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Ultrasound-guided Veress needle insertion in laparoscopic surgery: safety and efficacy evaluation

Laparoskopik cerrahide ultrasonografik radyolojik görüntüleme rehberliğinde Veress iğnesi girişi

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ABSTRACT

Aim: In laparoscopic surgery, abdominal access is one of the most critical steps with significant risk of complications, especially in high-risk patient groups. The Veress needle is a widely used technique for this access; however, serious complications can occur during its blind insertion. The aim of this study was to evaluate the safety and efficacy of ultrasound-guided Veress needle insertion.

Materials and Methods: This randomized prospective study was conducted at Suleyman Demirel University Faculty of Medicine. The 100 study participants were randomly assigned to receive ultrasound-guided or blinded Veress needle insertion. In both groups, insertion attempts, time, and complications were assessed. Student's t-test, Mann-Whitney U test and chi-square test were used for statistical analysis.

Results: In 88% of the ultrasound-guided accesses, success was achieved on the first attempt, while this rate was 82% with the conventional method (p=0.40).Total access time was shorter with ultrasound guidance with 92.6 ± 14.2 seconds compared to 100.4 ± 15.3 seconds with the conventional method (p=0.01). No major complications were observed in either group; there was no statistical difference in complications.

Conclusion: This study demonstrates that ultrasound-guided Veress needle insertion is a potential alternative to the traditional blind method and improves insertion time. However, the results cannot be generalized with certainty as there was no statistically significant difference in the study. A larger sample size and multicenter studies are needed to confirm the findings.

Keywords: veress needle, laparoscopic entry tecnique, ultrasound guide

ÖZ

Amaç: Laparoskopik cerrahide abdominal giriş, özellikle yüksek riskli hasta gruplarında önemli komplikasyon riski taşıyan en kritik aşamalardan biridir. Veress iğnesi, bu girişte yaygın olarak kullanılan bir tekniktir; ancak kör uygulanması sırasında ciddi komplikasyonlar meydana gelebilir. Bu çalışmanın amacı, ultrason rehberliğinde Veress iğnesi yerleştirmenin güvenilirliğini ve etkinliğini değerlendirmektir.

Gereçler ve Yöntem: Bu randomize prospektif çalışma, Süleyman Demirel Üniversitesi Tıp Fakültesi'nde gerçekleştirildi. Çalışmaya katılan 100 hasta, rastgele iki gruba ayrıldı: Birinci grup, geleneksel kör Veress iğnesi yerleştirme yöntemiyle; ikinci grup ise ultrason rehberliğinde Veress iğnesi yerleştirme yöntemiyle işlem gördü. Her iki grupta giriş denemesi sayısı, giriş süresi ve komplikasyon oranları gibi parametreler değerlendirildi. İstatistiksel analizler için Student's t-testi, Mann-Whitney U testi ve ki-kare testi kullanıldı.

Bulgular: Ultrason rehberliğinde yapılan girişlerin %88'inde ilk denemede başarı sağlanırken, geleneksel yöntemde bu oran %82 olarak bulundu (p=0.40). Toplam giriş süresi ultrason rehberliğinde 92,6 ± 14,2 saniye ile daha kısa iken, geleneksel yöntemde bu süre 100,4 ± 15,3 saniye olarak bulundu (p=0.01). Her iki grupta da büyük komplikasyonlar gözlenmedi; komplikasyon açısından da istatiksel bir fark bulunmamıştır.

Sonuç: Bu çalışma, ultrason rehberliğinde yapılan Veress iğnesi yerleştirmenin, geleneksel kör yönteme göre potansiyel bir alternatif olduğunu ve giriş süresini iyileştirdiğini göstermektedir. Ancak, çalışmada istatistiksel olarak anlamlı fark bulunmaması nedeniyle, sonuçlar kesin olarak genellenememektedir. Daha geniş örneklem büyüklüğü ve çok merkezli çalışmalarla bulguların doğrulanmasına ihtiyaç vardır.

Anahtar Kelimeler: Veress iğnesi, laparoskopik giriş tekniği, ultrason rehberliği

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INTRODUCTION

Laparoscopic surgery has become a widely used procedure in gynecology for both diagnostic and therapeutic purposes. However, gaining access to the abdominal cavity remains one of the most challenging aspects of laparoscopy (1,2). The Veress needle technique is the most commonly used method by gynecologists to create a pneumoperitoneum before trocar placement (3,4). However, serious complications may occur during blind application of this technique and these complications may have significant negative effects on the patient's health outcomes and quality of life (5,6). At least 50% of all complications occurring during laparoscopic surgery are related to the abdominal access stage, with complication rates ranging from 0.1% to 1.3% (7,8).

Ultrasound guidance has attracted attention as a method that has the potential to reduce the risks of complications during Veress needle placement. This potential benefit of ultrasound guidance may contribute to the prevention of serious complications such as major vascular injuries and gastrointestinal damage by increasing the probability of correct needle placement (9). Although, in the current literature, there is evidence of the advantages of using ultrasound guidelines in surgeries, the number of research papers analyzing the outcomes of the use of such a method when placing Veress needles is low. This study is one of the first studies to evaluate the clinical efficacy and complication rates of ultrasound guidance in relation to the goal of providing a potentially safer method for creating pneumoperitoneum in laparoscopic gynecologic procedures.

Our hypothesis is that ultrasound-guided Veress needle insertion may reduce access-related complications rates compared with the conventional blind procedure. The aim of the study was to compare the complication incidences of ultrasound-guided Veress needle placement with the conventional blind procedure.

MATERIALS AND METHODS

It is a randomized prospective study carried out on patients undergoing laparoscopic surgery at Obstetrics and Gynecology Clinic of Süleyman Demirel University Faculty of Medicine Hospital from April 2018 to January 2020. In this context, the study was initiated with the approval of the Ethics Committee of Süleyman Demirel University Faculty of Medicine and was conducted in accordance with the ethical principles of the Declaration of Helsinki (Ethics Committee Approval Number: 16042019-140).

Regarding sample size, one hundred patients who were listed for elective laparoscopic surgery were recruited in the study. Patients were randomly selected from a population with a homogeneous distribution in terms of demographic characteristics such as age, gender, ethnicity and socioeconomic status. The participants in the study were post-surgery women with age 18 and above, who sought for a laparoscopic surgery at the Hospital of Süleyman Demirel University Faculty of Medicine and who agreed to the surgical operations with signed consent. Patients who declined to join the surgeries, those with history of abdominal adhesions during past operations and other severe complications probable during surgeries were not considered for the study.

This study was a randomized controlled design comparing two different Veress needle insertion techniques. Patients were divided into groups by simple random sampling and the insertion procedures were performed by the same surgeon to minimize bias due to procedural variability. In Group I, the Veress needle was inserted classically by lifting the anterior abdominal wall with laundry clamps placed to the right and left of the umbilicus; in Group II, it was inserted under the guidance of a General Electric Pro 200 ultrasonography device (GE Healthcare, Milwaukee, WI, USA) without lifting the anterior abdominal wall. Correct needle placement was confirmed in both groups by aspiration test, hanging drop test, and initial entry pressure less than 10 mmHg. Subsequently, the intra-abdominal pressure was inflated to 20 mmHg and a 10 mm trocar was inserted through the umbilicus. After trocar insertion, complications such as vascular, intestinal, gastric and omentum injuries were recorded with a 0-degree laparoscope. Measures such as verification of Veress needle access, success of access attempts and surgical complications were evaluated for both groups.

The data obtained were analyzed using SPSS 23.0 (Statistical Package for Social Sciences). Student's t-test was used for the analysis of normally distributed continuous data and Mann-Whitney U test was used for non-normally distributed continuous data. Chi-square test was used to analyze categorical data. All analyses were performed at 95% confidence interval and 5% significance level. Missing data were analyzed using the listwise deletion method. A p-value of less than 0.05 was used to establish statistical significance for all tests.

RESULTS

This study included 100 patients to evaluate the safety and efficacy of ultrasound-guided Veress needle placement compared to conventional Veress needle placement. When the demographic data of the groups were analyzed, it was observed that there was no significant difference between the two groups in terms of height,

weight and body mass index (BMI). However the age parameter was found to be lower in Group II and this difference was statistically significant (p=0.03) (Table 1).

When evaluated in terms of previous surgical history, no significant difference was found between the two groups in terms of number of operations and types of surgery. Although the number of patients who underwent laparoscopic surgery was higher in Group II, this difference was not statistically significant (p=0.21). Similarly, no significant difference was observed between the two groups in terms of surgical incisions and previous upper and lower abdominal surgeries (Table 2).

Between groups, the number of successful Veress needle insertions was similar. Both groups had similar median access numbers. First attempt failure rates and alternative access methods were similar between groups. Changing the entry point usually fixed the failure to access (Table 3).

Table 1. Comparison of Demographic Data Between Groups

Parameter	Group I (n=50)	Group II (n=50)	p-value
Age (mean±SD)	41.82 ± 11.933	36.92 ± 10.307	0.03
Height (mean±SD)	161.24 ± 5.906	160.16 ± 6.319	0.37
Weight (median, range)	71.5 (42-101)	67 (45-109)	0.38
BMI (kg/m²) (mean±SD)	27.24 ± 5.326	27.19 ± 16.088	0.96
BMI Categories (%)			
Underweight (<18.5)	4% (2/50)	6% (3/50)	0.64
Normal (18.5-24.9)	40% (20/50)	42% (21/50)	0.85
Overweight (25-29.9)	36% (18/50)	34% (17/50)	0.79
Obese (≥30)	20% (10/50)	18% (9/50)	0.76

SD = Standard Deviation BMI = Body Mass Index

Table 2. Comparison of Surgical History Between Groups

Parameter	Group I (n=50)	Group II (n=50)	p-value
Number of Previous Surgeries (median, range)	1 (0-3)	2 (0-3)	0.507
Previous Laparoscopic Surgery (chi-square test)	8%	16%	0.21
Vertical Incision in Previous Surgery (chi-square test)	2%	4%	0.55
Horizontal Incision in Previous Surgery (chi-square test)	44%	32%	0.21
Previous Abdominal Surgeries			
Lower Abdominal Surgery	50% (25/50)	40% (20/50)	0.31
Upper Abdominal Surgery	10% (5/50)	14% (7/50)	0.54
Both Upper and Lower Abdominal Surgery	4% (2/50)	6% (3/50)	0.64
Surgical Complication Rates	12% (6/50)	10% (5/50)	0.78
Adhesions from Previous Surgeries	24% (12/50)	18% (9/50)	0.46

Table 3. Number of Successful Veress Needle Insertions

Parameter	Group I (n=50)	Group II (n=50)	p-value
Number of Successful Veress Needle Insertions			
Median (range)	1 (1-2)	1 (1-3)	0.921
Alternative Insertion Methods Used in Case of First Attempt Failure			
Direct Trocar Insertion	10% (5/50)	8% (4/50)	0.73
Open Laparoscopy (Hasson Technique)	6% (3/50)	4% (2/50)	0.65
Remedial Strategies Used in Failed Insertions			
Changing Insertion Point	12% (6/50)	10% (5/50)	0.75
Additional Skin Incision	4% (2/50)	2% (1/50)	0.55

Table 4. Details of Insertion Attempts and Minor Complications During Insertion

Parameter	Group I (n=50)	Group II (n=50)	p-value
Number of Attempts			
1st Attempt (% Success)	82% (41/50)	88% (44/50)	0.40
2nd Attempt (% Success)	18% (9/50)	10% (5/50)	0.25
3rd Attempt (% Success)	0% (0/50)	2% (1/50)	0.31
Total Insertion Time (seconds)	100.4 ± 15.3	92.6 ± 14.2	0.01
Minor Complications During Insertion			
Omental Injury	4% (2/50)	6% (3/50)	0.64
Gas Leakage	6% (3/50)	8% (4/50)	0.55

SD = Standard Deviation BMI = Body Mass Index

In terms of complications, major complications (bowel injury, vascular injury, gastric injury) were not observed in both groups. In terms of minor complications, the rates of omental injury and gas leakage were similar in both groups. Although the rate of omental injury was slightly higher in Group II, this difference was not statistically significant (p=0.64) (Table 4).

Looking at the details of the entry trials, the success rate in the first trial was 88% in Group II and 82% in Group I. In the second attempt, the success rate was 18% in Group I and 10% in Group II. In the third attempt, the success rate was 2% in Group II, while no success was observed in Group I. Total access time was shorter in Group II and this difference was statistically significant (p=0.01) (Table 4). As shown in the figures, patients with a surgical history showed decreased Veress needle insertion success in both groups (Figure 1 and Figure 2). This was particularly evident in patients with multiple surgeries.

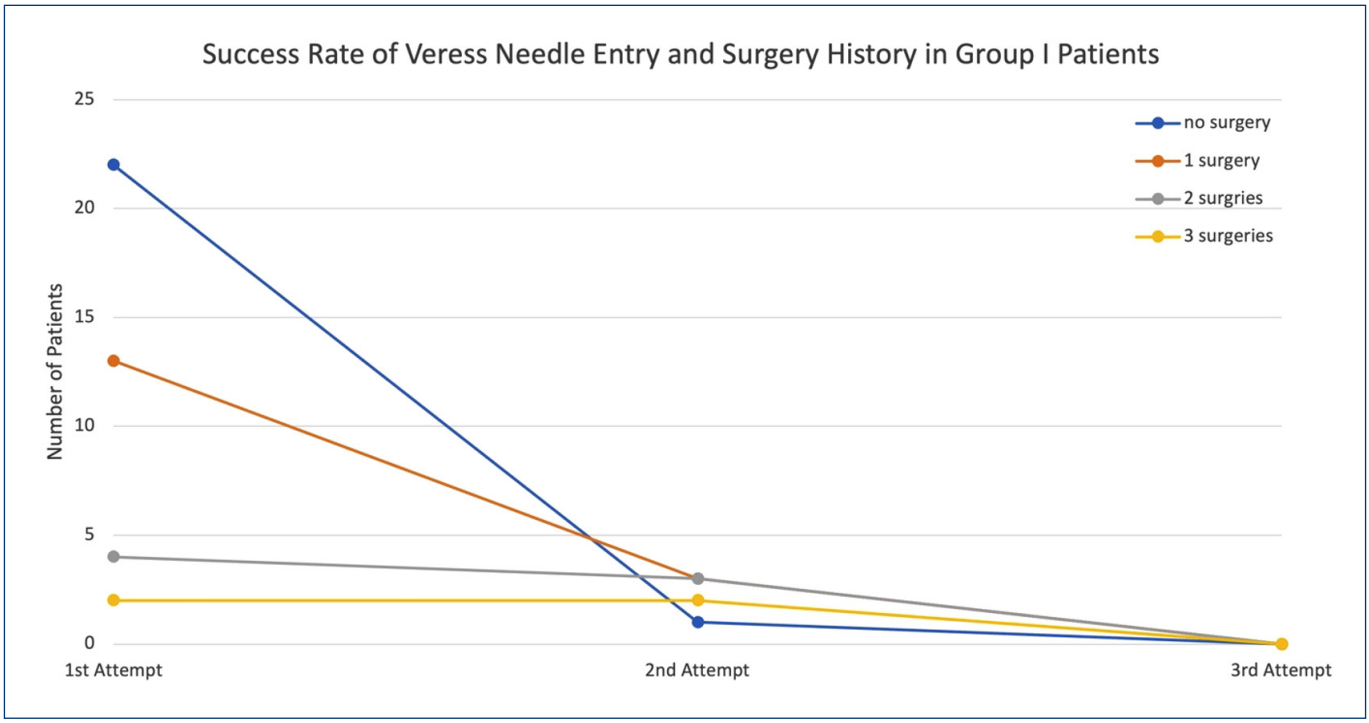

Figure 1. Success Rate of Veress Needle Entry and Surgery History in Group I Patients

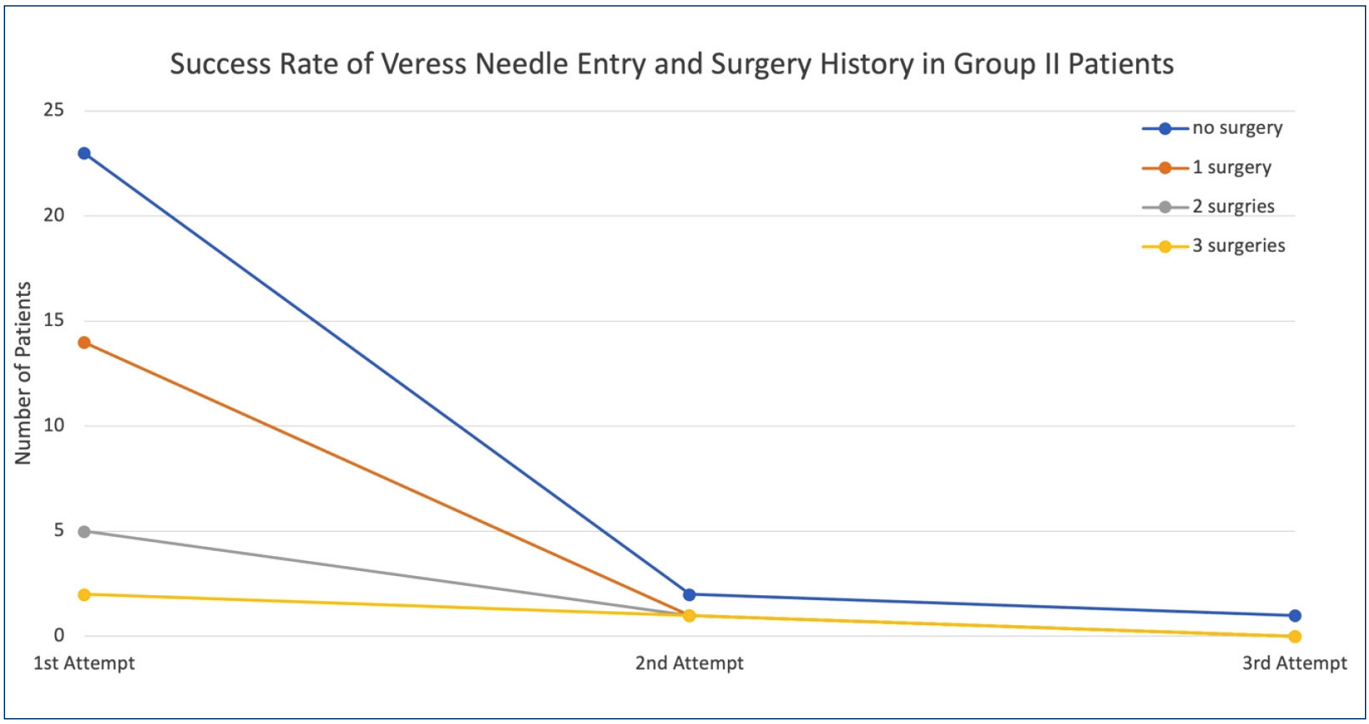

Figure 2. Success Rate of Veress Needle Entry and Surgery History in Group II Patients

DISCUSSION

The goal of this study was to determine whether ultrasound guidance can help to avoid complications while performing laparoscopic access with Veress needle. Laparoscopic surgical procedures become more complex depending on how abdominal access is achieved as this is the most sensitive and hazardous step of the surgery hence there is need for caution especially in the cases of patients on the high risk of complications. Ultrasound-guided Veress needle insertion helped shorten the insertion time without a statistically significant difference in the complication rate.

In laparoscopic surgery, the abdominal access phase is one of the most critical steps of the procedure. In the literature, although the Veress needle technique is the most commonly used method, it is reported to carry significant complication risks. In a systematic review by Azevedo et al. 1,575 (0.23%) injuries were found in 696,502 laparoscopic procedures, of which 126 (8%) were recorded as large vessel or hollow organ injuries (10). Rosen et al. compared different pneumoperitoneum creation methods including Veress needle, direct trocar access and open technique and concluded that no technique was completely superior (11). McKernan and Champion reported that the open technique was safer than the Veress needle in laparoscopic cholecystectomy (12). Günenç et al. showed that direct trocar access with elevation of the rectus sheath had a lower complication rate than the Veress needle technique (3.3% vs. 15.7%) (13). These literature findings suggest that laparoscopic access techniques are still controversial and more research is needed to determine the optimum method.

The technique of ultrasound-guided Veress needle insertion is an understudied topic in the literature. Several studies have shown the benefits of ultrasound guidance in surgery, but Veress needle research is scarce. For example, although Orlando et al. reported a low complication rate in Veress needle insertions, the role of ultrasound guidance in reducing these complications was not discussed in detail (14). The veterinary study by Fiorbianco et al. demonstrated the efficacy of ultrasound guidance in creating pneumoperitoneum and reducing complications in the use of Veress needle (15). Furthermore, in a retrospective evaluation, Zaraca and colleagues found that blind access with Veress needle increased complications and that open laparoscopy may be safer (16). In a study conducted by Santala and Järvelä on obese patients, it was shown that ultrasound-guided transfundal access was safer than Veress needle in transabdominal approach (17). These studies suggest that ultrasound-guided Veress needle access may be offer potential benefits in difficult anatomical situations, but more research is needed.

The Veress needle insertion success rates obtained in this study show some similarities and differences when compared with other studies in the literature. In a study by Inan et al. on laparoscopic cholecystectomy, it was reported that the access success rate was

92% with the use of Veress needle, but this rate increased to 98% with the direct trocar access method (18). A systematic review by Cornette and Berrevoet reported that no access technique for creating a pneumoperitoneum is free of complications and that the Veress method may also be associated with complications and failed access (19). These findings suggest that ultrasound-guided Veress needle access may potentially provide a higher success rate than blind access.

The complication rates obtained in this study show some important differences and similarities when compared with the available data in the literature. In a systematic review by Azevedo et al. it was reported that the complication rate in laparoscopic access with Veress needle was 0.23% and 8% of these complications were large vessel or hollow organ injuries (10). Sigman et al. reported that blind Veress needle accesses carried a higher risk of complications compared to open accesses and especially intestinal and vascular injuries were more common in blind accesses (20). Zaraca and colleagues compared the routinely applied Hasson technique with blind Veress needle access and reported that the Hasson technique had lower complication rates (16). Cornette and Berrevoet reported that minor complications were more frequent with Veress needle access, but most of these complications were not serious (19).

The safety and efficacy of ultrasound-guided Veress needle placement can be demonstrated by the lack of a statistical increase in the complication rate. Limitations of the study include the limited sample size, the lack of a multicenter study, and the lack of additional statistical analyses to confirm the initial homogeneity of the groups. This should be considered a methodological limitation of this study. These limitations affect the scope of the study.

CONCLUSION

The results of this study suggest that ultrasound-guided Veress needle placement can be used as an alternative method for abdominal access without statistically increasing the risk of complications. Larger, multicenter studies are needed to support this hypothesis and to evaluate its rationale in larger populations. More studies are needed to understand the impact of the increased use of ultrasound assistance in different surgical scenarios and populations and the impact of the learning curve of this technique on surgical outcomes.

Ethics Committee Approval:
The approval of the Ethics Committee of Süleyman Demirel University Faculty of Medicine was received (Ethics Committee Approval Number: 16042019-140).

Conflict of Interest:
The authors declare that they have no conflict of interest to disclose.

Author Contributions:
MB: Concept, author, analysis and interpretation, design, statistical analysis, supervision, concept. SCI: Concept, author, data collection, analysis and interpretation. EE: Concept, statistical analysis and interpretation The final version was read and approved by all authors.

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