



Assessment of the Safety of the Supraumbilical Compression Technique in Closed Laparoscopic Entry

Kapalı Laparoskopik Girişte Supraumbilikal Bası Tekniğinin Güvenilirliğinin Değerlendirilmesi

Supraumbilical Compression in Laparoscopy

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Özet

Amaç: Laparoskopide kapalı girişte eksternal supraumbilikal bası tekniğinin güvenilirliğinin değerlendirilmesi amaçlanmıştır. **Gereç ve Yöntem:** Bu prospektif çalışmada toplam 65 hasta 3 gruba randomize edildi: Grup 1 (n=22), kapalı laparoskopik girişte CO₂ insuflasyonu ile oluşturulmuş 15 mm Hg intraabdominal basınç (İAB), Grup 2 (n=22), supraumbilikal bası ve CO₂ insuflasyonunun kombine kullanımı ile oluşturulmuş 25 mm Hg İAB, Grup 3 (n=21), CO₂ insuflasyonu ile oluşturulmuş 25 mmHg İAB. Gruplar, CO₂ insuflasyon hacmi, pnömoperiton mesafesi, operasyona başlama-trokar girişi arasındaki süre ve cerrahi komplikasyonlar açısından karşılaştırıldı. **Bulgular:** Grup 1, 2 ve 3'teki pnömoperiton mesafesi sırasıyla 8,4, 7, 11,2 cm olarak saptandı (p<0.001 Grup 1 vs 2, Grup 2 vs 3, Grup 1 vs 3). Grup 1, 2 ve 3'teki operasyona başlama-trokar girişi arasındaki süre sırasıyla 377,2, 365,4 and 463,5 saniye olarak belirlendi (Grup 1 vs 3 ve Grup 2 vs 3 için p<0.001, Grup 1 vs 2 için p=0,838). Grup 3'teki CO₂ insuflasyon hacmi Grup 1 ve 2 ile karşılaştırıldığında anlamlı olarak daha yüksekti (Grup 1 vs 3 ve Grup 2 vs 3 için p < 0.001). Cerrahi komplikasyon oranları açısından gruplar istatistiksel olarak benzerdi (p=0.128). **Tartışma:** Klasik kapalı giriş teknikleriyle karşılaştırıldığında, eksternal bası tekniğindeki kısa pnömoperiton mesafesi bu tekniğin güvenilirliğinde potansiyel bir azalmaya neden olabilir.

Anahtar Kelimeler

Supraumbilikal Bası; İntraabdominal Basınç; Pnömooperiton Mesafesi; Laparoskopi

Abstract

Aim: It was aimed to assess the safety of the external supraumbilical compression technique in closed entry in laparoscopy. **Material and Method:** In this prospective study, a total of 65 patients were randomised into 3 groups; Group 1 (n=22) with closed laparoscopic entry with an intraabdominal pressure (IAP) of 15 mmHg obtained by CO₂ insufflation, Group 2 (n=22) with an IAP of 25 mmHg obtained by combined usage of supraumbilical compression and CO₂ insufflation and Group 3 (n=21) with an IAP of 25 mmHg achieved by CO₂ insufflation alone. Groups were compared in respect of the insufflated volume of CO₂, pneumoperitoneum distances, operation onset-to-trocar entry interval, and surgical complications. **Results:** The pneumoperitoneum distance was determined as 8.4, 7, 11.2 cm in Groups 1, 2 and 3 respectively (p<0.001 in Groups 1 vs 2, Groups 2 vs 3, Groups 1 vs 3). Operation onset-to-trocar entry interval was 377.2, 365.4 and 463.5 seconds in Groups 1, 2 and 3 respectively (p<0.001 in Groups 1 vs 3 and Groups 2 vs 3, p=0.838 in Groups 1 vs 2). Insufflated volume of CO₂ in Group 2 was statistically significantly higher compared to Group 1 and 2 (p < 0.001 in Groups 1 vs 3 and Groups 2 vs 3). Groups were statistically similar regarding the rate of surgical complications (p=0.128). **Discussion:** Compare to classic closed entry techniques, the external compression technique is associated with a shortened pneumoperitoneum distance which may result in a potential decrease in its safety.

Keywords

Supraumbilical Compression; Intraabdominal Pressure; Pneumoperitoneum Distance; Laparoscopy

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Introduction

Although the rate of major complications is comparable, up to 40% fewer minor complications are encountered in laparoscopy (LS) than laparotomy (LT). Advantages of laparoscopy include smaller scars, a more rapid recovery and lower levels of post-operative pain compared with laparotomy [1]. Evidence has also been presented which suggests that laparoscopic surgery entails a lower overall complication risk [2]. However, there have been reports of serious injuries to bowel, bladder and vascular structures which have occurred during laparoscopic surgery despite the relative safety of the technique [3]. The most common cause of serious laparoscopic complications has been seen to be related to primary trocar insertion, with an estimated 50% of laparoscopic complications determined as entry-related, and the majority of litigation related to injuries is trocar-associated [4].

Open-entry (Hasson technique), closed-entry and direct trocar entry techniques are the techniques used for entry into the abdomen in LS [5]. Most general surgeons prefer the open-entry technique (Hasson technique) while gynecologists mostly favor the closed entry technique [6,7]. In a recent Cochrane meta-analysis, the risk of failed entry has been reported to be lower in the open entry technique compared to the closed entry technique, while these two techniques were similar regarding the rate of visceral and vascular complications. Direct trocar entry technique was determined to be associated with a lower rate of failed entry and vascular injury compared to Veress needle entry [8].

The recommended intraabdominal pressure (IAP) in LS is between 12-16 mmHg [9]. It has been reported that pneumoperitoneum distance (PD), also called the intraabdominal security distance, increases in IAPs up to 25 mmHg achieved by CO₂ insufflation [10].

As an unpublished method of laparoscopic entry into the abdomen, in their routine practice, some laparoscopists have been applying external supraumbilical compression aiming to increase IAP. In this technique, initially an IAP of 15 mmHg is obtained by CO₂ insufflation. Then the surgeon applies external supraumbilical compression with his left hand until an IAP of 25 mmHg is obtained. The same surgeon, while compressing the supraumbilical region, inserts the main trocar into the abdominal cavity with his right hand without elevating the abdominal wall with clips.

The current study was designed to compare the safety of the external supraumbilical compression technique and the classic closed entry techniques.

Material and Method

This prospective randomised study was conducted at Kahramanmaraş Sütçü İmam University Hospital which is a tertiary level reference hospital. Approval for the study was granted by the Institutional Ethics Committee. Informed consent was obtained from all participants.

A total of 81 patients who underwent laparoscopy for benign gynecological indications between September 2013 and April 2015 were recruited into the study. Benign cystectomy, benign hysterectomy, tubal ligation, benign salpingectomy and diagnostic LS were the LS procedures applied to participants. If di-

rect entry was used due to 3 unsuccessful attempts at Veress needle entry or if Palmer's point entry was required for abdominal entry, those cases were excluded from the study. Any cases with evident adhesions on the anterior abdominal wall were also excluded from the study. By these exclusion criteria, 65 out of 81 patients were left. Simple randomization was conducted using computer-generated sequence. Allocation concealment was not performed.

Entry to the abdomen was achieved with a 10 mm vertical incision in the umbilical region up to the fascia through which the Veress needle was passed into the abdomen. After this step, the patients were recruited into 3 groups:

In Group 1 (n= 22), an IAP of 15 mmHg was achieved with CO₂ insufflation. Then the abdominal wall was elevated with a clip on each side of the umbilicus and the main trocar was inserted. In Group 2 (n= 22), initially CO₂ insufflation was used to obtain an IAP of 15 mmHg and then the gas was stopped. The surgeon on the right side of the patient applied external compression on the supraumbilical region with his left hand until IAP of 25 mmHg was achieved. At this point, the same surgeon placed the main trocar into the abdominal cavity with his right hand. The abdominal wall was not elevated during the entry of the main trocar. The surgeon stops compression after the insertion of the main trocar.

In Group 3 (n= 21), an IAP of 25 mmHg was achieved by CO₂ insufflation. Then the abdominal wall was elevated with a clip on each side of the umbilicus and the main trocar was inserted. A 10 mm trocar was inserted from the umbilicus and a 5 mm trocar was inserted from the inguinal area. A camera inserted through the inguinal trocar was used to measure the distance between the abdominal wall and the intestines (pneumoperitoneum distance) via a uterine sound placed into the abdomen through the umbilical trocar. The patients were in supine position during the measurement of the pneumoperitoneum distance. The 3 study groups were compared regarding the pneumoperitoneum distance, amount of CO₂ used to achieve pneumoperitoneum, operation onset-to-trocar entry interval and complications.

Statistical analysis was applied with Statistical Package for Social Sciences version 18.0 (SPSS IBM Software, Armonk, NY, USA). Mean values, frequency and statistical deviation values were determined. Conformity to normal distribution of variables was assessed using the Kolmogorov-Smirnov test. The Levene's test was used to evaluate the homogeneity of variations. If statistically significant differences were determined between the groups, the Tukey's test was used to make double post-hoc comparisons. A value of $p < 0.05$ was accepted as statistically significant.

Results

There was no statistically significant difference between the groups in respect of the age, gravida, parity, BMI, the number of previous surgeries, the mean preoperative haemoglobin, and the mean postoperative Hb levels. The groups were similar in respect of the procedures applied in LS ($p=0.591$) (Table 1).

The pneumoperitoneum distance was determined as 8.4 cm in Group 1, 7 cm in Group 2 and 11.2 cm in Group 3 ($p < 0.001$ in Group 1 vs 2, Group 2 vs 3, Group 1 vs 3). The mean operation

onset-to-trocar entry interval was 377 secs in Group 1, 365 secs in Group 2 and 463 secs in Group 3 ($p < 0.001$ in Group 1 vs 3, Group 2 vs 3, $p = 0.838$ in Group 1 vs 2). The mean amount of CO₂ insufflated to achieve pneumoperitoneum was 3.4 L in Group 1, 3.1 L in Group 2 and 5.3 L in Group 3 ($p < 0.001$ in Group 1 vs 2, Group 2 vs 3, $p = 0.943$ in Group 1 vs 2) (Table 2). No statistically significant differences were determined between the groups in respect of complications ($p = 0.128$) (Table 2).

Discussion

In laparoscopic parameters investigated to assure adequate pneumoperitoneum and safe trocar entry, IAP has been found

to be the most reliable predictor of operation onset-to-trocar entry interval, amount of insufflated CO₂ and IAP [11].

In closed entry techniques, the initial measured IAP should be less than 10 mm Hg to start gas insufflation through a Veress needle [12]. However, there has been debate over what the optimal IAP should be. Different IAP values of 10, 14-18, 20, 25, 30 have been studied [13]. Although the pneumoperitoneum distance increases with high IAP value, the upper limit of IAP has not been studied [5]. Thompson et al. [11] determined the pneumoperitoneum distance as 6.8 and 8.5 cm in IAPs below 15 and 20 mm Hg respectively.

In practice, external compression onto the supraumbilical area has been used to increase IAP prior to the trocar insertion in the

laparoscopic closed-entry technique. In this unpublished method, it is aimed to push the intraabdominal CO₂ to the lower pelvis and thereby obtaining an increment in IAP and the pneumoperitoneum distance. Moreover, it is expected that the operation onset-to-trocar entry interval would be shortened since the time elapsing until the achievement of a high IAP via CO₂ insufflation alone will be decreased. In addition, the potential hazards of high IAP would be prevented. The current study proved that the external compression technique had the benefit of reduction in the operation onset-to-trocar entry interval (365 secs in Group 2 vs 377 secs in Group 1, and 463 secs in Group 3).

In the current study, the pneumoperitoneum distance was determined to be higher at IAP of 25 mm Hg than at 15 mm Hg. It was found to be the shortest in Group 2 to whom external compression was applied to the supraumbilical region to reach an IAP of 25 mm Hg. This finding may be attributed to the fact that the area onto which supraumbilical pressure was applied is very close to the umbilical area where the uterine sound is inserted to measure the depth of the pneumoperitoneum distance. A compression onto the supraumbilical area will also push the anterior abdominal wall of the umbilicus inferiorly which may result in a shortening of the pneumoperitoneum distance and thereby in a reduction in the safety of this technique. Although statistically insignificant, omental injury was

Table 1. Demographic characteristics of the patient groups

	Group 1 (n= 22) (IAP=15 mmHg)	Group 2 (n= 22) (IAP= 25 mm Hg obtained by CO ₂ insufflation + supraumbilical compression)	Group 3 (n= 21) (IAP=25 mmHg)	P value
Age (years)	36.4±11	35.7±10.7	35.1±12.9	0.938
Gravida	3.1±1.9	2.9±1.5	2.6±2.5	0.777
Parity	2.4±1.6	2.2±1.3	2.2±2.2	0.943
BMI (kg/m ²)	29.3±7.5	30.6±8.2	30±6.4	0.856
Number of previous surgeries	1.2±0.4	1.2±0.4	1.1±0.3	0.783
Preoperative Hb level (g/dL)	12.4±1.7	12.2±1.6	12.8±1.3	0.402
Postoperative Hb level (g/dL)	11±1.3	10.9±1.4	11.3±1.3	0.632
L/S procedures number (%)				0.591
• BenignCystectomy	6 (33.3 %)	5 (27.8 %)	7 (38.9 %)	
• Benign hysterectomy	9 (42.9 %)	7 (33.3 %)	5 (23.8 %)	
• Benign Salpingectomy	1 (20.0 %)	2 (40.0 %)	2 (40.0 %)	
• Diagnostic L/S	3 (27.3 %)	2 (18.2 %)	6 (54.5 %)	
• Tubal Ligation	3 (30.0 %)	6 (60.0 %)	1 (10.0 %)	

BMI: Body mass index, Hb: Haemoglobin, L/S: Laparoscopy

Table 2. The outcomes of the study

	Group 1 (n= 22) (IAP=15 mmHg)	Group 2 (n= 22) (IAP= 25 mm Hg obtained by CO ₂ insufflation + supraumbilical compression)	Group 3 (n= 21) (IAP=25 mmHg)	P value
Pneumoperitoneum distance (cm)	8.4±0.9	7±0.6	11.2±0.7	<0.001 (Group 1 vs 2, Group 1 vs 3 Group 2 vs 3)
Operation onset to trocar entry interval (s)	377.2±77.4	365.4±76.7	463.5±75.3	<0.001 (Group 1 vs 3, Group 2 vs 3)
CO ₂ volume (L)	3.4±0.2	3.1±0.2	5.3±0.5	<0.001 (Group 1 vs 2) (Group 1 vs 3, Group 2 vs 3)
Complications				0.943 (Group 1 vs 2) 0.128
• Omental injury	0 (0 %)	2 (9.0 %)	0 (0 %)	
• Incision site bleeding	0 (0 %)	0 (0 %)	1 (4.7 %)	
• Preperitoneal insufflation	1 (4.5%)	4 (18.1 %)	2 (9.5 %)	
• Open entry	0 (0 %)	0 (0 %)	0 (0 %)	

cm: centimeters, s: seconds, L: Litre

only detected in 2 (9%) patients in Group 2 which may be due to the shortening of the pneumoperitoneum distance. Further studies of larger sample sizes are required to determine the complications of this technique.

To the best of our knowledge, there has not been any previous study in literature regarding the laparoscopic entry technique of increasing IAP via external supraumbilical compression. The current study will be a valuable addition to literature, as it has been observed that this technique is already used in practice. In a study by Philips et al., the pneumoperitoneum distance was measured during the application of pressure onto the umbilical region to evaluate pressure at the time of trocar entry. The pneumoperitoneum distance in that study was determined as 8.5 cm at 25 mm Hg and 5.7 cm at 10 mm Hg. With the application of 3 kg force to the umbilical area, a decrease in the pneumoperitoneum distance was determined up to 5.6 and 0.6 cm at 25 mm Hg and 10 mm Hg, respectively [14].

High IAP may lead to some hemodynamic alterations as demonstrated in a previous prospective, observational study. When IAP was increased over 12 mmHg significant hemodynamic changes were observed with a decrease in stroke volume and cardiac output and an increase in mean arterial pressure and systemic vascular resistance [15]. However, in a study by Abu-Rafea et al. [16], it was stated that these hemodynamic changes were of a minor level and did not have any clinical importance.

Hemodynamic changes, shoulder pain and a need for analgesics have been reported to have been observed less in low IAPs [17-19]. Therefore, the Royal College of Obstetricians and Gynecologists recommends that IAP should be 25 mm Hg during the first trocar entry and should then be decreased to 15 mm Hg [20]. In the current study, the highest pneumoperitoneum distance was determined in Group 3 with an IAP of 25 mm Hg obtained by CO₂ insufflation alone (11.2 cm in Group 3 vs 8.4 cm in Group 1, and 7 cm in Group 2). This finding supports the technique of laparoscopic closed entry with a high IAP. However, the prolonged operation onset-to-trocar entry interval in this technique due to the time period required for CO₂ insufflation may be considered as a disadvantage.

In conclusion, the closed entry technique using external compression onto the supraumbilical area is associated with a shortening of the pneumoperitoneum distance which may lead to a potential decrease in its safety. The power of the present study is limited by relatively small sample size. Further research is needed to evaluate the safety of this technique.

Declaration of Interest : We declare we have no conflict of interest.

Competing interests

The authors declare that they have no competing interests.

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