ZKTB

ORIGINAL RESEARCH

Comparison of the Effect of Two Different Routes of Hysterectomy Surgeries on the Pulmonary Function: Laparoscopic Versus Abdominal

İki Farklı Histerektomi Cerrahisi Yönteminin Solunum Fonksiyonuna Etkisinin Karşılaştırılması: Laparoskopik veya Abdominal

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ABSTRACT

Objective: *We aimed to compare pre and post-operative pulmonary function between women who underwent laparoscopic or abdominal hysterectomy.*

Material and Methods: *We prospectively collected data between January 2015 and November 2016 at Health Sciences University Zeynep Kamil Women and Children's Diseases Training and Research Hospital. Patients who were admitted to the Obstetrics and Gynecology clinic with a hysterectomy indication were non-randomly allocated into 2 groups as the laparoscopy group (n=24) and the open surgery group (n=26) according to patient priorities and surgeons' preference. Patients who had already undergone an abdominal operation and systemic disorders were excluded from the study. Pulmonary function tests were assessed and compared preoperatively and at postoperative day five.*

Results: *There were significant changes in majority of the parameters of pulmonary function test after surgery compared to baseline measurements except $PaCO^2$, PaO^2 and SaO^2 levels in group of women who underwent total abdominal hysterectomy. There were significant changes in majority of the parameters of pulmonary function test after surgery compared to baseline measurements except $PaCO^2$ levels in group of women who underwent total laparoscopic hysterectomy.*

Conclusion: *Both laparoscopic and abdominal hysterectomies were associated with deteriorated pulmonary function tests.*

Keywords: *pulmonary function test, laparoscopic hysterectomy, abdominal hysterectomy*

ÖZET

Amaç: *Laparoskopik veya abdominal histerektomi uygulanan kadınlarda ameliyat öncesi ve sonrası solunum fonksiyonlarını karşılaştırmayı amaçladık.*

Gereç ve Yöntemler: *Ocak 2015 - Kasım 2016 tarihleri arasında Sağlık Bilimleri Üniversitesi Zeynep Kamil Kadın ve Çocuk Hastalıkları Eğitim ve Araştırma Hastanesinde prospektif olarak veri topladık. Histerektomi endikasyonu ile Kadın Hastalıkları ve Doğum kliniğine başvuran hastalar, hasta öncelikleri ve cerrahların tercihine göre rastgele olarak laparoskopi grubu (n= 24) ve açık cerrahi grubu (n= 26) olmak üzere 2 gruba ayrıldı. Karın ameliyatı geçiren hastalar ve sistemik bozukluklar çalışma dışı bırakıldı. Solunum fonksiyon testleri değerlendirildi ve ameliyat öncesi ve ameliyat sonrası 5. gündeki değerler karşılaştırıldı.*

Bulgular: *Total abdominal histerektomi uygulanan kadınlarda $PaCO^2$, PaO^2 ve SaO^2 düzeyleri hariç cerrahi sonrası solunum fonksiyon testi parametrelerinin çoğunda bazal ölçümlere göre anlamlı değişiklikler vardı. Total laparoskopik histerektomi uygulanan kadınlarda $PaCO^2$ düzeyleri hariç cerrahi sonrası solunum fonksiyon testi parametrelerinin çoğunda bazal ölçümlere göre anlamlı değişiklikler vardı*

Sonuç: *Hem laparoskopik hem de abdominal histerektomiler bozulmuş solunum fonksiyon testleri ile ilişkiliydi.*

Anahtar Kelimeler: *histerektomi, solunum fonksiyon testi*

INTRODUCTION

Carbon dioxide (CO^2) insufflation into the peritoneal space is the most commonly preferred method to provide pneumoperitoneum. In majority of the cases, this pneumoperitoneum results in increased intra-abdominal pressure, which results in altered respiratory system and cardiac function. The respiratory system function is affected mainly by the increased CO^2 concentration [1, 2] and reduced diaphragmatic movements. Additionally, general anesthesia also impairs respiratory function [3].

One of the most common surgical procedures in the female genital system is hysterectomy [4]. Vaginal hysterectomy has been proposed to have some advantages over other types of hysterectomies [5]. On the other hand, in the case of relative or absolute contraindications to vaginal hysterectomy, laparoscopy may be the first choice to avoid 5 unnecessary laparotomies [5].

A significant problem of major abdominal surgery is lung complications [6]. The incidence of the development of lung complications following major abdominal surgery is approximately 20–25% in the literature, and the mortality rate of these complications is reported to be 3–4% [7]. In such cases, lung complications are considered to develop due to the incisional pain and the atelectasis as the result of inadequate ventilation, diaphragmatic dysfunction, and deterioration of the ventilation mechanism due to other reasons [8]. Laparoscopic abdominal surgery is considered to cause less pulmonary dysfunction than open abdominal surgery since it causes less incisional pain in the postoperative period and consequently has less effect on postoperative lung oxygenation [6, 8]. While there are many studies in the literature that compared open and laparoscopic

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surgery regarding their pulmonary effects in procedures such as cholecystectomy, obesity surgery, esophagogastric surgery, and nephrectomy, however there is no study on hysterectomy surgery [9].

In this study, we aimed to compare pre and post-operative pulmonary function among women who underwent laparoscopic or abdominal hysterectomy.

MATERIAL AND METHOD

We prospectively collected data between January 2015 and November 2016 at Health Sciences University Zeynep Kamil Women and Children's Diseases Training and Research Hospital. The study was conducted in Obstetrics and Gynecology and Pulmonary Diseases departments and was granted approval by the local ethics committee of Health Sciences University Zeynep Kamil Women and Children's Diseases Training and Research Hospital. Written consent was obtained from all patients participating in the study. Patients who were admitted to the Obstetrics and Gynecology clinic with a hysterectomy indication were non-randomly allocated into 2 groups as the laparoscopy group (n=24) and the open surgery group (n=26) according to patient priorities and surgeon preference. Patients who had already undergone an abdominal operation and systemic disorder were excluded from the study.

Pulmonary function tests were assessed preoperatively and at postoperative day five. In both patient groups, we recorded and retrospectively evaluated demographic data (age, body mass index, smoking history), type and duration of surgery, pulmonary function test (PFT) parameters, duration of hospitalization, need for intensive care, need for non-invasive mechanical ventilator support.

During spirometric tests, the patients remained seated and performed the forced vital capacity (FVC) maneuvers. All tests conformed to the criteria of the American Thoracic Society (ATS) (10). The measurements included FVC, FEV, FEV /FVC ratio, forced expiratory flow between 25 and 75% (FEF25%75%) and peak expiratory flow (PEF). Rates of changes for each parameter of pulmonary function test following surgery were calculated by the change for each parameter divided by preoperative value and multiplied by one hundred.

Abdominal hysterectomy technique

After anesthesia is provided, the patient is brought to the lithotomy position and examined under anesthesia. The vagina is prepared with a sterile solution, a foley catheter is placed and the patient is placed in the bed position. The abdomen is prepared with a sterile solution and surgical drapes are placed. The surgical timeout was done. The selection of the incision depends on the expected pathological condition. For a smaller uterus, a transverse incision may be used, such as a Pfannenstiel incision. In cases where uterus is a wide or wide disease extending beyond uterus, such as endometriosis or adhesions, a vertical middle line incision was used. After incision was done and following entry into the peritoneal cavity, abdominal and pelvic examination was done. After the retractor is placed, the bowel is packed away from the operative area using moist surgical towel. In cases of very large masses, the mass may need to be delivered prior to placing the retractor and packing the intestine. The uterus is then held in the proximal round ligament, Fallopian tube and the utero-ovarian ligament. Traction is then used to move the uterus to one side, and the surgeon starts the hysterectomy by clamping and passing the round ligament. Transcription of the round ligament allows access to the retroperitoneal cavity. The peritoneal incision is extended to the back, not to the right, paying attention to the incision parallel to the ovarian veins. The ureter is identified by visualization of the passage on common iliac artery through the bifurcations and progression to the pelvis in the medial leaf of the broad ligament. If adnexes were needed to be removed, the infundibulopelvic ligament with ovarian veins was clamped, cut and ligated. If adnexes were not needed to be removed, the utero-ovarian ligament was clamped, cut and tied to the distal portion of the adnexa. The same procedure is done on the opposite side. After controlling ovarian veins on both sides, the anterior peritoneum was cut. Sharp dissection is performed to separate the bladder from the lower uterine segment and the cervix. The uterine vessels were visualized with the removal of loose connective tissue around the vessels. The bladder was moved side by side and the urethral vessels were compressed securely. Vessels were ligated with the Heaney clamp, which was perpendicular to the uterine veins. After the uterine vessels were compressed, cut and ligated, the consecutive bites of the remaining parametrial tissue were taken using straight clamps placed along the side of the cervix. The parametric tissue was gradually compressed, cut and secured until it reaches the upper vagina. At this point, the scissors was inserted and a circumferetial incision was made to separate uterin cervix from vaginal apex. The corners of the vaginal cuff are held and the cuff was usually closed using figure of 8 or flowing sutures. The pelvis is then watered with hot saline and all the dissection areas were checked for hemostasis. The lap sponges were removed and counted, the incision of the abdomen is closed.

Laparoscopic hysterectomy Technique / procedure (detailed steps)

Pneumoperitoneum was obtained by entering the abdomen with a Veress needle. Then, the abdomen was entered with a 10-mm trocar and then a 10mm telescope with 0 degrees. Since the surgeon was working on the left side of the patient, the first 5 mm ipsilateral lateral port was placed laterally to the inferior epigastric artery about 2 cm from the anterior-posterior of the left crista iliaca. The second 5 mm trocar was placed in the periumbilical region on the same line and the third 5 mm trocar was placed in the right lower quadrant.

Then, the patient started the operation after being placed in the Trendelenburg position as much as possible. During operation, advanced bipolar electrocoagulation (Li-gasure, Covidien Company, MA, USA) was used.

A VCare uterine manipulator (Conmed, NY, USA) was used as a uterine manipulator. After exploration of the intraabdominal region and the passageway of the ureter, the round ligament, utero-ovarian and infundibulopelvic ligament on both sides were cut after coagulation with Ligasure. After dissection of the anterior and posterior leaves of the broad ligament, the bladder was separated from the cervix by blunt and sharp dissection. Uterine arteries were coagulated and then cut from both sides. The parametric tissues around the cervix were coagulated with Ligasure, and then cut and the areas of the bleeding were clotted, the entire vaginal wall was circularly separated from the cervix using a monopolar L-tip cautery through a cervix. The surgical material was removed vaginally. The vaginal cuff was laparoscopically sealed with late absorbable suture material.

STATISTICAL ANALYSIS

SPSS 20 statistical analysis software (IBM Corp, released 2011, IBM SPSS Statistics for Windows, Version 20.0, Armonk, NY: IBM Corp.) was used to evaluate the data. The normality assumption was examined by the Kolmogorov-Smirnov test. The differences between the 2 groups were evaluated by the Mann-Whitney U test as the parametric test prerequisites were not met. ANCOVA was used to calculate and compare adjusted means. Statistical significance was set at $p<0.05$.

Table 1: Summary of some demographic and clinical paramters of whole study population.

	Groups	N	Mean	Std. Deviation	P Value
Age (years)	TAH	24	47.6	6.8	0.3
	TLH	26	48.6	5.7	
BMI (kg/m²)	TAH	24	28.8	5.6	0.05
	TLH	26	31.8	5.3	
Duration of operation (min)	TAH	24	90.1	28.5	0.4
	TLH	25	98.2	24.8	
Duration of anesthesia (min)	TAH	24	111.6	22.4	0.04
	TLH	25	124.6	24.7	

TAH:*Total abdominal hysterectomy,* ***TLH:*** *Total laparoscopic hysterectomy*

Table 2: Comparison of preo and post operative pulmonary funtion test results among women who underwent total abdominal hysterectomy.

	Preoperative values		Postoperative values		p Value
	Mean	SD	Mean	SD	
FEV1	2.1	0.5	1.3	0.3	<0.001
FVC	2.7	0.6	1.6	0.4	<0.001
FEF25	3.5	1.1	2.1	0.7	<0.001
FEF75	1.7	0.6	0.9	0.3	<0.001
FEF2575	2.7	0.7	1.5	0.5	<0.001
PEF	3.8	1.3	2.3	0.6	0.001
$PaCO^2$	36.2	3.5	36.2	4.5	0.8
PaO^2	87.9	24.6	88.4	22.4	0.7
SaO^2	93.7	12.9	94.9	9.03	0.7
PPH	7.4	0.02	7.3	0.05	0.001
VAS	0.6	1.6	7.2	1.3	<0.001

RESULTS

Comparison of some demographic and clinical characteristics between the two groups revealed significant difference in terms of duration of anesthesia, which was found to significantly prolonged in women who underwent laparoscopy (124 vs. 111 min., $p<0.05$, Table 1).

Table 3: Comparison of preo and post operative pulmonary funtion test results among women who underwent total laparoscopic hysterectomy.

	Preoperative values		Postoperative values		P Value
	Mean	SD	Mean	SD	
FEV1	2.1	0.5	1.6	0.3	<0.001
FVC	2.5	0.6	1.9	0.3	<0.001
FEF25	3.4	1.4	2.4	0.8	0.001
FEF75	1.5	0.6	1.06	0.4	0.004
FEF2575	2.5	1.04	1.9	0.6	0.007
PEF	3.9	1.5	2.8	0.8	0.001
$PaCO^2$	36.6	5.1	38.1	4.5	0.08
PaO^2	93.4	20.04	80.03	18.6	0.006
SaO^2	97.8	3.8	93.02	12.02	0.001
PPH	7.4	0.03	7.4	0.05	<0.001
VAS	0.2	1.2	5.9	1.9	<0.001

Table 4: Comparison of adjusted and unadjusted rates of changes of pulmonary funtion tests following operation between groups of women who underwent total laparoscopic hysterectomy or total abdominal hysterectomy.

	Group Istatistics				P Values
	Groups	**N**	**Mean**	**SD**	
FEV1 rate (%)	TAH	24	30.6	31.5	0.03
	TLH	26	20.6	21.04	
DOA Adjusted means	TAH	24	31.4	5.6	0.2
	TLH	26	19.8	5.5	
FVC rate (%)	TAH	24	38.4	14.9	0.003
	TLH	26	8.8	84.2	
DOA Adjusted means	TAH	24	41.4	13.3	0.06
	TLH	26	5.4	12.7	
FEF 25 rate (%)	TAH	24	34.4	35.1	0.07
	TLH	26	-12.2	187.5	
DOA Adjusted means	TAH	24	43.2	28.5	0.115
	TLH	26	-22.1	27.9	
FEF 75 rate (%)	TAH	24	40.7	27.3	0.03
	TLH	26	-3.08	137.8	
DOA Adjusted means	TAH	24	47.3	20.9	0.06
	TLH	26	-10.5	20.5	
FEF 2575 rate (%)	TAH	24	40.8	22.2	0.01
	TLH	26	-15.2	178.2	
DOA Adjusted means	TAH	24	47.8	27.1	0.07
	TLH	26	-23.1	26.5	
PEF rate (%)	TAH	24	2.5	163.3	0.06
	TLH	26	-5.7	155.2	
DOA Adjusted means	TAH	24	10.5	33.4	0.6
	TLH	26	-13.8	32.6	
PAC O_2 rate (%)	TAH	24	-0.5	13.04	0.3
	TLH	26	+4.7	11.5	
DOA Adjusted means	TAH	24	-1.1	2.7	0.4
	TLH	26	-4.2	2.5	
PA O_2 rate (%)	TAH	24	-18.09	81.8	0.2
	TAH	26	10.9	25.5	
DOA Adjusted means	TAH	24	-17.8	12.8	0.1
	TLH	26	10.9	12.3	
Sa O_2 rate (%)	TAH	24	-4.8	26.5	0.007
	TLH	26	4.7	13.1	
DOA Adjusted means	TAH	24	-4.3	4.4	
	TLH	26	4.4	4.3	0.2
Ph rate (%)	TAH	24	0.5	0.7	0.8
	TLH	26	0.4	0.6	
DOA Adjusted means	TAH	24	0.7	0.1	0.2
	TLH	26	0.4	0.1	

TAH:*Total abdominal hysterectomy,* ***TLH:*** *Total laparoscopic hysterectomy* ***DOA:****Duration of anesthesia*

There were significant changes in majority of the parameters of pulmonary function test after surgery compared to baseline measurements except $PaCO^2$, PaO^2 and SaO^2 levels in group of women who underwent total abdominal hysterectomy (Table 2). There were significant changes in majority of the parameters of pulmonary function test after surgery compared to baseline measurements except $PaCO^2$ levels in group of women who underwent total laparoscopic hysterectomy (Table 3). Rates of changes for each parameter following surgery were compared between the groups, comparison revealed significant differences between two groups in terms of FEV1 rate, FVC rate, FEF 75 rate, FEF 2575 rate and SaO^2 rate, however after adjustment for duration of anesthesia, all rates of parameters were found to be comparable between the groups (Table 4).

DISCUSSION

In this study, we aimed to compare pre and post-operative pulmonary function among women who underwent laparoscopic or abdominal hysterectomy, our data analysis revealed that, both laparoscopic and open surgery resulted in deteriorated pulmonary function tests, however FEV1 rate, FVC rate, FEF 75 rate, FEF 2575 rate and SaO^2 rate parameters were significantly more deteriorated following abdominal approach, on the other hand after adjustment for duration of anesthesia rates were found to be similar between the two approach.

Surgery and anesthesia often change the ongoing respiratory functions in the postoperative period. Such complications contribute significantly to perioperative morbidity and mortality rate. Pulmonary complications are encountered approximately in 6.8% of all operations. PFT can be used to determine pulmonary functions in the preoperative period. Postoperative pulmonary complications for non-malignant gynecological diseases are rare, but increase the length of hospital stay, smokers are at higher risk (11). It has been shown that some surgical factors independently increase the risk of postoperative respiratory complications following major operations including: chronic obstructive pulmonary disease, over 60 years of age, ASA grade II or higher, duration of operation for 3 hours, and upper abdominal and thoracic surgery (12). Postoperative complications are now considered to be very important parameters in the evaluation of surgical technique [8]. Pulmonary complications such as hypoxia, atelectasis, pulmonary embolism and pneumonia are major complications after major abdominal surgery [13]. In a previous study, lung functions were assessed following colorectal surgery, authors of the study concluded that, both the laparoscopic surgery and the open surgical procedure have the same results for pulmonary functions. However, laparoscopy was reported to be more reliable in terms of hospital stay and lung infections (14). Authors of this study showed that lung ventilation is better and that there is less pulmonary complication in laparoscopic surgery than open surgery and less incision pain in the postoperative period. They found no statistically significant difference in PFT parameters between two groups in the preoperative or postoperative period. Study revealed lower FEV1 and FVC1 values in both groups on postoperative 5th day than those of the preoperative period.

In addition to the type of surgical approach, type of anesthetic agents may contribute to the altered lung functions following surgery, previous study compared to most frequently used agents in terms of postoperative lung functions, study revealed that both desflurane and sevoflurane provide similar intraoperative hemodynamic and early postoperative respiratory functions in morbidly obese patients in laparoscopic sleeve gastrectomy. Both agents were considered as an alternative to inhalation anesthetics for the protection of anesthesia (15).

Early postoperative pulmonary function and arterial blood gases in patients who have undergone laparotomic or laparoscopic nephrectomy were assessed in a previous study, analysis of the data revealed that all spirometric variables decreased after both laparotomic and laparoscopic nephrectomy on postoperative day 1. FEV1, FVC, FEF25 and FEF25-75 values decreased on postoperative day 1 in the laparotomy group and they were significantly lower in group of patients who underwent laparoscopy. No significant differences was shown in FEF50, PEF and FEV1 between the groups. Authors of this study concluded laparoscopic nephrectomy to be better than open nephrectomy in terms of pulmonary functions (16).

In a study on 296 patients who underwent robotic gynecological operations, among all the study population only 5 patients (2%) experienced a pulmonary complication. Average airway pressure and maximum airway pressure were both shown to be associated with a significantly higher risk of pulmonary complications. Differences of some demographic and clinical characteristics including age, body mass index, tidal volume, respiratory rate, estimated blood loss, and length of procedure were not found be statistically significant in patients who experienced a pulmonary complication versus patients who did not experience one. Authors of this study concluded that robotic gynecological surgery may be a safe and well tolerated procedure (17). Vaginal hysterectomy was compared to total laparoscopic hysterectomy, study revealed a vaginal approach to hysterectomy was associated with the shortest operative times, but the increase in BMI causes a rapid increase in the duration of operation. On the other hand, total laparoscopic hysterectomy was associated with shorter hospitalizations and low blood transfusion rates in women with high BMI (18). In our study, BMI was significantly higher in laparoscopy group.

To the best of our knowledge, this is the first study which compared pre and post-operative pulmonary function among women who underwent laparoscopic versus abdominal hysterectomy, and adjusted and unadjusted comparisons were presented in this study, however groups consisted of non randomly selected women, this is major drawback in this study.

In conclusion, both laparoscopic and abdominal hysterectomy were associated with deteriorated

pulmonary function tests and duration of anesthesia was longer in group with laparoscopic hysterectomy. FEV1 rate, FVC rate, FEF75 rate, FEF2575 rate and SaO^2 rate parameters were significantly more deteriorated following abdominal approach, however after adjustment for duration of anesthesia rates were similar between the two approach. Authors have nothing to declare.

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