist. Compared to women <50 years of age, the odds of treatment by a gynecologist for women 60–69 years of age was 2.26 (95% CI, 1.30–3.92) and 2.41 (95% CI, 1.12–5.20) for women ≥ 70 years. The only statistically significant association between provider specialty and gynecologic oncologist care for atypical hyperplasia was ASA class 4 status.

A minimally invasive hysterectomy was performed in 73.6% (95% CI, 72.1–75.1%) of women with endometrial cancer operated on by gynecologic oncologists compared to 73.8% (95% CI, 68.8–78.2%) of those treated by other physicians (OR=0.99; 95% CI, 0.80–1.23) (Table 3). Vaginal hysterectomy was more commonly performed in women treated by non-gynecologic oncologists (OR=0.33; 95% CI, 0.17–0.65). Lymphadenectomy was performed in 56.3% of women treated by gynecologic oncologists vs. 34.8% of those treated by other

specialists (OR=2.42; 95% CI, 1.99–2.94). There was no difference in complication rates 2.6% (95% CI, 2.2–3.1%) vs. 2.0% (95% CI, 0.8–3.3%) (P=0.44), rates of readmission (5.8% vs. 4.5%) (P=0.22) or length of stay (P=0.051) based on specialty. Similar trends were seen in the analysis of women with stage I tumors.

For both endometrial hyperplasia without atypia and atypical endometrial hyperplasia, non-gynecologic oncologists were more likely to perform vaginal hysterectomy than gynecologic oncologists while gynecologic oncologists were more likely to perform minimally invasive hysterectomy. (Table 4) There were no differences in the major complication rates, length of stay or readmissions based on specialty for either condition.

Discussion

Our findings suggest that gynecologic oncologists provide care for the majority of women with endometrial cancer who undergo hysterectomy in the U.S and are also involved in the care of a large percentage of women with endometrial hyperplasia. Despite the availability of gynecologic oncologists, disparities in access remain for some patient groups.

For women with endometrial cancer, outcomes are improved when care is rendered by a gynecologic oncologist.^{12–14,23} In an analysis of over 18,000 women with endometrial cancer, care by a gynecologic oncologist was associated with a 30% reduction in mortality.¹⁴ While likely driven by numerous factors, the improved outcomes achieved by gynecologic oncologists are likely due in part to the delivery of guideline-adherent care and adherence to recommended process measures.^{12–14} We identified similar findings, women operated on by gynecologic oncologists were more likely to have nodal evaluation and less likely to have a tumor of unknown stage.

Compared to historical data, we noted a dramatic shift in patterns of care and found that the majority of women with uterine cancer now undergo surgery with a gynecologic oncologist. Among Medicare recipients with endometrial cancer who underwent hysterectomy from 1991–2002, 21% were treated by gynecologic oncologists.¹⁴ In our data, by 2014, over 90% of women with uterine cancer had their hysterectomies performed by gynecologic oncologists. We also found that over two thirds of women with atypical endometrial hyperplasia and nearly half of those with hyperplasia without atypia are treated by gynecologic oncologists. These data suggest that most gynecologists are now referring patients with endometrial cancer to gynecologic oncologists for primary surgery.

Although studies have demonstrated that oncologic outcomes and long-term survival are superior in patients treated by gynecologic oncologists, differences in complications and perioperative events based on specialty have not been consistently found. Similarly, in our series the overall complication rates were similar between providers. The overall low rate of serious adverse perioperative events, the lack of data on other risk factors, and the high percentage of patients treated by gynecologic oncologists limit our ability to distinguish differences in complication rates based on specialty. We noted that gynecologic oncologists are more likely to offer minimally invasive hysterectomy while other providers are more likely to perform vaginal hysterectomy.

These findings should be interpreted in light of a number of limitations. The NSQIP Targeted Hysterectomy File only contains data from a subset of hospitals that report to NSQIP. As such, these data may not be representative of all regions in the country. Although the Targeted File contains academic and community centers, our findings may overestimate gynecologic oncology care, particularly if small, rural hospitals are underrepresented. Similarly, we cannot exclude the possibility that provider specialty was misclassified in a small number of cases and we cannot capture when gynecologic oncologists functioned as intraoperative consultants. However, NSQIP data is abstracted by trained registrars and has been validated in a number of studies; thus, any classification error is likely to be very small. Data on pathologic diagnoses is based on claims and data on tumor characteristics, such as histology and grade, and some clinical characteristics, including comorbidity, that likely influenced patterns of referral as well as outcomes are lacking. Lastly, while we analyzed perioperative outcomes, longer-term follow-up including adjuvant therapy, patterns of recurrence, and survival would be of great interest.

A number of factors likely underlie the changes in the patterns of care for uterine cancer that we observed. First, there has been a greater awareness among patients and providers about the benefits of treatment by specialist surgeons.¹¹ In addition to heightened public awareness, referral to specialized surgeons has been recommended for a number of tumors types, including for endometrial cancer by the American College of Obstetricians and Gynecologists.¹⁵ Second, as the number of hysterectomies performed in the U.S. has declined, many general gynecologists now perform a low number of procedures annually and may lack the desire to treat gynecologic cancers.²⁴ Third, the complexity of care for endometrial cancer has increased greatly potentially limiting the interest of general gynecologists to care for these women. Lastly, as gynecologic oncology has matured as a specialty, the number of specialists, along with the ease of referral, has increased.

These data have important policy implications for the delivery of endometrial cancer care. While a high percentage of women now undergo surgery with gynecologic oncologists, access for some women remains a challenge. A recent report suggested that 9% of the female population have barriers to access to gynecologic oncologists.²⁵ Similarly, although many initiatives to concentrate care to specialists have been successful, opportunities remain to increase the use of minimally invasive surgery, improve quality, and to minimize complications and hospital readmissions.^{26–30} Continued focus on quality improvement can further enhance the achievements that have been made for the care of endometrial cancer over the last decade.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1. Trends in referral to gynecologic oncologists for women with endometrial cancer and hyperplasia. Point estimates with 95% confidence intervals. P values derived from Cochran-Armitage trend tests.

Table 1

Association between clinical and demographic characteristics and treatment by a gynecologic oncologist for women with uterine cancer.

	Uterine cancer (any stage)						Uterine cancer (stage I)					
	Other physician			Treatment by a gynecologic oncologist			Other physician			Gynecologic oncologist		
	N	%	N	%	P-value	OR	N	%	N	%	P-value	OR
<i>All</i>	492	(9.1)	4,916	(90.9)			347	(9.3)	3,367	(90.7)		
<i>Admission year</i>					0.37						0.15	
2014	209	(42.5)	2,191	(44.6)		Referent	138	(39.8)	1,476	(43.8)		Referent
2015	283	(57.5)	2,725	(55.4)		0.92 (0.76–1.12)	209	(60.2)	1,891	(56.2)		0.83 (0.66–1.05)
<i>Age (years)</i>					<0.001						0.18	
<50	67	(13.6)	489	(9.9)		Referent	44	(12.7)	368	(10.9)		Referent
50–59	161	(32.7)	1,318	(26.8)		1.07 (0.79–1.46)	110	(31.7)	946	(28.1)		1.01 (0.69–1.48)
60–69	167	(33.9)	1,852	(37.7)		1.37 (1.01–1.86)*	128	(36.9)	1,281	(38.0)		1.08 (0.75–1.57)
≥70	97	(19.7)	1,257	(25.6)		1.43 (1.02–2.01)*	65	(18.7)	772	(22.9)		1.12 (0.74–1.70)
<i>Race</i>					<0.001						<0.001	
White	323	(65.7)	3,918	(79.7)		Referent	224	(64.6)	2,715	(80.6)		Referent
Black	46	(9.3)	456	(9.3)		0.77 (0.56–1.07)	29	(8.4)	280	(8.3)		0.78 (0.52–1.17)
Other	28	(5.7)	186	(3.8)		0.57 (0.37–0.87)*	19	(5.5)	137	(4.1)		0.60 (0.36–1.00)*
Unknown	95	(19.3)	356	(7.2)		0.30 (0.23–0.39)*	75	(21.6)	235	(7.0)		0.25 (0.19–0.34)*
<i>BMI (kg/m²)</i>					0.30						0.32	
Normal	63	(12.8)	674	(13.7)		Referent	41	(11.8)	420	(12.5)		Referent
Overweight	83	(16.9)	970	(19.7)		1.00 (0.70–1.42)	52	(15.0)	619	(18.4)		1.08 (0.70–1.68)
Obese	343	(69.7)	3,254	(66.2)		0.73 (0.54–0.99)*	252	(72.6)	2,318	(68.8)		0.70 (0.48–1.01)
Unknown	3	(0.6)	18	(0.4)		0.52 (0.14–1.87)	2	(0.6)	10	(0.3)		0.40 (0.08–1.98)
<i>ASA class</i>					<0.001						<0.001	
1	17	(3.5)	64	(1.3)		Referent	14	(4.0)	51	(1.5)		Referent
2	236	(48.0)	1,992	(40.5)		2.28 (1.28–4.06)*	167	(48.1)	1,373	(40.8)		2.31 (1.21–4.42)*
3	226	(45.9)	2,693	(54.8)		3.27 (1.82–5.88)*	157	(45.2)	1,838	(54.6)		3.53 (1.82–6.84)*

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Table 2

Association between clinical and demographic characteristics and treatment by a gynecologic oncologist for women with endometrial hyperplasia with and without atypia

Endometrial Hyperplasia without Atypia										Atypical Endometrial Hyperplasia									
Other physician					Treatment by a gynecologic oncologist					Other					Gynecologic oncologist				
N	%	N	%	P-value	OR	N	%	OR	N	%	N	%	P-value	OR	N	%	N	%	OR
<i>All</i>																			
237	(50.7)	230	(49.3)			211	(33.2)		424	(66.8)									
<i>Admission year</i>																			
101	(42.6)	110	(47.8)	0.26	Referent	95	(45.0)		182	(42.9)			0.62	Referent					
2014																			
136	(57.4)	120	(52.2)		0.77 (0.52–1.15)	116	(55.0)		242	(57.1)				1.08 (0.76–1.52)					
2015																			
<i>Age (years)</i>																			
87	(36.7)	59	(25.7)	<0.001	Referent	62	(29.4)		110	(25.9)			0.69	Referent					
<50																			
99	(41.8)	75	(32.6)		1.12 (0.70–1.80)	72	(34.1)		164	(38.7)				1.02 (0.66–1.59)					
50–59																			
38	(16.0)	66	(28.7)		2.26 (1.30–3.92)*	56	(26.5)		108	(25.5)				0.82 (0.51–1.33)					
60–69																			
13	(5.5)	30	(13.0)		2.41 (1.12–5.20)*	21	(10.0)		42	(9.9)				0.95 (0.50–1.81)					
≥70																			
<i>Race</i>																			
180	(75.9)	182	(79.1)	0.03	Referent	167	(79.1)		354	(83.5)			0.01	Referent					
White																			
13	(5.5)	14	(6.1)		0.78 (0.34–1.81)	18	(8.5)		37	(8.7)				0.89 (0.48–1.65)					
Black																			
9	(3.8)	17	(7.4)		2.09 (0.86–5.04)	5	(2.4)		18	(4.2)				2.07 (0.72–5.95)					
Other																			
35	(14.8)	17	(7.4)		0.49 (0.26–0.94)*	21	(10.0)		15	(3.5)				0.31 (0.15–0.63)*					
Unknown																			
<i>BMI (kg/m²)</i>																			
35	(14.8)	27	(11.7)	0.34	Referent	23	(10.9)		44	(10.4)			0.06	Referent					
Normal																			
48	(20.3)	39	(17.0)		1.00 (0.49–2.06)	34	(16.1)		45	(10.6)				0.78 (0.39–1.57)					
Overweight																			
154	(65.0)	164	(71.3)		0.86 (0.46–1.63)	151	(71.6)		334	(78.8)				1.10 (0.61–1.97)					
Obese																			
–	–	–	–		–	3	(1.4)		1	(0.2)				0.14 (0.01–1.52)					
Unknown																			
<i>ASA class</i>																			
17	(7.2)	2	(0.9)	<0.001	Referent	9	(4.3)		12	(2.8)			0.01	Referent					
1																			
148	(62.4)	103	(44.8)		5.34 (1.17–24.33)*	121	(57.3)		198	(46.7)				1.32 (0.51–3.40)					
2																			
69	(29.1)	122	(53.0)		12.21 (2.56–58.12)*	80	(37.9)		202	(47.6)				2.09 (0.78–5.59)					
3																			

Atypical Endometrial Hyperplasia									
Endometrial Hyperplasia without Atypia					Treatment by a gynecologic oncologist				
Other physician		Gynecologic oncologist			Other		Gynecologic oncologist		
N	%	N	%	P-value	N	%	N	%	OR
4	2 (0.8)	3	(1.3)		1	(0.5)	12	(2.8)	10.65 (1.10–103.45)*
Unknown	1 (0.4)	0	(0.0)		–	–	–	–	–

* P<0.05.

Non-estimable.

Table 3

Univariate association between type of surgery, performance of lymphadenectomy, and complications by surgical specialty

	Uterine cancer (any stage)						Uterine cancer (stage I)									
	Other			Gynecologic oncologist			Gynecologic oncologist vs. other specialty			Gynecologic oncologist			Gynecologic oncologist vs. other specialty			
	N	%		N	%	P-value	N	%		N	%	P-value	N	%		
<i>Hysterectomy</i>																
Abdominal	112	(22.8)		1,238	(25.2)	<0.001				60	(17.3)	650	(19.3)		1.14 (0.80–1.63)	
Minimally invasive	363	(73.8)		3,620	(73.6)					278	(80.1)	2,675	(79.4)		0.96 (0.68–1.35)	
Vaginal	17	(3.5)		58	(1.2)					9	(2.6)	42	(1.2)		0.47 (0.19–1.15)	
<i>Lymphadenectomy</i>																
No	321	(65.2)		2,148	(43.7)	<0.001				246	(70.9)	1,609	(47.8)		-	
Yes	171	(34.8)		2,768	(56.3)					101	(29.1)	1,758	(52.2)		2.66 (2.09–3.39) *	
<i>Complications</i>																
No	482	(98.0)		4,788	(97.4)	0.44				344	(99.1)	3,294	(97.8)		-	
Yes	10	(2.0)		128	(2.6)					3	(0.9)	73	(2.2)		2.54 (0.80–8.10)	
<i>Length of stay (days)</i>																
0	33	(6.7)		206	(4.2)	0.051				18	(5.2)	149	(4.4)		0.85 (0.45–1.60)	
1	281	(57.1)		2,930	(59.6)					231	(66.6)	2,218	(65.9)		0.97 (0.72–1.31)	
2–4	135	(27.4)		1,291	(26.3)					80	(23.1)	788	(23.4)		1.02 (0.73–1.42)	
5	43	(8.7)		489	(9.9)					18	(5.2)	212	(6.3)		1.23 (0.65–2.31)	
<i>Readmission</i>																
No	470	(95.5)		4,630	(94.2)	0.22				340	(98.0)	3,208	(95.3)		-	
Yes	22	(4.5)		286	(5.8)					7	(2.0)	159	(4.7)		2.41 (1.12–5.17) *	

Odds ratio (OR) for gynecologic oncologist vs. other specialty were unadjusted. For hysterectomy and length of stay, the comparison was made between each level and the rest.

* P<0.0166 for the outcome of hysterectomy with Bonferroni correction; P<0.0125 for the outcome of LOS with Bonferroni correction; P<0.05 for the outcomes of lymphadenectomy, complications.

Univariate association between type of surgery, performance of lymphadenectomy, and complications by surgical specialty for women with endometrial hyperplasia

Table 4

	Endometrial Hyperplasia without Atypia						Atypical Endometrial Hyperplasia					
	Other			Gynecologic oncologist			Other			Gynecologic oncologist		
	N	%	N	%	P-value	Gynecologic oncologist vs. other specialty	N	%	N	%	P-value	Gynecologic oncologist vs. other specialty
<i>Hysterectomy</i>					<0.001						<0.001	
Abdominal	49	(20.7)	37	(16.1)		0.74 (0.41–1.31)	28	(13.3)	35	(8.3)		0.59 (0.31–1.12)
Minimally invasive	157	(66.2)	186	(80.9)		2.15 (1.28–3.62)*	160	(75.8)	384	(90.6)		3.06 (1.76–5.32)*
Vaginal	31	(13.1)	7	(3.0)		0.21 (0.07–0.58)*	23	(10.9)	5	(1.2)		0.10 (0.03–0.32)*
<i>Complications</i>					0.17						0.73	
No	236	(99.6)	226	(98.3)		-	210	(99.5)	421	(99.3)		-
Yes	1	(0.4)	4	(1.7)		4.18 (0.46–37.66)	1	(0.5)	3	(0.7)		1.50 (0.15–14.47)
<i>Length of stay (days)</i>					0.10						0.10	
0	26	(11.0)	18	(7.8)		0.69 (0.31–1.54)	16	(7.6)	35	(8.3)		1.10 (0.50–2.40)
1	142	(59.9)	159	(69.1)		1.50 (0.92–2.44)*	144	(68.2)	321	(75.7)		1.45 (0.91–2.31)*
2–4	62	(26.2)	43	(18.7)		0.65 (0.37–1.14)	44	(20.9)	58	(13.7)		0.60 (0.35–1.04)*
5	7	(3.0)	10	(4.3)		1.49 (0.43–5.23)	7	(3.3)	10	(2.4)		0.70 (0.20–2.45)
<i>Readmission</i>					0.76						0.21	
No	229	(96.6)	221	(96.1)		-	199	(94.3)	409	(96.5)		-
Yes	8	(3.4)	9	(3.9)		1.17 (0.44–3.08)	12	(5.7)	15	(3.5)		0.61 (0.28–1.32)

Odds ratio (OR) for gynecologic oncologist vs. other specialty were unadjusted. For hysterectomy and length of stay, the comparison was made between each level and the rest.

* P<0.0166 for the outcome of hysterectomy with Bonferroni correction; P<0.0125 for the outcome of LOS with Bonferroni correction; P<0.05 for the outcomes of lymphadenectomy, complications.