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ORIGINAL ARTICLE

The Effects of Two Different Types of Incentive Spirometry Applied Postoperatively on Vital Signs, Pain and Fatigue Status of Patients Undergoing Urological Surgery

Ürolojik Cerrahi Geçiren Hastalarda Postoperatif Uygulanan İki Farklı İnsentif Spirometrinin Vital Bulgular, Ağrı ve Yorgunluk Durumlarına Etkileri

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Abstract

Introduction: It is important for patients to be included in a pulmonary rehabilitation program before and after surgery to prevent postoperative complications. Incentive spirometry is designed to mimic maximum deep inspiration and encourages the patient to take long, deep, slow breaths that increase lung volume. The aim of this study is to investigate the effects of two different types of incentive spirometry applied postoperatively on vital signs, pain, fatigue and dyspnea of patients undergoing urological surgery.

Methods: 159 patients who underwent urological surgery were randomly assigned to the Volume-Oriented Incentive Spirometry Group (VISGr) (n=53), Flow-Oriented Incentive Spirometry Group (FISGr) (n=53) and Standard Respiratory Exercise Group (SREGr) (n=53). After surgery, 10 breathing exercises and 10 incentive spirometry were performed 4 times. Participants' vital values, fatigue, pain and dyspnea parameters were evaluated at certain times preoperative stage, postoperative stage, before exercise (BE) and after exercise (AE).

Results: As a result of the evaluations, a significant difference was found between the groups in systolic blood pressure values before and after the fourth exercise session and in postoperative Borg Leg fatigue and visual analog scale general fatigue values after the last exercise session. In the intra-group evaluation, a significant improvement was found in pain values in all three groups.

Discussion and Conclusion: Incentive spirometry, which is used to prevent adverse effects on lung volumes that may occur in surgical situations, can be considered as an economical method of additional sort to provide symptom control, regardless of its type.

Keywords: Breathing exercises; Incentive spirometry; Surgery; Urology

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Despite advances in surgical techniques, every surgical procedure carries a certain risk of complications. Respiratory complications encountered after surgery are a significant source of morbidity and mortality. The cause of these complications is complex and has not yet been fully elucidated due to the patient's medical condition, general anesthesia and the effects of the surgery on the respiratory system. Postoperative pulmonary complications lead to prolonged hospital stays and increased healthcare costs. The risks of such complications depend on the sensitivity of the patient and the type of procedure performed.[1–6]

In terms of urological surgeries, it is apparent that these surgeries are widely performed, and the number of cases is increasing due to the increase in the elderly population particularly in recent years owing to the novelties in national and international healthcare systems. The narrow and limited surgical field, on the other hand, constitutes a difficulty in performing most urological surgeries. In addition, the elderly population is exposed to the risk of complications before and after surgery.[7]

Especially considering the complications mentioned, deep breathing exercises such as improving total lung capacity by emphasizing the use of the diaphragm have been shown to inflate the alveoli and reverse postoperative hypoxemia. It is very important to include patients in a pulmonary rehabilitation program before and after surgery to prevent the mentioned complications. The use of techniques that increase lung volumes to improve vital signs such as oxygen saturation after postoperative surgery may be a good option for patient health after surgery. Practices such as breathing exercises, incentive spirometry, continuous positive airway pressure (CPAP) application, expiratory maneuvers, intermittent positive pressure breathing (IPPB), active breathing technique cycle are also frequently observed in the relevant line of studies. Incentive spirometries are mechanical devices developed to achieve this purpose. The incentive spirometry is designed to mimic maximum deep inspiration and encourages the patient to take long, deep, slow breaths that increase lung inflation.[8–10]

Postoperative fatigue is defined as a set of physical and psychological symptoms that delay the return to normal life after surgery. Postoperative fatigue is indeed one of the main causes of rehabilitation failure after surgery. It can limit recovery and have negative effects on early rehabilitation. Several studies have reported that incentive spirometry training has positive effects on many parameters such as functional capacity, muscle strength, balance, dyspnea and fatigue.[11,12]

The aim of this study is then to investigate the effects of two different types of postoperative incentive spirometry on vital signs, pain and fatigue of patients undergoing urological surgery.

Material And Methods

Study Place and Design

This study is a randomized controlled trial and was conducted at Haydarpaşa Numune Training and Research Hospital. The patients who underwent urological surgery by a urology specialist at the Haydarpaşa Numune Training and Research Hospital were included in the study.

Population and Sample of the Research

In our study, power analysis was performed using G*Power3.1.7 programme to determine the sample size (Kiel University, Kiel, Germany). As a result of the power analysis performed for the study, considering ANOVA: Fixed Effects, omnibus, one-way test analysis alpha: 0.05 and effect size (f): 0.25, it was calculated that at least 159 patients should be included in the study in order to obtain 80% power at 80% confidence level. In this direction, the current study was completed with 159 male participants.

Including Criteria

The inclusion criteria for the study were as follows: being between the ages of 40-75, being male, volunteering to participate in the study, having undergone urological surgery in the urology clinic of Haydarpaşa Numune Training and Research Hospital, having a negative Covid PCR test result immediately before the surgery, and having a fever between 36.5 and 37.0 degrees at the time of inclusion in the study and during the exercises.

Excluding Criteria

The patients who refused to participate in the study, those who had a mini mental test score below 24 or those who could not understand the exercise commands, those with a history of effort-related syncope or any comorbidity (such as severe orthopedic or neurological deficits or unstable heart disease) that prevented trainings that encouraged deep breathing, and the ones that had participated in an academic study within the last 12 months were excluded from the present study.

Interventions

The cases that met the study inclusion criteria were randomized and divided into three groups. For randomization, numbers from 1 to 159 were assigned to 3 groups using a computer program (https://www.randomizer.org/) without repeating numbers. The groups were named Volume Oriented Incentive Spirometry Group (VISGr), Flow Oriented Incentive Spirometry Group (FISGr), Standard Respiratory Exercise Group (SREGr). After surgery, 10 times of breathing exercise and 10 times of incentive spirometry were applied 4 times.

Triflo (Plasti med 3 600-900-1200 ml code: 180 101 origin: Türkiye), used as a flow-oriented incentive spirometry, contains light plastic balls. When the patient breathes through the mouthpiece, negative pressure is created in the tubes and the balls rise. The number of balls and the level to which they rise depend on the magnitude of the flow achieved and, depending on the magnitude of the flow, the first ball, the second ball and the third ball rise in order. Volumetric incentive spirometry (B-spiro 5000 code: 186 500 Origin: İstanbul/Türkiye) allows the patient to inhale air through a mouthpiece and corrugated tube, and the volume of inhaled air is displayed on a scale located on the device. When the patient reaches the maximum volume, he/she is asked to hold this volume for 3 to 5 seconds.[13,14]

After the surgical operation, when the patient regained consciousness and vital signs were stable, respiratory control, 10 deep diaphragmatic breathing and lower basal breathing exercises, and volumetric incentive spirometry breathing exercises were performed 4 times. Diaphragmatic breathing exercise was explained to the patient and performed as 10 cycles after respiratory control. The patient was trained in the use of volumetric incentive spirometry and the process was applied as follows: Control-evaluation of vital signs before exercise (temperature, heart rate, SpO_2, blood pressure), then 10 repetitions of inspiration, 1 min rest, 10 repetitions of expiration, re-checking and noting vital signs after exercise, and re-checking and noting vital signs after a 3-min recovery period. After the surgical operation on the FISGr, when the patient regained consciousness and vital signs were stable, respiratory control, diaphragmatic breathing (10 times each) and lower basal breathing exercises (10 times each), and respiratory exercise with flow-oriented incentive spirometry were performed 4 times. Diaphragmatic breathing exercise was explained to the patient as 10 cycles after respiratory control and applied. The use of flow-oriented incentive spirometry was explained to the patient by providing the relevant training in the following way: Control-assessment of vital signs before exercise (temperature, heart rate, SpO2, blood pressure), then 10 repetitions of inspiration, 1 min rest, 10 repetitions of expiration, re-checking and noting vital signs after exercise, re-checking and noting vital signs after a 3-min recovery period. When SREGr regained consciousness after the surgical operation and vital signs were stable, respiratory control, deep diaphragmatic breathing (10 times) and lower basal breathing exercises (10 times each) and volume-focused incentive spirometry breathing exercises were performed for 4 times.

Data Collection Tools

Demographic data: The demographic data of the participants were recorded.

Modified Borg Scale

The Modified Borg Scale was used to assess participants' dyspnea and leg fatigue. The scale has a score of 0–10, with '0' indicating no shortness of breath and leg fatigue, while '10' indicates the most severe fatigue and pain.[15]

Visual Analog Scale

The participants' pain ratings and general fatigue values were evaluated using the Visual Analog Scale. This scale is a commonly used Likert-type scale. For the Visual Analog Scale, '0' is no pain and '10' is the worst pain imaginable.[16]

Oxygen Saturation

A finger pulse oximeter was used to determine and monitor the oxygen saturation and heart rate of the participants before, after and during the program.[17]

Resting Systolic and Diastolic Blood Pressure

The participants' systolic blood pressure (SBP) and diastolic blood pressure (DBP) were evaluated with a digital blood pressure monitor before and after the program. The measurements were performed while the participants were in a sitting position and the results were recorded in mmHg.[18]

Statistical Analysis

The data obtained from the study were analyzed on the computer using the SPSS 25.0 (Statistical Package for the Social Sciences) package program (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.). In the evaluation of demographic data, frequencies (number, percentage) were used for categorical variables, and descriptive statistics (mean, standard deviation, median,

Table 1. Characteristics of participants

Parameter	Group 1 (n=53)	Group 2 (n=53)	Group 3 (n=53)	p
Cigarette				0.665$^{\chi 2}$
Yes	22 (41.5%)	22 (41.5%)	26 (49.05%)	
No	31 (58.5%)	31 (58.5%)	27 (50.95%)	
Previous operation				0.249$^{\chi 2}$
Tur m	13 (24.5%)	11 (20.8%)	11 (20.8%)	
Tur p	4 (7.5%)	5 (9.4%)	8 (15.1%)	
Urs	17 (32.1%)	13 (24.5%)	6 (11.3%)	
Cystoscopy	4 (7.5%)	9 (17%)	7 (13.2%)	
Other	15 (28.3%)	15 (28.3%)	21(39.6 %)	
Age (years)	57.47±7.87	56.32±9.38	55.43±8.3	0.470*
Height (cm)	1.71±0.60	1.71±0.68	1.69±0.57	0.319*
Weight (kg)	82.91±13.59	82.47±14.30	83.70±10.71	0.885*
Body mass index (kg/m^2)	28.18±4.17	27.92±4.08	28.89±2.70	0.383*

χ^2: Pearson Chi-Sqaure Test; *: One Way ANOVA Test. Group 1: Volume-oriented incentive spirometry group (VISGr); Group 2: Flow-oriented incentive spirometry group (FISGr); Group 3: Standard respiratory exercise group (SREGr).

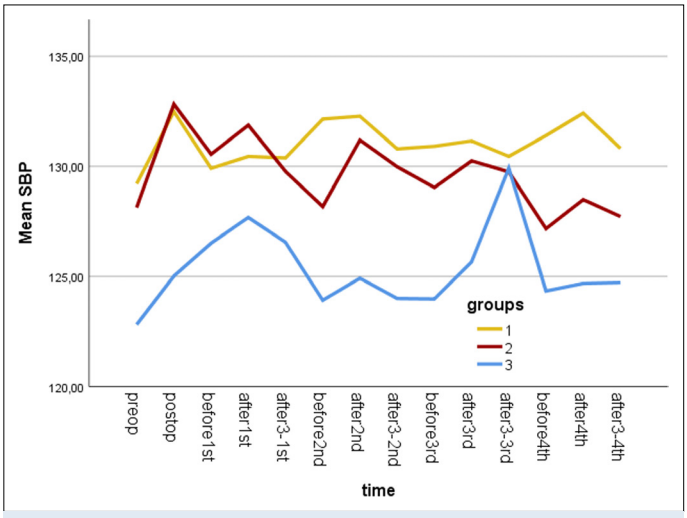

Figure 1. Changes in systolic blood pressure values of the groups.

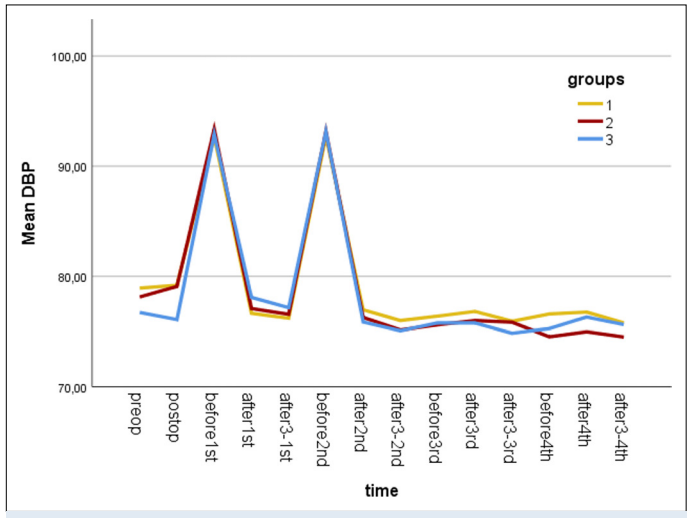

Figure 2. Changes in diastolic blood pressure values of the groups.

min, max) were used for numerical variables. When evaluating demographic data, Pearson Chi-Square and Fischer Exact Tests were used. Intra-group changes were evaluated with Paired Sample T Test. In the analysis of groups, One-Way Anova Test was used to compare parametric data. In case of a difference in the analysis results, Bonferroni test, one of the post-hoc methods, was used for analysis. Kruskal Wallis Test was used for nonparametric data and Tamhane's T2 was used for post-hoc evaluations. The effect size for the significant data was calculated with eta2. The formula used was the division of the sum of squares between groups by the total sum of squares. The value of $p<0.05$ was considered statistically significant.

Ethical Approval

Our study was approved by the Haydarpasa Numune Hospital Clinical Research Ethics Committee (Date: 18.04.2022, number: 2022/63-3593.). The study was carried out following the international declaration and guidelines. A written informed consent was obtained from each patient for the study and was conducted in accordance with the Declaration of Helsinki.

Results

No statistically significant difference was found between the descriptive data of the groups shown in Table 1.

When the participants' pulse, blood pressure and oxygen saturation values were examined, a significant difference was found between the groups in SBP values before and after the fourth exercise session. The significant difference for both values was due to Groups 1 and 3 (Table 2).

The Eta Squared value for systolic blood pressure was calculated as 0.03 before and 0.045 after the 4th treatment session. It was found to have a small effect level. The graphs regarding the participants' SBP and DBP data are shown in Figure 1 and Figure 2.

When the participants' dyspnea, fatigue and pain values were examined, a significant difference was found between the groups in postoperative Borg Leg fatigue and VAS general fatigue values after the last exercise session. The significant difference in postoperative Borg Leg fatigue values is due to the difference between Group 1-Group 2 and Group 2-Group 3. The significant difference in VAS general fatigue values after the last exercise session is due to the difference between Group 1 and Group 3 (Table 3).

When the pain assessments of the participants within the group were examined, a significant difference was found between the postoperative assessment and the assessments after the last exercise session in all three groups (Table 4).

Discussion

Our study, which evaluates the effects of incentive spirometry application with two different mechanisms on vital signs, dyspnea, leg fatigue, general fatigue and pain perception in patients undergoing urological surgery, is the first study in the literature to our knowledge. When the study results were examined, it was seen that the results of different types of incentive spirometry were similar in terms of many parameters.

A study of patients undergoing elective major abdominal procedures reported that the impact of postoperative complications on quality of life persisted for at least 1 year after surgery. Numerous factors such as smoking, advanced age, and preexisting lung disease lead to the risk of developing postoperative pulmonary complications. Some practices such as quitting smoking and respiratory rehabilitation provide significant positive results in order to minimize the frequency and severity of these complications.[19,20]

Despite the widespread use of incentive spirometry, some reviews have suggested that this technique is controversial in preventing postoperative complications. In the results of a study conducted in 2016, it was reported that chest therapy with positive pressure and volume-oriented intensive spirometry was effective in improving the vital capacity of patients undergoing abdominal surgery. In our study, in addition to the respiratory exercises, two incentive spirometry applications were performed on the patients in the postoperative period, supporting the literature. That said, as a result of our study, no effect was detected in terms of vital signs other than systolic blood pressure. We believe that this is due to the relatively shorter duration of the exercise program we provided. In addition, it would be fair to think that providing pulmonary rehabilitation to all groups during the rehabilitation process might have contributed to this situation.[21]

In the studies of Gökçe et al.,[22] it was reported that regular spirometry use provided beneficial results in terms of the vital signs in the postoperative period, and it was stated that it could reduce complications. In their studies, they reported that vital signs such as blood pressure would reflect the status of the pulmonary and cardiovascular systems, and that incentive spirometry would increase oxygenation and reduce the workload of the heart and contribute to the stabilization of blood pressure. In our study, a difference in blood pressure was detected between the groups before and after the fourth exercise session, and it was also determined that this difference was due to the higher systolic blood pressure in the Volume-Oriented Incentive Spirometry Group compared to the control group, both before and after exercise. Contrary to the observation that the systolic blood pressure of the participants decreased after the 3-day postoperative incentive spirometry training by Gökçe et al.,[22] no significant difference was detected in our study except for the increase reported on the 4th day. We are of the opinion that the reason for this difference may be due to the fact that Gökçe et al.[22] took the measurements during rest. In addition, the difference in the surgeries undergone should also be taken into consideration. We did not find any studies in the literature evaluating the effects of different types of incentive spirometry on blood pressure. Gökçe et al.[22] used Flow-Oriented Incentive Spirometry in their study. However, the fact that the participants' blood pressures were high before exercise suggests that this may be related to their postoperative condition, independent of the exercise. We think that longer-term exercise training may be beneficial for blood pressure stabilization, and that blood pressure changes during this process may be due to the postoperative process.

However, similar studies using incentive spirometry-based exercise programs in the short period until discharge in the postoperative period have shown that they can produce positive results in terms of arterial blood gas parameters and hospital stay.[23,24]

Table 2. Differentiation status of vital signs in pre- and post-exercise measurements

Parameter	Time period	Groups			p
		Group 1 (n=53)	Group 2 (n=53)	Group 3 (n=53)	
Pulse (BPM)	PRO	77.09±10.15	78±12.17	76.13±11.90	0.703*
	PO	75.38±11.78	76.25±16.48	76.13±13.64	0.993**
	Before 1st exercise	75.04±11.97	76.23±14.66	76.85±13.78	0.783*
	After 1st exercise	78.42±11.89	78.11±14.80	78.51±14.40	0.988*
	3 min after 1st exercise	75.09±12.47	76.51±14.16	75.64±13.79	0.862*
	Before 2nd exercise	74.30±12.43	74.42±14.65	74.06±11.54	0.989*
	After 2nd exercise	78.81±13.07	77.08±14.38	76.66±12.21	0.676*
	3 min after 2nd exercise	74.04±12.57	75.62±14.78	74.06±11.89	0.776*
	Before 3rd exercise	75.28±11.34	74.09±12.26	73.75±12.70	0.793*
	After 3rd exercise	80.36±12.21	76.96±13.63	76.38±13.35	0.242*
	3 min after 3rd exercise	74.58±11.49	88.04±95.82	73.06±12.91	0.660**
	Before 4th exercise	75.96±10.88	73.6±12.66	74.85±11.23	0.580*
	After 4th exercise	80.89±11.28	76.91±12.89	77.09±11.97	0.163*
	3 min after 4th exercise	75.55±11.06	73.38±15.82	74.51±11.35	0.689*
SBP (mmHg)	PRO	129.21±14.60	128.13±16.17	122.81±17.31	0.093*
	PO	132.49±20.66	132.83±19.82	125.02±19.6	0.079*
	Before 1st exercise	129.91±18.31	130.55±19.08	126.51±19.03	0.496*
	After 1st exercise	130.45±18.46	131.87±19.01	127.68±18.99	0.509*
	3 min after 1st exercise	130.38±17.14	129.77±19.10	126.55±19.34	0.522*
	Before 2nd exercise	132.15±17.55	128.17±17.77	123.92±17.61	0.059*
	After 2nd exercise	132.28±18.31	131.19±19.77	124.92±17.38	0.075*
	3 min after 2nd exercise	130.79±16.90	129.98±17.19	124±17.69	0.115*
	Before 3rd exercise	130.91±15.65	129.04±15.68	123.98±15.05	0.061*
	After 3rd exercise	131.15±16.35	130.25±15.20	125.66±15.14	0.154*
	3 min after 3rd exercise	130.45±15.05	129.75±14.75	129.92±15.17	0.122*
	Before 4th exercise	131.40±14.02[a]	127.17±16.68	124.34±12.57	**0.045***
	After 4th exercise	132.42±15.25[a]	128.49±15.40	124.68±12.97	**0.026***
	3 min after 4th exercise	130.81±14.46	127.72±15.18	124.72±13.09	0.093*
DBP (mmHg)	PRO	78.96±11.89	78.15±10.40	76.74±12.45	0.608*
	PO	79.21±12.86	79.11±10.28	76.08±12.92	0.319*
	Before 1st exercise	92.70±1.99	93.36±2.03	92.89±1.98	0.748**
	After 1st exercise	76.66±10.22	77.09±12.29	78.11±13.08	0.813*
	3 min after 1st exercise	76.21±10.83	76.57±12.22	77.17±13.39	0.919*
	Before 2nd exercise	92.74±2.02	93.17±2.16	93.15±1.84	0.727**
	After 2nd exercise	76.98±10.82	76.28±11.13	75.87±10.23	0.865*
	3 min after 2nd exercise	76±10.14	75.15±11.05	75.08±10.49	0.883*
	Before 3rd exercise	76.40±9.23	75.62±11.74	75.79±10.48	0.924*
	After 3rd exercise	76.83±9.08	76±12.30	75.79±10.81	0.872*
	3 min after 3rd exercise	75.94±9.04	75.85±11.57	74.85±10.75	0.835*
	Before 4th exercise	76.6±8.15	74.53±11.47	75.28±8.05	0.422**
	After 4th exercise	76.77±7.87	74.98±11.30	76.32±8.25	0.656**
	3 min after 4th exercise	75.79±7.87	74.51±11.70	75.64±8.53	0.831**

Table 2 (cont). Differentiation status of vital signs in pre- and post-exercise measurements

Parameter	Time period	Groups			p
		Group 1 (n=53)	Group 2 (n=53)	Group 3 (n=53)	
SPO_2 (%)	PRO	95.60±1.29	94.77±1.17	94.23±1.01	0.068*
	PO	92.42±1.75	93.25±1.78	92.92±1.88	0.061*
	Before 1st exercise	92.02±1.92	92.53±2.08	92.83±1.93	0.107*
	After 1st exercise	94.68±1.84	94.13±2.00	94.23±1.64	0.264*
	3 min after 1st exercise	92.70±1.99	93.36±2.03	92.89±1.98	0.222*
	Before 2nd exercise	92.45±2.04	92.51±2.10	92.81±1.85	0.613*
	After 2nd exercise	94.83±1.74	94.08±1.93	94.60±1.41	0.069*
	3 min after 2nd exercise	92.74±2.02	93.17±2.16	93.15±1.84	0.457*
	Before 3rd exercise	92.91±2.18	93.11±1.99	93.21±1.61	0.717*
	After 3rd exercise	94.98±1.69	94.55±1.78	94.6±1.33	0.325*
	3 min after 3rd exercise	93.25±2.13	93.72±1.80	93.51±1.56	0.475**
	Before 4th exercise	93.21±2.21	93.25±1.98	93.58±1.55	0.545*
	After 4th exercise	95.09±1.80	94.45±1.81	94.7±1.17	0.125*
	3 min after 4th exercise	93.45±1.91	93.77±1.63	93.81±1.49	0.489*

*: One Way ANOVA; **: Kruskal Wallis Test; a: Significantly different than than Group 3. PO: Postoperative; PRO: Preoperative; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; SPO_2: Oxygen saturation; Group 1: Volume-oriented incentive spirometry group (VISGr); Group 2: Flow-oriented incentive spirometry group (FISGr); Group 3: Standard respiratory exercise group (SREGr).

Table 3. Differentiation status of dyspnea, fatigue and pain values in pre- and post-exercise measurements

Parameter	Group 1 (n=53)	Group 2 (n=53)	Group 3 (n=53)	p*
PO-borg dyspnea	1 (0–3)	0 (0–3)	0 (0–3)	0.061
After the last exercise-borg dyspnea	0 (0–2)	0 (0–2)	0 (0–2)	0.893
PO-borg leg	0 (0–2)	0 (0–4)[a]	0 (0–2)	**0.001**
After the last exercise-borg leg	0 (0–0)	0 (0–2)	0 (0–0)	0.134
PO-VAS-pain	3 (0–6)	3 (0–6)	3 (0–5)	0.164
After the last exercise-VAS-pain	0 (0–4)	0 (0–4)	0 (0–4)	0.811
PO-VAS- fatigue	0 (0–2)	0 (0–6)	0 (0–3)	0.238
After the last exercise-VAS- fatigue	0 (0–1)	0 (0–2)	0 (0–2)	**0.036**

a: Significantly different than Group 1 and Group 3. *: Kruskal Wallis Test; VAS: Visual Analog Scale; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; SPO_2: Oxygen saturation; PO: Postoperative; Group 1: Volume-oriented incentive spirometry group (VISGr); Group 2: Flow-oriented incentive spirometry group (FISGr); Group 3: Standard respiratory exercise group (SREGr).

Table 4. Intragroup pain assessments

Outcomes	Groups	Time period		p*
		PO	After the last exercise session	
VAS-pain	Group 1	2.57±1.68	0.92±1.19	**<0.001**
	Group 2	3.13±1.87	1.15±1.43	**<0.001**
	Group 3	3.0±1.76	1.0±1.27	**<0.001**

*: Paired Sample T Test; PO: Postoperative; Group 1: Volume-oriented incentive spirometry group (VISGr); Group 2: Flow-oriented incentive spirometry group (FISGr); Group 3: Standard respiratory exercise group (SREGr); P: <0.05.

Both volume-oriented and flow-oriented incentive spirometries are used to encourage participants to breathe up to their lung capacity with visual feedback support. The studies comparing flow-oriented and volume-oriented spirometries have reported a physiological difference in the effects of the devices, with flow-oriented devices

requiring more work of breathing. Volume-oriented devices, on the other hand, require less breathing work and have been reported to improve diaphragm activity. In a study published by Lunardi et al.[25] in 2014, the effectiveness of 2 different types of incentive spirometries was evaluated in adults and elderly individuals. The study results reported that incentive spirometries provided similar sorts of increase in chest volumes in the elderly, but the flow-oriented type required more inspiratory muscle activity. Therefore, it was recommended that the clinician consider the patient's age and clinical condition, as well as the goal of the treatment when evaluating a patient for incentive spirometry. In contrast, Chang et al.[26] suggested that inspiratory flow, regardless of the type of spirometer, determines the breathing pattern and respiratory muscle activation in healthy individuals. The age range in our study covers young, middle and advanced adulthood age ranges. We believe that not including advanced group participants in the study has created a positive result in terms of eliminating the effect of the age factor in the study.

Jafari et al.[27] conducted a systematic review in 2017 to examine whether lung volume increasing techniques can be used to relieve pain. They published a total of 31 publications between 1984 and 2015. The findings showed that it affects respiration by increasing the flow, frequency and volume of pain. Moreover, some studies have associated slow breathing with pain reduction, but they stated that evidence explaining the physiological mechanisms underlying this effect is lacking and that further research is needed. With our study, we found that both types of lung volume increasing techniques, incentive spirometry, are effective in relieving pain. Our study can contribute to the accumulated literature both in terms of breathing exercises and in terms of comparing the differences in devices used in breathing exercises.

To our knowledge, no study in the related literature has hitherto delved into the effect of lung volume increasing breathing techniques on the perception of pain of individuals before or after urological surgery. Post-surgical pain complaints can be frequent and do not only include respiratory surgeries. The effect of lung volume increasing breathing techniques on respiratory patients and pain conditions before and after surgical procedures has been frequently examined in the literature. In our study, we examined the effect of lung volume increasing breathing techniques on post-surgical pain conditions in male patients undergoing urological surgery. In their study conducted in 2018, Devecel et al.[28] stated that inadequate pain control after surgery may cause additional complications. The most important of these may be atelectasis, which is the collapse of the lung alveoli. We also witnessed in our study that two types of lung volume increasing techniques, which can be easily applied in post-surgical pain control regardless of the type of pathology, may have an effect on pain control.

Fatigue is a complex symptom and has been associated with conditions such as dyspnea, circulatory disorders, and low oxygen levels in various studies. Respiratory training can have positive effects on fatigue due to its positive effects such as positively affecting gas exchange and effective use of respiratory muscles. In our study, an increase in fatigue was observed in the volume-oriented incentive spirometry group compared to the control group after the last exercise session. The literature reports that exercise sessions will have a positive effect. We hold the belief that the increase in our study may be due to the assessment of fatigue immediately after exercise.[29]

One of the limitations of our study is that the treatment program and evaluations were only conducted for male patients who underwent urological surgery. There is a need for comprehensive studies to be conducted on both genders.

Another limitation of our study was that the patients could not be included in the pulmonary rehabilitation program before surgery. Various studies have presented data indicating that exercises performed with incentive spirometry, especially in the preoperative period, reduce pulmonary complications in the postoperative period and improve oxygenation before and after surgery. The fact that we did not have the opportunity to evaluate the patients in our study before surgery may have prevented us from obtaining more meaningful data in this sense.[30]

Conclusion

In conclusion, we believe that interventions such as incentive spirometry can be used as an economical and easily applicable additional method to improve vital signs and provide pain control, regardless of the type of spirometry, to prevent possible adverse effects in surgical situations. We recommend the use of incentive spirometry to create positive effects on the cardiopulmonary system and support pain control. We also recommend further studies be conducted by distinguishing the pathology and type of surgery.

Ethics Committee Approval: The Haydarpaşa Numune Hospital Clinical Research Ethics Committee granted approval for this study (date: 18.04.2022, number: 2022/63-3593).

Informed Consent: All participants gave written informed consent before data collection began.

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