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Early Postoperative Pain After Keyless Abdominal Rope-Lifting Surgery

Kahraman Ülker, MD, Ürfettin Hüseyinoğlu, MD, Melek Çiçek, MD

ABSTRACT

Background and Objectives: Keyless abdominal rope-lifting surgery is a novel, gasless, single-incision laparoscopic surgical technique. In this study we aimed to compare the postoperative pain from keyless abdominal rope-lifting surgery with carbon dioxide laparoscopy performed for benign ovarian cysts.

Methods: During a 20-month period, 77 women underwent surgery for a benign ovarian cyst. Keyless abdominal rope-lifting surgery and conventional carbon dioxide laparoscopy techniques were used for the operations in 32 women and 45 women, respectively. The 2 operative techniques were compared with regard to demographic characteristics; preoperative, intraoperative, and postoperative data including early postoperative pain scores; and frequency of shoulder pain and analgesic requirements.

Results: Data regarding demographic characteristics, preoperative findings, cyst diameters and rupture rates, intra-abdominal adhesions, intraoperative blood loss, and postoperative hospital stay did not differ between groups ($P > .05$). However, the mean operative and abdominal access times were significantly longer in the keyless abdominal rope-lifting surgery group ($P < .05$). Visual analog scale pain scores at initially and at the second, fourth, and 24th hours of the postoperative period were significantly lower in the keyless abdominal rope-lifting surgery group ($P < .05$). Similarly, keyless abdominal rope-lifting surgery caused significantly less shoulder pain and additional analgesic use ($P < .05$).

Conclusion: Keyless abdominal rope-lifting surgery seems to cause less pain in the management of benign ovarian cysts in comparison with conventional carbon dioxide laparoscopy.

Key Words: Laparoscopic surgery, Minimal access surgical procedures, Ovarian cysts, Scarless, Single port, Visual analog pain scale.

INTRODUCTION

During the past 2 decades, laparoscopic surgery has gained worldwide popularity resulting from its well-known characteristics of less postoperative pain, fewer complications, earlier discharge, and better cosmesis. Smaller skin incisions in laparoscopic surgery were related to fewer unwanted side effects, including less postoperative pain. However, in recent studies comparing conventional and single-incision laparoscopic surgical procedures, the postoperative pain scores were not different.[1–3]

Keyless abdominal rope-lifting surgery (KARS) is a novel, gasless (isobaric), single-incision laparoscopic surgical technique used in various gynecologic operations and cholecystectomies.[4–7] Besides being a single-incision laparoscopic technique, KARS does not require carbon dioxide (CO_2) use to inflate the abdominal wall and the intra-abdominal pressure is not elevated during the operation. Thus the procedure may yield lower postoperative pain scores. In addition, postoperative shoulder pain seems to be more frequently observed after laparoscopic surgical procedures in which the intra-abdominal pressure is elevated to between 12 and 18 mm Hg by use of CO_2.

In this study we aimed to compare the postoperative pain levels for KARS and conventional multiport laparoscopy performed for adnexal cysts.

METHODS

Although KARS has been performed in our institute since the first half of 2010, the study included benign ovarian cysts operated on between November 2011 and June 2013. Beginning in November 2011, intraoperative and postoperative pain management for all operations performed in our unit was standardized; thus the uniform

Department of Obstetrics and Gynecology, Kafkas University School of Medicine, Kars, Turkey (Drs. Ülker, Çiçek).

Department of Anesthesia and Reanimation, Kafkas University School of Medicine, Kars, Turkey (Dr. Hüseyinoğlu).

Address correspondence to: Kahraman Ülker, MD, Kafkas Üniversitesi Tıp Fakültesi, 36000, Kars, Turkey. Telephone: 0090 474 225 11 50, Fax: 0090 474 225 11 93, E-mail: kahramanulker@hotmail.com.

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management approach allowed us to collect and analyze the data from different surgical techniques. The study was approved by the local institutional ethical committee of Kafkas University School of Medicine. All participating women gave informed consent before the operations.

The included women had cystic masses including simple cysts with or without septation, endometriomas, and benign cystic teratomas. The cysts either measured >6 cm or had persisted for >2 months. Most of the participants complained of groin pain, menstrual bleeding disorders, dysmenorrhea, and infertility.

The study included women in stable clinical condition. Emergency cases including patients with hemodynamic instability, severe abdominal pain, and inaccurate preoperative diagnoses were excluded. Malignant cysts were excluded based on the patient's history, clinical findings, ultrasonography and magnetic resonance imaging, and levels of cancer antigen 125, alpha fetoprotein, carcinoembryonic antigen, and cancer antigen 199.

Women who were diagnosed with an adnexal cyst and in whom a laparoscopic operation was indicated were invited to choose one of the operative techniques. The details of KARS and conventional multiport CO_2 laparoscopy were explained. Because KARS was performed only in our center, we could not design a randomized trial. Thus the groups of this cross-sectional prospective clinical study were formed according to the women's choice as the KARS or conventional CO_2 laparoscopy groups.

Power analysis was performed after we included the first 10 operations in each group. Initial visual analog scale (VAS) scores of 5.7 ± 1.42 and 6.3 ± 1.42 in patients undergoing KARS and conventional laparoscopy, respectively, indicated that we needed at least 30 operations in each group to perform a study with a statistical power of 80% at an α level of .05.

The demographic and physical characteristics of the participating patients included their age, gravidity, parity, height, weight, and body mass index, as well as the number of abortions, ectopic pregnancies, and offspring. Hematocrit and hemoglobin levels were also obtained preoperatively.

Preoperative bowel preparation was started 3 days before the anticipated operation. Oral intake was prohibited starting at 11 PM, and a 135-mL solution containing 19 g of sodium dihydrogen phosphate and 7 g of disodium hydrogen phosphate was administered rectally at 6 AM on the operation day.

We used the Operative Laparoscopy Study Group's classification system for staging intra-abdominal adhesions: 0, none; 1, filmy and avascular; 2, dense and vascular; and 3, binding and cohesive.[8]

The abdominal access time in KARS patients included the time needed for the construction of the pathway into the abdominal cavity and the placement of the lifting ropes.[4–6] In conventional laparoscopy patients, the abdominal access time included the time needed for the creation of the CO_2 pneumoperitoneum at 14 mm Hg of pressure and the insertion of the 3 intra-abdominal access ports.

All included patients were considered class 1 or 2 according to the American Society of Anesthesiologists classification and received a standard anesthetic management regimen during the operations. We used propofol, 1.5 to 2.5 mg/kg, to induce anesthesia and facilitated intubation with rocuronium, 0.4 to 0.6 mg/kg. Oxygen was supplemented before and after the intubation at rates of 100% and 50% (mixed with the operating theater's air), respectively. We used 2% sevoflurane and 50 μg of fentanyl for anesthesia maintenance. To replace the fluid deficit, we used sodium chloride or Ringer lactate solution at 10 mL/kg on intravenous insertion at 2 mL/kg per hour. Unexpected bleeding was managed by use of additional crystalloid solution at 3 mL/kg per hour. Atropine, 1 to 1.2 mg intravenously, was used to reverse the neuromuscular blockade. All patients were transferred to the ward within 1 hour after the operation.

The severity of postoperative abdominal pain was evaluated with the VAS pain score.[9] The number and percentage of participants with shoulder pain are presented. The postoperative pain management and VAS pain score recordings were initiated in the obstetrics and gynecology service. Arrival into the service was accepted as the initiation of the postoperative period. All patients, regardless of initial VAS pain score, received 50 mg of meperidine intramuscularly at the beginning of the postoperative period and 75 mg of diclofenac sodium during the second postoperative hour. The second dose of diclofenac sodium was scheduled 12 hours after the first dose. VAS pain scores were recorded at the beginning and second, fourth, and 24th hours of the postoperative period. Beginning from the fourth postoperative hour, patients with VAS pain scores of >4 points received an additional dose of meperidine, 25 mg intramuscularly.

Keyless Abdominal Rope-Lifting Surgery

Abdominal access. KARS has common features of conventional laparoscopy and laparotomy. During the creation of the abdominal access pathway, the umbilical fold is lifted with 2 clamps bilaterally and a third clamp at the center of the umbilicus.

A 1.5- to 2-cm transverse incision is performed at the center of the umbilicus. Depending on the need for multiple instrument use or the depth and thickness of the subcutaneous tissue, the length of the incision may be adjusted smaller or larger.

After the skin incision, the subcutaneous tissue is dissected bluntly with the tip of a fine instrument until the underlying fascia is reached. The fascia and the underlying peritoneum are cut. The opening is bluntly widened with the moderate stretching force of 2 fine retractors. At this stage, the surgeon can examine the intra-abdominal viscera by using his or her index or little finger to identify possible adhesions.

Rope-lifting process. The fascia at the entry site is lifted by 2 stitches placed at the lower and upper borders at the 6- and 12-o'clock positions (**Figure 1**) to guide the rest of the process. While the 2 stitches elevate the entry site, the intra-abdominal viscera is observed for possible injuries and adhesions by use of the introduced telescope.

The Veress needle is unloaded from its cannula, and one tip of a No. 1 nylon suture is inserted into the cannula (**Figure 2**). The loaded cannula is introduced into the elevated entry site under direct or telescopic vision. The tip of the cannula is inserted toward the abdominal wall, 1 to 2 cm below the entry, under direct eye vision, and the tip is slid just above the peritoneum. It is turned to the right 6 to 7 cm to avoid injury to the epigastric vessels, and the abdominal wall is pierced from the inside toward the outside at approximately 5 cm below the umbilical entry. During this procedure, the tip of the Veress cannula should always be maintained in an upward direction to avoid an accidental bowel injury. The tip of the suture is unloaded from the cannula outside the abdominal wall, and the unloaded cannula is withdrawn back from the entry. The other tip of the suture is loaded into the cannula, and the same steps are repeated. However, this time, the tip of the cannula is taken outside the abdominal cavity, 5 cm below the first tip.

The same procedure is repeated on the left lateral side of the abdominal wall. Then, an assistant elevates the abdominal wall, and the surgeon ties the sutures over the prepared sterile retractor located between the pubis and umbilicus (**Figure 3**).

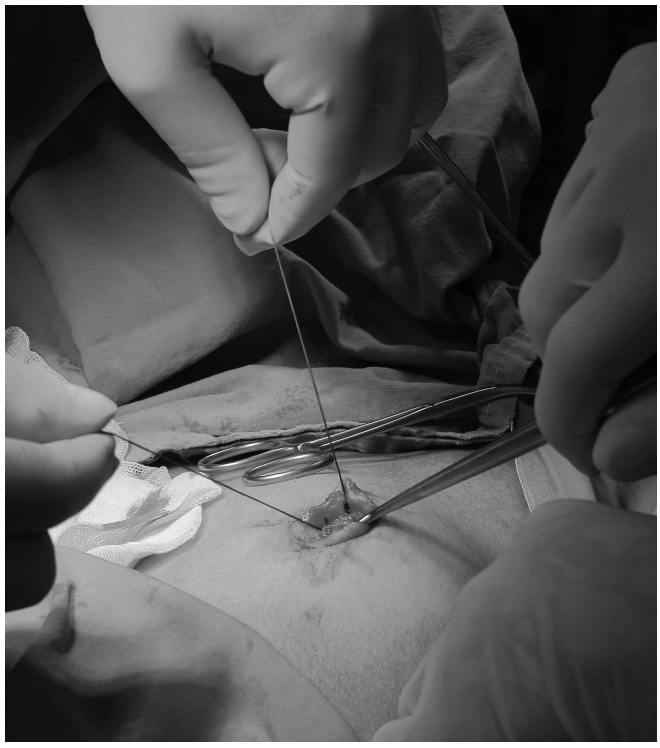

Figure 1. The lower and upper borders of the fascia underlying the umbilical incision are sutured at the 6- and 12-o'clock positions.

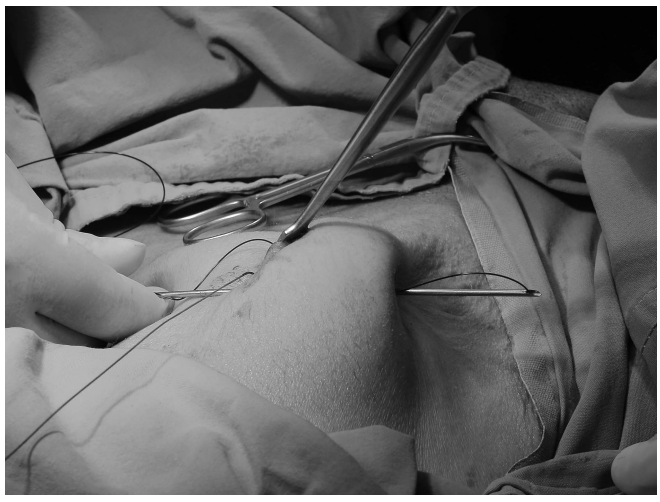

Figure 2. Initial transabdominal passage of Veress cannula loaded with nylon suture through entry site.

The entry-site sutures are stretched during introduction of the telescope into the abdominal cavity to prevent staining

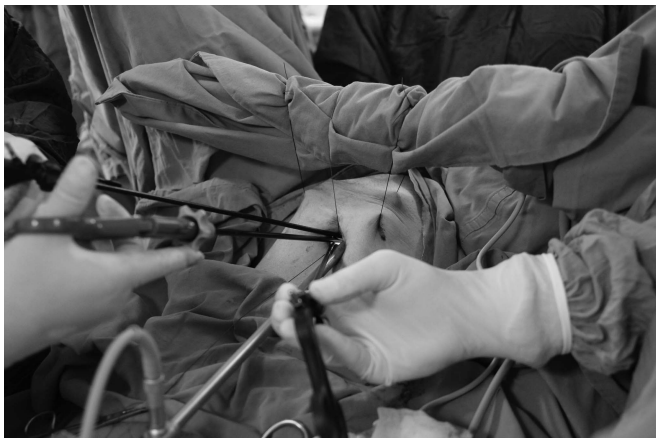

Figure 3. Multiple laparoscopic hand instruments are used through the same single incision without using trocars.

of the optic of the telescope. The laparoscopic hand instruments are used through the same single incision (**Figure 3**). There is no need to use trocars (keyless) to prevent gas leakage, and any surgical instrument (a laparoscopic hand instrument or a conventional surgical hand instrument) that can pass through the incision can be used.

If the intra-abdominal operative space is not adequate to perform the operation, additional lifting sutures can be placed at the sites at which further elevations are required. Lifting of a particular area (eg, protrusion of the peritoneal folds or adipose tissue into the operative field, particularly in overweight patients) can be managed by a suture just penetrating the skin and tied to the same retractor.

If the operation is limited to the pelvis, the retractor used does not limit the surgeon's motions. However, if an additional operation is anticipated at the upper side of the abdominal cavity, the placement of the retractor should be changed.

Wound closure. Lifting sutures are simply cut and removed. The fascial layer is closed with continuous unlocked sutures while the lifting sutures assist the elevation of the fascial layer. The umbilical skin is closed with No. 3-0 or 4-0 intracutaneous absorbable sutures and hidden into the umbilical fold. One month after the operation, the umbilical incision and the scars of the Veress cannula are nearly indemonstrable (**Figure 4**).

CO_2 Conventional Laparoscopy

CO_2 laparoscopy is performed with the use of a 10-mm port (infraumbilical port for the telescope) and two 5-mm

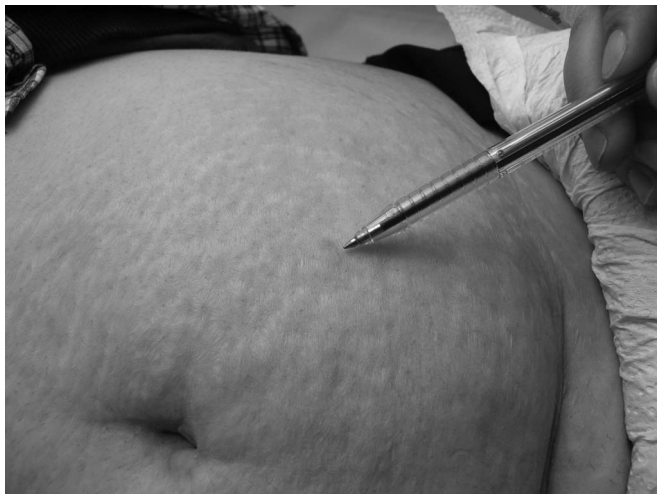

Figure 4. The umbilical incision and the scars of the Veress cannula are nearly indemonstrable 1 month after surgery.

ports (lateral ports for the hand instruments) placed after the creation of CO_2 pneumoperitoneum using the Veress needle. At the end of the surgical procedures, all fascial-layer incisions of the 10-mm ports are sutured before the placement of skin sutures; however, only the skin incisions of 5-mm ports are closed with No. 3-0 or 4-0 intracutaneous absorbable sutures.

Statistical Analysis

Statistical analysis was performed with SPSS software, version 16.0 (SPSS, Chicago, Illinois). The variables are presented as mean ± standard deviation, median, or percentage. The distribution of variables was studied by use of kurtosis, skewness, and Shapiro-Wilk tests. Normally distributed variables of the 2 groups were compared by use of the Student t test, and non–normally distributed variables were compared by use of the Mann-Whitney U test. The χ^2 test was used to assess the probability of existence of shoulder pain in the 2 groups. A logistic regression model was created to study the confounding factors that influenced the perception of shoulder pain. The Hosmer-Lemeshow test showed that the model fit (χ^2 = 13 762, P = .88, N = 77). Pearson correlation was used to study the relationship among the variables. $P < .05$ was considered statistically significant.

RESULTS

During a 20-month period, 77 women with benign ovarian cysts were operated on by KARS (n = 32) or conventional CO_2 laparoscopy (n = 45). The demographic data, physical characteristics, and preoperative findings of the

participating women were summarized in **Table 1**. The demographic findings, surgical histories, and preoperative hematologic statuses of the groups did not differ significantly ($P > .05$).

Minor bleeding and unintended cyst ruptures were the only observed intraoperative complications. In none of the cases was a blood transfusion or postoperative intensive care admission needed. In addition, we did not observe any hernia formation in either group.

We did not need to convert to conventional laparoscopy or laparotomy in the KARS group or to laparotomy or mini-laparotomy in the conventional laparoscopy group. Simple oral analgesic use after the 24th hour of the postoperative period was adequate for postoperative pain relief in both groups.

Table 1.
Demographic Data, Physical Characteristics, and Preoperative Findings of Participating Women in Both Groups

Characteristic	KARS (n = 32)	CO_2 Laparoscopy[a] (n = 45)	*P* Value
Age (y)	35.72 ± 1.28	37.82 ± 1.09	.440[b]
Gravidity (median)	3	4	.156[b]
Parity (median)	3	3	.124[c]
Miscarriage (median)	0	0	.522[b]
Induced abortion (median)	0	0	.229[c]
Ectopic pregnancy (median)	0	0	.129[c]
Offspring number (median)	2	3	.807[c]
Height (m)	1.62 ± 0.4	1.62 ± 0.5	.917[b]
Weight (kg)	64.22 ± 11.02	65.64 ± 11.10	.579[b]
Body mass index (kg/m^2)	24.49 ± 4.55	25.08 ± 4.99	.597[b]
Initial hemoglobin level (g/dL)	12.95 ± 2.04	12.88 ± 1.48	.864[b]
Initial hematocrit level (%)	38.88 ± 5.07	38.42 ± 3.49	.640[b]
Previous abdominal operation (%)	43.7	42.2	.894[c]

Data are presented as mean ± standard deviation unless otherwise indicated.

[a]Conventional multiport laparoscopy performed after creation of pneumoperitoneum.

[b]Student *t* test (used for normal distribution).

[c]Mann-Whitney test (used for non-normal distribution).

The intraoperative and postoperative findings of the study groups are summarized in **Table 2**. Most of the intraoperative and postoperative findings were similar in the 2 groups ($P > .05$); however, the abdominal cavity access and total operative times in the KARS group were significantly longer than those in the conventional laparoscopy group ($P < .05$).

Table 3 summarizes the postoperative pain scores and additional analgesic requirements of the groups. The VAS pain scores at the beginning and second, fourth, and 24th hours of the postoperative period were significantly lower in the KARS group ($P < .05$), although the differences in mean VAS scores never exceeded 1 point. In addition, the women in the KARS group needed less additional analgesia in comparison with those in the conventional laparoscopy group ($P < .05$). Moreover, a higher number and percentage of the patients in the conventional CO_2 laparoscopy group had shoulder pain ($P < .05$).

The χ^2 test analyzing shoulder pain showed that postoperative shoulder pain was significantly less frequent in the KARS group ($\chi^2 = 5.304$, $P = .021$, N = 77). Logistic regression for postoperative shoulder pain predicted that shoulder pain was affected only by the operation type and duration (**Table 4**). Although the operation duration was longer in the KARS group, the frequency of shoulder pain was higher in the conventional laparoscopy group.

In the KARS group, the total operative time correlated positively with the abdominal access and rope-lifting process time, weight and body mass index of the women, adhesion score, cyst diameter, cyst rupture rate, length of hospital stay, and shoulder pain frequency ($P < .05$).

In the conventional laparoscopy group, the total operative time correlated positively with the abdominal access time, weight and body mass index of the women, adhesion score, cyst diameter, cyst rupture rate, length of hospital stay, and shoulder pain frequency ($P < .05$).

DISCUSSION

Principal Findings

In comparison with conventional CO_2 laparoscopy, KARS performed to treat benign ovarian cysts causes less postoperative abdominal and shoulder pain. In addition, it decreases additional analgesic requirements.

Table 2.
Intraoperative and Postoperative Findings According to Operative Technique

Parameter	KARS (n = 32)	CO_2 Laparoscopy[a] (n = 45)	*P* Value
Cyst diameter (mm)	78.61 ± 37.92	73.78 ± 25.13	.899[b]
Cyst rupture (spontaneous or intended) (%)	53.1	64.4	.321[b]
Intra-abdominal adhesion score	1.31 ± 0.89	1.24 ± 0.93	.749[c]
Abdominal cavity access time (min)	21.06 ± 4.86	16.71 ± 4.97	<.001[c]
Operation duration (min)	86.44 ± 33.91	70.35 ± 31.53	.036[c]
Final hemoglobin level (g/dL)	11.97 ± 2.06	11.95 ± 1.44	.675[b]
Final hematocrit level (%)	36.03 ± 5.20	35.80 ± 3.94	.824[c]
Decrease in hemoglobin level (g/dL)	0.98 ± 0.64	0.93 ± 0.44	.668[c]
Decrease in hematocrit level (%)	2.84 ± 1.70	2.62 ± 1.52	.542[c]
Postoperative hospital stay (d)	1.34 ± 0.48	1.51 ± 0.59	.190[c]

Data are presented as mean ± standard deviation unless otherwise indicated.

[a]Conventional multiport laparoscopy performed after creation of pneumoperitoneum.

[b]Mann-Whitney *U* test (used for non-normal distribution).

[c]Student *t* test (used for normal distribution).

Table 3.
Postoperative Pain Scores and Additional Analgesic Requirements According to Operative Techniques

Parameter	KARS (n = 32)	CO_2 Laparoscopy[a] (n = 45)	*P* Value
Initial VAS pain score	6.00 ± 1.34	6.75 ± 1.38	.019[b]
VAS pain score at second hour	4.41 ± 1.43	5.27 ± 1.37	.009[b]
VAS pain score at fourth hour	3.53 ± 1.48	4.40 ± 1.56	.016[b]
VAS pain score at 24th hour	0.81 ± 1.00	1.44 ± 1.29	.023[b]
Patients with shoulder pain [n (%)]	5 (15.6)	18 (40)	.022[c]
Patients requiring additional analgesic (%)	12.5	37.7	.015[c]

Data are presented as mean ± standard deviation unless otherwise indicated.

[a]Conventional multiport laparoscopy performed after creation of pneumoperitoneum.

[b]Student *t* test (used for normal distribution).

[c]Mann-Whitney test (used for non-normal distribution).

Strengths of Study

To our knowledge, our study is the first comparing the postoperative pain scores and additional analgesic requirements of a gasless single-incision laparoscopic technique with conventional multiport CO_2 laparoscopy. Postoperative pain scores during single-incision and conventional multiport CO_2 laparoscopic surgical procedures were compared previously; however, the abdominal viscera was inflated by using CO_2 in all these studies.[1–3]

In our study all the operations for ovarian cysts were performed by the same surgical team under the same operating theater conditions.

Limitations of Study

Although the study included a control group, the participants determined which operative technique they would undergo; thus the study lacks the power of randomization. In addition, the study included the results of a single center. The VAS pain scores measured pain severity at the beginning and second, fourth, and 24th hours of the postoperative period; however, the pain scores between the fourth and 24th hours were missing. Postoperative shoulder pain was evaluated by its presence or absence; however, its severity was not evaluated.

Pain sensation is subjective and may even differ for the same individual under different conditions. It develops motivations to avoid damaging conditions, to be cautious about the damaged tissue, and to prevent future conditions related to pain. From this point of view, we did not gather information about the past pain experiences of the

Table 4.
Logistic Regression Predicting Shoulder Pain From Variables

Predictor	*B*	Wald χ^2	*P* Value	Odds Ratio [95.0% Confidence Interval for Odds Ratio (Lower–Upper)]
Operation type: KARS or conventional laparoscopy	−2405	7.777	.005[a]	0.090 (0.017–0.489)
Age	−0.003	0.006	.941	0.997 (0.913–1.088)
Gravidity	15 947	0.000	.999	8.43 (0.000–0.000)
Parity	−16 062	0.000	.9999	0.0 (0.000–0.000)
Miscarriage	−16 194	0.000	.9999	0.0 (0.000–0.000)
Induced abortion	−15 552	0.000	.999	0.0 (0.000–0.000)
Ectopic pregnancy	−17 117	0.000	.998	0.0 (0.000–0.000)
Body mass index	−0.006	0.005	.943	0.994 (0.845–1.170)
Cyst diameter	−0.005	0.118	.732	0.995 (0.967–1.024)
Operative time	0.048	7.907	.005[a]	1.049 (1.015–1.085)
Adhesion score	−0.567	1.370	.242	0.567 (0.220–1.466)
Previous abdominal operation	0.128	0.023	.880	1.136 (0.217–5.948)
Initial VAS pain score	0.301	1.159	.282	1.351 (0.781–2.336)
VAS pain score at second hour	−0.328	0.819	.366	0.721 (0.354–1.465)
VAS pain score at fourth hour	0.278	1.321	.250	1.320 (0.822–2.121)
VAS pain score at 24th hour	−0.073	0.049	.825	0.930 (0.488–1.771)

[a]Statistically significant.

patients. Although the frequencies of previous operations were similar in both groups, we cannot truly argue that the pain sensation, perception, and definition of the participants were similar.

Comparison With Previous Studies

From early 1990s on, data on gasless laparoscopy began to accumulate.[10,11] Gynecologic operations including myomectomy,[12–14] hysterectomy,[15] ovarian cyst resection,[16] colposuspension,[17] and radical hysterectomy[18] were performed by various surgeons. However, most of the published articles dealt with the feasibility, complications, operative times, and cosmesis of the procedures. In addition, although the previous surgical techniques consisted of gasless laparoscopic procedures, they had multiple abdominal entry sites.

Gargiulo and Nezhat[19] published an article describing the details of 3 new minimally invasive surgical approaches, including single-incision laparoscopic surgery. They discussed several well-performed studies. Single-incision laparoscopic surgery seemed to yield more intraoperative complications because of the poor visualization and difficulty in maintaining pneumoperitoneum. Gargiulo and Nezhat concluded that the improved postoperative pain with single-incision laparoscopic surgical procedures was not proven in comparison with the conventional multiport CO_2 laparoscopies. Similarly, Murji et al[20] conducted a meta-analysis of randomized controlled trials and high-quality observational studies with >2000 patients and failed to ascertain the impact of single-incision laparoscopy surgery on postoperative pain because of the paucity of data and lack of uniform collection. However, both articles reviewed the results of studies including surgical procedures performed under elevated intra-abdominal pressure created by the insufflation of CO_2. In our study we did not use CO_2 and did not elevate the intra-abdominal pressure. In addition, postoperative shoulder pain experienced more frequently after CO_2 laparoscopies may increase the severity of perceived pain. Thus the gasless (isobaric) nature of our technique may be an explanation for the contradiction with the findings of the previous publications.

Recently, Gerbershagen et al[21] studied postoperative pain scores on the first postoperative day in 70 764 German

patients. Surprisingly, they found that patients had reported high pain scores after many minor surgical procedures, and contrary to this finding, many major abdominal surgical procedures had caused comparatively less pain because of sufficient epidural analgesia. In our study we compared 2 operative techniques used for the surgical management of the same disease.

Different pain management regimens may cause different results. We used a standardized pain management protocol in both groups; thus our results suggest that the single-incision gasless laparoscopic technique yielded better pain scores than conventional CO_2 laparoscopy. In addition, at the 24th hour of the postoperative period, 59.3% of the women in the KARS group and 35.5% of the women in the conventional multiport CO_2 laparoscopy group had VAS pain scores of 0 points. Moreover, none of the scores in either group were >4 points.

Previous studies comparing the postoperative pain scores after single-incision and conventional laparoscopies mostly included cholecystectomies[1–3,22] and showed similar pain scores for the same surgical procedures. In the prospective, randomized, multicenter trial conducted by Marks et al,[23] the postoperative pain scores did not differ between single-incision and multiport laparoscopies. However, a substantial increase in the incidence of hernia with cholecystectomies performed by single-incision laparoscopic surgery was found. In their study the closure techniques for the access sites were not briefly defined, and one of the centers unavoidably lost more than one third of its patients to follow-up. In addition, there were contradictory findings in other publications dealing with postoperative hernia formation after single-incision laparoscopies.[24,25] Moreover, all of the included operations had been performed after the creation of pneumoperitoneum by using CO_2. Better pain scores after KARS may be the result of the avoidance of CO_2 pneumoperitoneum. The finding of significantly lower rates of shoulder pain after KARS supports this statement.

Although single-incision laparoscopic surgery was found to be feasible, safe, and reproducible in gynecology patients with benign and cancerous diseases,[26–28] only a few articles suggested better postoperative pain scores, and some of them were case reports or pilot studies.[29–32]

In 2011 Fagotti et al[33] published their randomized controlled trial comparing postoperative pain after conventional laparoscopy and laparoendoscopic single-site surgery (LESS) for benign adnexal disease. They concluded that LESS was more advantageous than conventional multiport laparoscopy in terms of postoperative pain and the need for rescue analgesia. Although we had similar postoperative findings in terms of pain, the need for rescue analgesics, and length of hospital stay, we also had different findings. The women included in the previous study had a higher median age (49 years in the LESS group and 42 years in the conventional laparoscopy group) than the women in our study (33.5 years in the KARS group and 38 years in the conventional laparoscopy group). The median body mass index, major cyst diameter, and previous abdominal operation rate and the mean operative time in both groups in our study were higher than the values in both groups in the previous study. Whereas Fagotti et al showed a lower bleeding rate in the LESS group, we observed similar bleeding rates in the KARS and conventional multiport laparoscopy groups.

In comparison with conventional multiport laparoscopy, Fagotti et al[33] showed significantly lower pain scores in the LESS group at the second and fourth postoperative hours; however, we showed lower pain scores in the KARS group initially postoperatively and at the second, fourth, and 24th hours of the postoperative period. In addition, we showed significantly less postoperative shoulder pain in the KARS group, which may result from the gasless nature of KARS.

In 2011 Prasad et al[34] published their study comparing the postoperative pain scores after single-incision and conventional laparoscopic cholecystectomies. They observed similar pain scores in both groups and noticed that pain scores decreased after the operative times decreased in the single-incision group. Although the decreased pain scores were also lower than the pain scores in the conventional laparoscopy group, the difference was not significant. In our study, although the KARS group had significantly longer operative times (by a mean of 16 minutes), the postoperative pain scores and additional analgesic requirements were significantly lower.

Our results suggest that KARS yields better pain scores than conventional multiport CO_2 laparoscopy and that fewer additional analgesics are required after KARS. However, one should note that our study included the results of surgical procedures performed for ovarian cysts. To increase the level of evidence, randomized prospective studies including various operations are needed. In addition, the gasless single-incision technique should be compared with single-incision laparoscopic surgical procedures using CO_2 to create pneumoperitoneum.

CONCLUSION

KARS seems to cause less postoperative pain during the management of benign ovarian cysts in comparison with conventional multiport CO_2 laparoscopy. In addition, shoulder pain is less frequently experienced after KARS operations.

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