SURGICAL RESEARCH

Openventio PUBLISHERS

ISSN 2377-8407 Open Journal http://dx.doi.org/10.17140/SROJ-2-107

Research

*Corresponding author
Lisa Beth Spiryda MD, PhD
Associate Professor
University of Florida
College of Medicine
Department of Obstetrics and Gynecology, PO. Box 100294
Gainesville, FL 32610, USA
Tel. 352-273-7660
Fax: 352-392-3498
E-mail: spirlb@ufl.edu

Volume 2 : Issue 1
Article Ref. #: 1000SROJ2107

Article History
Received: March 30th, 2015
Accepted: May 19th, 2015
Published: May 28th, 2015

Citation
McLeod JB, Cao J, Spiryda LB. Introduction of laparoscopic hysterectomy approach: decreasing the abdominal hysterectomy approach or replacing vaginal hysterectomy. *Surg Res Open J*. 2015; 2(1): 36-42. doi: 10.17140/SROJ-2-107

Introduction of Laparoscopic Hysterectomy Approach: Decreasing the Abdominal Hysterectomy Approach or Replacing Vaginal Hysterectomy

Jill B. McLeod[1], Joseph Cao[2] and Lisa Beth Spiryda[3*]

[1]Physician, Sumter OB-GYN, 115 N. Sumter Street, Sumter, 29150 SC, USA
[2]University of South Carolina, School of Medicine, Columbia, SC, USA
[3]Associate Professor, Department of Obstetrics and Gynecology, University of Florida, College of Medicine, PO Box 100294, Gainesville, FL 32610, USA

ABSTRACT

Background: It has been noted in the medical literature that abdominal hysterectomy rates continue to be over 66%, with less than one-third of hysterectomies performed *via* minimally invasive approaches despite the rapidity of recovery. We compared trends in hysterectomy routes for the years 2000 and 2010 at our institution.
Methods: Expedited IRB approval was obtained for a retrospective chart review of all hysterectomies performed during 2000 and 2010. Medical records were abstracted for basic demographics, including age, Body Mass Index (BMI), uterine size (grams), and route of hysterectomy (laparoscopic, vaginal, laparotomy). Laparoscopic approaches included Total Laparoscopic Hysterectomy (TLH), Laparoscopic Supracervical Hysterectomy (LSH), Laparoscopy Assisted Vaginal Hysterectomy (LAVH), and Da Vinci robotic hysterectomy. Standard statistical analysis was performed using JMP statistical programming.
Results: No differences were found between mean age and racial distribution in the years analyzed. In 2000 and 2010, 50% of hysterectomies were performed using minimally invasive techniques. In 2000, 47% were performed *via* the vaginal route whereas in 2010, 47.7% were performed *via* laparoscopy. When patients were stratified by weight class, obese women (BMI>30) had a statistically significant greater number of hysterectomies performed *via* the abdominal route when compared to normal weight women; this was independent of uterine weight. African-American women were also found more likely to have an abdominal hysterectomy, but once controlled for uterine weight, this difference dissipated.
Conclusions: At our institution, 50% of hysterectomies were performed using minimally invasive techniques in both 2000 and 2010, with laparoscopic approaches essentially replacing vaginal hysterectomies by 2010 without affecting abdominal hysterectomy rates. Minimally invasive approaches continue to lag in obese women.

KEYWORDS: Surgery; Laparoscopic Hysterectomy (LH); Cancer; Minimally invasive technique; Obese patients.

ABBREVIATIONS: TVH: Total Vaginal Hysterectomy; LH: Laparoscopic Hysterectomy; AH: Abdominal Hysterectomy; LAVH: Laparoscopic Assisted Vaginal Hysterectomy; TLH: Total Laparoscopic Hysterectomy; BMI: Body Mass Index.

INTRODUCTION

Hysterectomies continue to be one of the most common surgeries performed on women in the United States, peaking at 681,234 in 2002 and declining to 433,621 in 2010.[1] Despite

several minimally invasive techniques now available, including Total Vaginal Hysterectomy (TVH) and Laparoscopic Hysterectomy (LH) approaches, the vast majority are still performed with a laparotomy or *via* the Abdominal Hysterectomy (AH).[1-3] It has been reported that over two thirds of hysterectomies continue to be performed in the United States as open abdominal procedures, with the lowest rates in the Southern region.[1-4]

It has been well established that minimally invasive techniques, both laparoscopic and vaginal hysterectomy, have distinct advantages over abdominal approaches, including decreased length of hospitalization, reduced postoperative infections, shorter recovery times, and decreased blood loss.[1-11]

Historically, TVH has been the route of choice among gynecologists; training for this surgical procedure has been well integrated into Obstetrics and Gynecology residency programs over the past 30 years.[5,8] The introduction of laparoscopic techniques, including Laparoscopic Assisted Vaginal Hysterectomy (LAVH), Total Laparoscopic Hysterectomy (TLH), Laparoscopic Supracervical Hysterectomy (LSH), and robotic-assisted hysterectomy (TLH/LSH), had promise to continue decreasing the numbers of AH performed in the United States; these approaches have become integrated into residency training since the early to mid-2000's. The expectation from residency programs is that graduates should be already skilled and credentialed to readily perform these procedures, and do not specifically need to acquire additional fellowship training to attain these skills. Despite the advantages of laparoscopic approaches and emphasis during residency training, many gynecologists have been slow to adopt these newer surgical techniques, with 65% of hysterectomies still being performed abdominally.[1-5] Studies have shown increased rates of AH in African-American and Hispanic women, patients with Medicaid or the uninsured, and those receiving care at a resident teaching clinic, indicating that racial and socioeconomic factors also play a decision-making role on hysterectomy approaches.[4-11]

Hospitals have tried to develop strategies to decrease AH rate including developing logarithms for predicting success of a minimally invasive approach and hiring laparoscopic fellowship trained physicians. These strategies have decreased AH rates but are more difficult to implement in smaller communities.

The objective of our study was to compare trends in routes of hysterectomy over the course of a decade, specifically comparing the year 2000 and 2010, at our hospital site, which is located in the southern region of the country. These two years were selected for analysis because in 2000 LH was just being introduced as a novel approach for hysterectomy. During this 10 year period, LH was becoming fully integrated into Obstetrics and Gynecology residency programs as well as becoming more routine in both academic and private practices; by 2010, Laparoscopic Hysterectomy (LH) techniques were validated in the literature to have significant patient benefits over LH as discussed above. Our secondary analysis was to examine whether any specific patient characteristics (obesity, uterine size, prior surgeries) or social and demographic qualities influenced the choice of hysterectomy route during these years to determine if any disparities existed in minimally invasive surgical techniques.

METHODS

IRB-exempt status was obtained for the retrospective chart review through the Palmetto Health Institutional Review Board. CPT codes for all hysterectomy types were used by the medical records department to identify the charts of all women 18 years of age and older who underwent a hysterectomy at Palmetto Health Richland Hospital during the two time periods of interest (January 1, 2000 through December 31, 2000 and January 1, 2010 through December 31, 2010).

Medical records were abstracted for the following data points: year of surgery, race/ethnicity, age, type of insurance, Body Mass Index (BMI), route of hysterectomy, indication for hysterectomy, preoperative estimate and intraoperative assessment of uterine size, uterine weight; prior pelvic surgery, length of surgery, length of hospital stay, intraoperative complications, and postoperative complications leading to readmission or emergency department visit.

Hysterectomies were categorized as Total Vaginal Hysterectomy (TVH), Laparoscopic Hysterectomy (LH), or Abdominal Hysterectomy (AH). Included in the laparoscopic category were the following approaches: Total Laparoscopic Hysterectomy (TLH), Laparoscopic Supracervical Hysterectomy (LSH), Laparoscopic Assisted Vaginal Hysterectomy (LAVH), and all robotic (Da Vinci-assisted) hysterectomies. Vaginal and laparoscopic approaches were both considered minimally invasive techniques. The route of hysterectomy performed was ultimately chosen by the surgical attending along with the patient preference with no standard protocol; costs of a particular route of hysterectomy were not a factor in the decision making process, even in patients receiving charity care though our hospital system. All information was placed into an Excel spreadsheet. Exclusion criteria included age less than 18 years old and surgery performed for any type of cancer.

Statistical analysis was performed with Fisher Exact testing for categorical data and Student's *t*-test for all numerical/continuous data (controlling for confounders) using JMP statistical software (Copyright© 2014 SAS Institute Inc., Cary, North Carolina, USA). Null hypothesis was rejected for p-values<0.05.

RESULTS

At our institution, 334 women in the year 2000 and 250

ISSN 2377-8407 Open Journal http://dx.doi.org/10.17140/SROJ-2-107

women in the year 2010 underwent a hysterectomy for benign conditions. The age range was 18-87 (mean 44.6±9.3) in 2000 and 18-85 (mean 45±8) in 2010; women under 18 years old were excluded from analysis. Race/ethnic distribution was not different between the two years, and reflected the population of patients seen in clinics and hospital. The mean uterine preoperative assessment by weeks (12.95 week size, 2000 *versus* 13.5 week size, 2010) was not statistically different, but postoperative uterine size in grams was statistically greater in 2010 (410.6 g) compared to 2000 (310.8 g). There was also a statistically significant difference in BMI when comparing years; BMI in 2010 was greater (32.7±7.4) compared to 2000 (29.9±7.31), which is reflective of local and national trends ($p < 0.05$; Table 1).

	2000	2010	p value
Race (%)			
Caucasian	45.3	39.5	
African-American	51.7	58.5	0.15
Hispanic	0.3	0.4	1.0
Other	2.7	1.6	0.77
Age (years)	44.6	45	0.69
BMI	29.9	32.7	<0.0001
Preoperative uterine size (weeks)	12.95	13.51	0.28
Uterine Weight (g)	310.8	410.6	0.02

Table 1: Demographics.

In both 2000 and 2010, 50% of the hysterectomies were performed with a minimally invasive technique (Table 2). What differed was the type of minimally invasive route performed for the hysterectomy. In 2000, 47% of hysterectomies were vaginal hysterectomies and only 2% utilized laparoscopy. These statistics were completely reversed in 2010: 47% were performed with a laparoscopic approach and only 3% were performed vaginally. The estimate of preoperative uterine size in weeks did not influence the hysterectomy route (data not shown). In 2000, women with a history of pelvic surgery underwent more AHs (65.3%) than TVH/LH (34.7%; $p<0.0001$). However, with the introduction of laparoscopy, in 2010, this was no longer statistically different: 49.5% of the women with prior surgery underwent a minimally invasive technique ($p=1.0$).

Surgical Approach (No (%))	2000	2010
Abdominal	160 (50.7)	124 (50)
Laparoscopic	8 (2.4)	117 (47.2)
Vaginal	156 (46.9)	7 (2.82)

Table 2: Trends in routes of hysterectomy.

Past studies have reported that both race and socioeconomic factors (income level, private *versus* teaching clinic) influence the route of hysterectomy.[6-11] The patient population studied was racially diverse, with over 50% being African-American in both 2000 and 2010 (Table 1). Caucasian women had significantly less AHs in 2010 compared to 2000. Conversely, African-American women had statistically more AHs than Caucasian women in both 2000 and 2010, with less minimally invasive approaches performed (Table 3A). African-American women had statistically larger uteri than Caucasian women in both years studied (526 g *vs* 213 g; $p=0.015$). Once the data was stratified by uterine weight categories and compared among races, no statistical differences among races and hysterectomy route were noted, except in the >1000 g uterine weight category in 2010. Caucasian women with uteri >1000 g were more likely to have a minimally invasive approach than African-American

Year	2000			2010		
	Abdominal	Laparoscopic	Vaginal	Abdominal	Laparoscopic	Vaginal
Caucasian	40.4%	3.3%	56.3%	34.3%	59.6%	6.1%
African-American	60.1%	1.2%	38.7%	59.3%	40%	0.7%
Hispanic	0	0	100%	100	0	0
Other	55.6%	11.1%	33.3%	66.7%	0	33.3%

Table 3A: Stratified by year.

			Uterine Weight (grams)				
	Race	Approach	< 250 g	250 - < 500 g	500 - < 750 g	750 - < 1000g	> 1000 g
2000	African-American	Minimally Invasive	51.3%	47.5%	8.3%	20%	5%
		Abdominal	48.7%	52.5%	91.7%	80%	95%
	Caucasian	Minimally Invasive	59.8%	61.5%	50%	0	0
		Abdominal	40.2%	38.5%	50%	100%	100%
2010	African-American	Minimally Invasive	74.1%	36.1%	8.3%	0	0
		Abdominal	25.9%	63.9%	91.7%	100%	100%
	Caucasian	Minimally Invasive	70.5%	54.5%	0	0	33.3%
		Abdominal	29.5%	45.5%	100%	100%	66.7%

Table 3B: Race and uterine weight.

Table 3: Race and hysterectomy type.

women (Table 3B).

We also examined if type of insurance or which clinic the patient presented for surgery (resident clinics verses private offices) influenced route of hysterectomy. Women who had Medicaid/Medicare were more likely to have AH than those with private insurance or Tricare (military) in both 2000 and 2010 (odds ratio 1.68; 95% confidence interval 1.2-2.4; p value=0.0068) than *via* a minimally invasive route; this trend continued when controlled for uterine weight. Women presenting to resident clinics in 2010 were also more likely to have an AH (as opposed to a minimally invasive technique) than those presenting to private offices (p<0.0001). This trend dissipated when the data was stratified by uterine weight. Women who presented to the resident clinics had statistically larger uteri (494.01 g) than women who received care in private offices (309.2 g; p value=0.0002).

Lastly, data was stratified by BMI (Table 4A and 4B); we found that obese women (BMI>30) had statistically more AHs performed than minimally invasive hysterectomies (vaginal or laparoscopic) when compared to normal weight women in both 2000 and 2010 (p=0.039, p=0.045, respectively). Normal weight class women were more likely to undergo a minimally invasive route of surgery compared to the obese weight class in 2000 (OR 1.8; 95% CI 1.3-2.5) as well as 2010 (OR 1.9; 95% CI 1.5-3.1).This was statistically significant in both years studied, and this difference persisted when data was controlled by uterine weight. There was no statistical difference or trend when comparing overweight to low or normal BMI women. When the obesity category was stratified by classes (Table 4C), in the year 2000, class III obese patients had statistically more AHs than underweight, normal, and overweight women (p values = 0.01, 0.03, and 0.03 respectively). In 2010, class III continued to have less minimally invasive approaches to hysterectomies, but was only significantly different (p=0.047) when compared to normal BMI patients.

DISCUSSION

Several conclusions can be drawn from our data analysis. At the studied institution, AH rates have remained steady over the past decade. Most interestingly, the rate of minimally invasive routes has also remained steady; however, the type of minimally invasive technique has shifted. In 2000, 47% of hysterectomies were performed as TVH and, in 2010, 47% were performed *via* a laparoscopic route. This demonstrates several points. As laparoscopy is being introduced into residency programs, this approach is readily being accepted by general gynecologists given that there are no fellowship trained gynecologic laparoscopic surgeons in this region of the state, as shown by our 2010 data. Other institutions only saw a significant decrease of AH once minimally invasive laparoscopic gynecologists hired as part as faculty and provided mentorship.[12]

An unanticipated consequence of increasing LH at our institution was the loss of vaginal hysterectomies, which is the

Body Mass Index Class	Abdominal	Vaginal And Laparoscopic
Underweight (<18.5)	33.3%	66.7%
Normal (18.5 – 24.9)	41.7%	58.3%
Overweight (25 – 29.9)	47%	53%
Obese (>30)	56.6%	43.4%

Table 4A: Year 2000.

Body Mass Index Class	Abdominal	Vaginal and laparoscopic
Underweight (<18.5)	0	0
Normal (18.5 – 24.9)	34.3%	65.7%
Overweight (25 – 29.9)	50.0%	50.0%
Obese (>30)	52.9%	47.1%

Table 4B: Year 2010.

		Weight Class					
	Approach (%)	Underweight (< 18.5)	Normal (18.5-24.9)	Overweight (25 – 29.9)	Class I Obesity (30 – 34.9)	Class II Obesity (35 – 39.9)	Class III Obesity (> 40)
2000	Minimally Invasive	80.0 %	58.3 %	53 %	45.1 %	51.6 %	30.0 %
	Abdominal	20.0 %	41.7 %	47 %	54.9 %	48.4 %	70.0 %
2010	Minimally Invasive	0	63.9 %	50 %	47.2 %	51.2 %	41.0 %
	Abdominal	0	36.1 %	50 %	52.8 %	1.8 %	59.0 %

Table 4C: Stratification of obesity classes.

Table 4: BMI and route of hysterectomy.

most minimally invasive route. Instead of laparoscopy replacing AH, it is replacing the already minimally invasive TVH; this is irrespective of a history of pelvic surgeries. One minimally invasive approach has been replaced by another without reducing the overall AH as the originally intended route upon introduction of laparoscopy. Several other studies including one in Canada and another in PA in a similar time periods,[13-15] confirmed that as LH approaches increased AH decreased. These institutions also showed a decrease of VH (27.5% to 21.1%; 13 and 22.2% to 17.2%; 14) but not to the same degree as we saw at our institution; the baseline VH rates were also not as high as we reported in 2000. Other additional factors that contribute to the decreasing rates of VH are graduating residents confidence and experience in performing this route; one study reported that only 42% of residents reported the vaginal route as the preferred route for hysterectomy despite its distinct advantages over both LH and AH.[16]

Various conclusions can be inferred from the study results. As both resident duty hour's decrease and overall hysterectomies performed in the United States decrease, there is limited time to become adept at all surgical approaches. It appears, at the expense of vaginal hysterectomies, laparoscopy is becoming the technique. One benefit of the introduction of laparoscopic approaches to hysterectomies has allowed women with prior pelvic surgery to undergo minimally invasive hysterectomies; in 2000, 34.7% of women with prior pelvic surgeries had the minimally invasive approach compared to 49.5% in 2010. This is an important finding given the increasing rates of cesarean delivery in the United States.

Reported in several studies, women of African-American race are more likely to have AH.[1,5,6,17] Initially, when our data was stratified by race, it appeared that African-American women were less likely to have surgery by a minimally invasive approach in both 2000 and 2010. However, when data was controlled for postoperative uterine weight (g), this was not evident; African-American women were having the same rates of minimally invasive approaches to hysterectomies.

Other socioeconomic factors that have been shown to decrease the use of minimally invasive approaches are annual household income, insurance type, and receiving care at a resident clinic.[5-9] Our data also showed that women who had Medicaid/Medicare/free care were more likely to have an AH than a TVH (2000) or LH (2010) compared to women with private or military insurance. These findings persisted even when controlled for uterine weight. It is unclear why this difference existed as Tricare and Medicaid are both government type insurances, and are comparable in coverage. Additionally, these differences were independent of where they received care; in a resident clinic or private office. Patients seen in a resident clinic were more likely to have an AH than *via* a minimally invasive route in both 2000 and 2010, but, again, this finding dissipated when data was controlled for by uterine weight.

The other interesting conclusion that can be drawn from our data is that obese patients resulted in having more AHs than normal weight women, and were less likely to undergo a minimally invasive approach (vaginal or laparoscopic) in both 2000 and 2010; this was most significant with Class III obese women. Two potential confounders, uterine weight and history of pelvic surgery, did not vary among weight classes. There are several factors for this disparity in minimally invasive hysterectomy in obese women. Obese women have a decreased tolerance to the Trendelenburg position secondary to respiratory distress; this position is necessary, to a certain degree, for both laparoscopic and vaginal approaches. An additional laparoscopic limitation in obese patients is physician fatigue from the torque required in using the laparoscopic instruments to overcome the pannus associated with truncal obesity, as well as access to bariatric equipment by the general gynecological surgeon. Given the faster recovery, decreased wound infections, and shorter time to ambulation, it is important to routinely offer minimally invasive techniques to all patients but, in particular, to obese patients. Multiple studies have shown the safety of LH and VH for both benign and malignant conditions in obese patients and that are superior to AH with lower short term and long complication rates.[18-26]

General gynecologists need to continue expanding the use of minimally invasive approaches for hysterectomies for all populations in order to decrease overall AH rates. Laparoscopic surgery was introduced to decrease AH, and not to replace VH. We would encourage the increased use of laparoscopic and/or vaginal approaches in obese women and those with larger uteri. Increasing the surgical volume of these cases during residency and in the initial years of practice, along with increased laparoscopic simulation exercises, would help achieve this goal.[27-30] Surgeons performing less than 10 hysterectomies a year have the highest rates of AH.[27-29] Additionally, VH should continue to be reinforced in resident training as the preferred minimally invasive route.[31] As robotic surgery becomes more integrated into residency programs and adapted by the general gynecologist, it will be interesting to examine whether its use decreases AH rates or if it just replaces one of the minimal invasive approaches.

CONFLICTS OF INTEREST: None.

DISCLOSURES

Authors have no pertinent disclosures to report.

ACKNOWLEDGEMENTS

This work was presented in part as an oral presentation at Society of Laparoendoscopic Surgeons Annual Meeting Washington DC (2013) by McLeod JB.

REFERENCES

1. Wright JD, Herzog TJ, Tsui J, et al. Nationwide trends in the

performance of inpatient hysterectomy in the United States. *Obstet Gynecol.* 2013; 122(2 Pt 1): 233-241. doi: 10.1097/AOG.0b013e318299a6cf

2. Merrill RM. Hysterectomy surveillance in the United States, 1997 through 2005. *Med Sci Monit.* 2008; 14(1): CR24-CR31.

3. AAGL Advancing Minimally Invasive Gynecology Worldwide. AAGL Position Statement: Route of Hysterectomy to Treat Benign Uterine Disease. *J Minim Invasive Gynecol.* 2011; 18: 1-3. doi: 10.1016/j.jmig.2010.10.001

4. Jacoby VL, Autry A, Jacobson G, Domush R, Nakagawa S, Jacoby A. Nationwide use of laparoscopic hysterectomy compared with abdominal and vaginal approaches. *Obstet Gynecol.* 2009; 114(5): 1041-1048. doi: 10.1097/AOG.0b013e3181b9d222

5. Nieboer TE, Johnson N, Lethaby A, et al. Surgical approach to hysterectomy for benign gynaecological disease. *Cochrane Database Syst Rev.* 2009; 3: CD003677. doi: 10.1002/14651858.CD003677.pub4

6. Abenhaim HA, Azziz R, Hu J, Bartolucci A, Tulandi T. Socioeconomic and racial predictors of undergoing laparoscopic hysterectomy for selected benign diseases: analysis of 341487 hysterectomies. *J Minim Invasive Gynecol.* 2008; 15: 11-15. doi: 10.1016/j.jmig.2007.07.014

7. Tu FF, Beaumont JL, Senapati S, Gordon TE. Route of hysterectomy influence and teaching hospital status. *Obstet Gynecol.* 2009; 114(1): 73-78. doi: 10.1097/AOG.0b013e3181aa9597

8. Burkett D, Horwitz J, Kennedy V, Murphy D, Graziano S, Kenton K. Assessing current trends in resident hysterectomy training. *Female Pelvic Med Reconstr Surg.* 2011; 17: 210-214. doi: 10.1097/SPV.0b013e3182309a22

9. Cohen SL, Vitonis AF, Einarsson JI. Updated Hysterectomy Surveillance and Factors Associated With Minimally Invasive Hysterectomy. *JSLS.* 2014; 18(3). doi: 10.4293/JSLS.2014.00096

10. Wu JM, Wechter ME, Geller EJ, Nguyen TV, Visco AG. Hysterectomy rates in the United States, 2003. *Obstet Gynecol.* 2007; 110(5): 1091-1095. doi: 10.1097/01.AOG.0000285997.38553.4b

11. Dorsey JH, Steinberg EP, Holtz PM. Clinical indications for hysterectomy route: patient characteristics or physician preference? *Am J Obstet Gynecol.* 1995; 173(5): 1452-1460. doi: 10.1016/0002-9378(95)90632-0

12. Loring M, Morris SN, Isaacson KB. Minimally invasive specialists and rates of laparoscopic hysterectomy. *JSLS.* 2015; 19(1): e2014.00221. doi: 10.4293/JSLS.2014.00221

13. Chen I, Lisonkova S, Allaire C, Williams C, Yong P, Joseph KS. Routes of hysterectomy in women with benign uterine disease in the Vancouver Coastal Health and Providence Health Care regions: a retrospective cohort analysis. *CMAJ Open.* 2014; 2(4): E273-E280. doi: 10.9778/cmajo.20130080

14. Turner LC, Shepherd JP, Wang L, Bunker CH, Lowder JL. Hysterectomy surgical trends: a more accurate depiction of the last decade? *Am J Obstet Gynecol.* 2013; 208(4): 277.e1-e7. doi: 10.1016/j.ajog.2013.01.022

15. Jacoby VL, Autry A, Jacobson G, Domush R, Nakagawa S, Jacoby A. Nationwide use of laparoscopic hysterectomy compared with abdominal and vaginal approaches. *Obstet Gynecol.* 2009; 114(5): 1041-1048.

16. Antosh DD, Gutman RE, Iglesia CB, Sokol AI, Park AJ. Resident opinions on vaginal hysterectomy training. *Female Pelvic Med Reconstr Surg.* 2011; 17(6): 314-317. doi: 10.1097/SPV.0b013e31823a08bf

17. Jacoby VL, Fujimoto VY, Giudice LC, Kuppermann M, Washington AE. Racial and ethnic disparities in benign gynecologic conditions and associated surgeries. *Am J Obstet Gynecol.* 2010; 202(6): 514-521. doi: 10.1016/j.ajog.2010.02.039

18. Bogani G, Cromi A, Serati M, et al. Laparoscopic and vaginal approaches to hysterectomy in the obese. *Eur J Obstet Gynecol Reprod Biol.* 2015; 189: 85-90. doi: 10.1016/j.ejogrb.2015.02.035

19. Mikhail E, Scott L, Imudia AN, Hart S. Total laparoscopic hysterectomy in the obese patient. *Surg Technol Int.* 2014; 25: 167-174.

20. Brezina PR, Beste TM, Nelson KH. Does route of hysterectomy affect outcome in obese and nonobese women? *JSLS.* 2009; 13(3): 358-363.

21. Shah DK, Vitonis AF, Missmer SA. Association of body mass index and morbidity after abdominal, vaginal, and laparoscopic hysterectomy. *Obstet Gynecol.* 2015; 125(3): 589-598. doi: 10.1097/AOG.0000000000000698

22. Tinelli R, Litta P, Meir Y, et al. Advantages of laparoscopy versus laparotomy in extremely obese women (BMI> 35) with early-stage endometrial cancer: a multicenter study. *Anticancer Res.* 2014; 34(5): 2497-2502.

23. Bardens D, Solomayer E, Baum S, et al. The impact of the body mass index (BMI) on laparoscopic hysterectomy for benign disease. *Arch Gynecol Obstet.* 2014; 289(4): 803-807. doi: 10.1007/s00404-013-3050-2

24. Morgan-Ortiz F, Soto-Pineda JM, López-Zepeda MA, Peraza-Garay Fde J. Effect of body mass index on clinical out-

ISSN 2377-8407 Open Journal http://dx.doi.org/10.17140/SROJ-2-107

comes of patients undergoing total laparoscopic hysterectomy. *Int J Gynaecol Obstet*. 2013; 120(1): 61-64. doi: 10.1016/j.ijgo.2012.08.012

25. Siedhoff MT, Carey ET, Findley AD, Riggins LE, Garrett JM, Steege JF. Effect of extreme obesity on outcomes in laparoscopic hysterectomy. *J Minim Invasive Gynecol*. 2012; 19(6): 701-707. doi: 10.1016/j.jmig.2012.07.005

26. Kondo W, Bourdel N, Marengo F, et al. What's the impact of the obesity on the safety of laparoscopic hysterectomy techniques? *J Laparoendosc Adv Surg Tech A*. 2012; 22(10): 949-953. doi: 10.1089/lap.2012.0213

27. Boyd LR, Novetsky AP, Curtin JP. Effect of surgical volume on route of hysterectomy and short-term morbidity. *Obstet Gynecol*. 2010; 116(4): 909-915. doi: 10.1097/AOG.0b013e3181f395d9

28. Hoyer-Sorensen C, Hortemo S, Lieng M. Changing the route of hysterectomy into a minimal invasive approach. *ISRN Obstet Gynecol*. 2013; 2013: 249357. doi: 10.1155/2013/249357

29. Moen M, Walter A, Harmanli O, et al. Considerations to improve the evidence-based use of vaginal hysterectomy in benign gynecology. *Obstet Gynecol*. 2014; 124(3): 585-588. doi: 10.1097/AOG.0000000000000398

30. Kovac SR. Route of hysterectomy: an evidence-based approach. *Clin Obstet Gynecol*. 2014; 57(1): 58-71. doi: 10.1097/GRF.0000000000000009

31. Moen MD, Richter HE. Vaginal hysterectomy: past, present, and future. *Int Urogynecol J*. 2014; 25(9): 1161-1165. doi: 10.1007/s00192-014-2459-x