

# Should We Continue Using Palmer's Test to Check the Correct Positioning of the Veress Needle During Laparoscopic Access?

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## Abstract

**Background:** The aim of this study was to check the efficacy of Palmer's test in preventing failed access to the abdominal cavity and the surgical complications associated with these maneuvers.

**Methods:** We conducted a multicenter, observational, prospective cohort study. The exposed cohort (n = 390) consisted of patients for whom Palmer's test was employed during maneuvers to access the abdominal cavity, while the non-exposed cohort (n = 390) included patients for whom only the pressure test was employed to ensure the correct positioning of the Veress needle.

**Results:** Our study's results show that implementing Palmer's test appears not to be useful for determining the correct positioning of the Veress needle when compared with the isolated reading of intraabdominal pressure. Additionally, the use of the Palmer's test entails a greater risk of complications and adverse effects during access maneuvers.

**Conclusions:** The use of Palmer's test in addition to the reading of intraabdominal pressure has not shown effectiveness in preventing failed access to the abdominal cavity or the associated complications.

**Keywords:** Laparoscopy; Veress needle; Safety maneuvers; Palmer's test; Pressure test

## Introduction

The laparoscopic approach is one of the main technological

advances in current surgical practice [1]. This pathway entails insufflating the interior of the abdominal cavity with carbon dioxide (CO<sub>2</sub>) to create a workspace where various diagnostic and therapeutic procedures can be conducted [1]. Endoscopic surgery shortens recovery times compared with laparotomy, given that the former is associated with reduced postoperative pain, lower surgical wound infection rates, reduced hospital stays, lower morbidity and mortality, and improved patient quality of life [2]. Despite its numerous advantages, endoscopic surgery is not without risk [3]. Up to 50% of the complications or adverse effects occur during the maneuvers to access and insufflate the abdominal cavity, given that the maneuvers are often executed blind [3].

The Veress needle is employed to perform the pneumoperitoneum using the closed or blind technique [4]. To minimize the possibility of complications during the access maneuvers, a series of safety mechanisms and tests have been developed whose objective is to indicate the correct positioning of the Veress needle in the abdominal cavity before starting the insufflation process [5]. These maneuvers include Palmer's test, the pressure test and the double-click acoustic test [5]. Palmer's test consists of instilling 5 mL of saline solution into the abdominal cavity through the needle (checking that it enters without resistance and that the aspirate is not recovered) before assessing the intrabdominal pressure. Although these safety maneuvers are widely used in routine surgical activity, there are no randomized studies that evaluate their results in terms of safety or effectiveness in reducing complications during entry maneuvers.

The aim of this study was to check the efficacy of Palmer's test in preventing failed access to the abdominal cavity and the surgical complications associated with these maneuvers, compared with only reading the intracavitary pressure at the start of the insufflation.

## Materials and Methods

### Patient selection

This study presents a prospective, observational, analytical, multicenter cohort study. The cohort exposed underwent gynecological laparoscopic surgeries in which Palmer's test was used during the access to the abdominal cavity with the Veress needle. We used the determination of intraabdominal pres-

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**Table 1.** Population Characteristics of Both Groups

	PT	NPT	P
Mean age (years)	40 (33 - 51)	41 (27 - 55)	0.07
Average BMI (kg/m <sup>2</sup> )	26 (20 - 32)	26 (20 - 30)	0.23
Percentage of patients with history of laparotomy	21.02	21.28	0.5
Percentage of patients with urgent surgery	16.4	16.4	0.5

BMI: body mass index; NPT: non-Palmer test; PT: Palmer test.

sure at the start of insufflation to ensure the correct placement of this device. The non-exposed cohort of patients underwent gynecological laparoscopic surgeries in which the correct placement of the Veress needle was only assured by the determination of intra-abdominal pressure. Only surgeries carried out by gynecologists who performed a minimum of  $\geq 25$  laparoscopic surgeries annually for the last 5 years were included. These surgeons were randomized to either performing or not Palmer's test when accessing the abdominal cavity. However, the hypothesis, the objectives of the study as well as the variables to be studied were not made known to the surgeons to avoid bias.

The study subjects were women who underwent gynecologic laparoscopic surgery for either benign or malignant pathology, in which access to the abdominal cavity was achieved with trocar entry technique after previous Veress needle insufflation. In all surgeries, the intra-abdominal pressure was determined as a maneuver for correct location of the needle, complementing half of the surgeries previously with Palmer's test. The surgeries were carried out in the Gynecology Unit of the Virgen Macarena University Hospital or in the Gynecology Unit of the General Hospital Santa Maria del Puerto between October 2014 and March 2023.

Since the study only evaluates the complications derived from the insufflation and entry maneuvers, the adverse effects secondary to the placement of the accessory trocars have not been considered.

### Statistical analysis

Statistical processing was performed with IBM SPSSv25 software. For the analysis of the data, a descriptive statistical study with the median and interquartile range of the general variables of the patients was performed. Group comparison was performed using the following procedure. The degree of relationship between the two independent categorical variables was determined using  $\chi^2$ , while the degree of relationship between categorical and quantitative variables was determined using Student's *t*-test (if normal distribution) or Mann-Whitney's U test (if nonnormal distribution). To analyze if the variable followed a normal distribution, the Kolmogorov-Smirnov and Shapiro-Wilk tests were used. All statistical tests were two-tailed at the  $P < 0.05$  level. Finally, a multivariate logistic regression model was performed.

### Ethical consideration

This study does not violate the policies and/or procedures

established by journals such as those described in "Specific Inappropriate Acts in Publication Process". The protocol for the research project has been approved by the Health Research Subcommittee of the Health Ethics and Research Committee of the Virgen Macarena University Hospital in Seville, and by the Ethics and Research Committee of the Hospital General Santa Maria del Puerto. This research complied with the fundamental principles relating to human rights and biomedicine recovered in the Declaration of Helsinki (as revised in Tokyo 2004) and in the Convention of the European Council and Ethical Premises included in Law 41/2002 of November 2014.

### Results

Data were obtained from 780 patients who underwent gynecological laparoscopic surgery. In 390 patients, the safety maneuvers employed during the laparoscopic access to determine the correct location of the Veress needle were Palmer's test followed by measuring the intraabdominal pressure (Palmer test (PT) group). In the remaining 390 patients, only the reading of the intraabdominal pressure was employed (non-Palmer test (NPT) group). Table 1 shows the descriptive analysis of the sample, highlighting the homogeneity among the two study groups, with no statistically significant differences in terms of age, proportion of emergency surgeries, mean body mass index (BMI), or incidence of a history of previous laparotomy. Table 2 presents a summary of the indications and procedures performed, showing that the most common surgical indication was benign adnexal disease, which represented 549 surgeries (70.4%), with adnexectomy being the most common surgical procedure (185 cases, 23.7%).

Optimal access to the abdominal cavity was achieved after the first attempt in 680 patients (87.2%), after the second attempt in 67 patients (8.6%), after the third attempt in 24 patients (3.1%), and after the fourth or greater attempt in nine patients (1.1%). The mean number of attempts for the entire sample was 1.18. The proportion of accesses that succeeded in the first attempt was higher in the NPT group than in the PT group (88.7% vs. 85.6%), a difference that was statistically significant ( $P < 0.05$ ). It is interesting to highlight how despite carrying out the test, the incorrect positioning was not recognized, so the test was ineffective in verifying it. The mean number of access attempts by group was also lower in the NPT group (1.13 vs. 1.23). In terms of the time employed in the peritoneal cavity access maneuvers, the median for the entire sample was 182 s (90 - 720), with no statistically significant differences between the two groups (median of 180 s for the

**Table 2.** Surgical Indications and Surgical Procedures Performed

	n	%
Surgical indications		
Adnexal pathology	549	70.4
Uterine pathology	157	20.1
Oncological pathology	60	7.7
Pelvic floor defects	14	1.8
Surgical procedures		
Adnexectomy	185	23.7
Cystectomy	178	22.8
Hysterectomy	155	19.9
Salpingectomy	151	19.4
Myomectomy	34	4.4
Diagnostic laparoscopy	24	3.1
Definitive contraception	17	2.2
Oophorectomy	12	1.5
Colposacropexy	12	1.5
Hemostasis	6	0.8
Adhesiolysis	4	0.5
Hysterectomy + lymphadenectomy	2	0.3

PT group (range 120 - 720) and 185 s for the NPT group (range 90 - 315)).

No complications were recorded for the peritoneal cavity access maneuvers in 739 patients (94.7%). The proportion of complications related to these maneuvers, which is listed in Table 3, was 5.3%. The most common complication was subcutaneous emphysema, which was recorded for 19 patients (2.4%), representing 46.3% of all complications. The proportion of patients with subcutaneous emphysema was higher in the PT group than in the NPT group (3.8% vs. 1%), a difference that was statistically significant ( $P < 0.05$ ). Only one case of major vascular injury (0.12%) and three cases of intestinal

perforation (0.38%) were recorded. The comparative analysis between the two groups showed that the proportion of patients who had no complications of any type was higher in the NPT group than in the PT group (97.7% vs. 91.8%), a difference that was statistically significant ( $P < 0.001$ ) and may be related to the greater number of access attempts in NPT group. Similarly, no major complications were recorded in the NPT group (intestinal perforation or major vascular injury).

With regard to the need for conversion to laparotomy due to complications or adverse effects related to the peritoneal cavity access maneuvers, there were 19 such cases (2.4%), all of them in the PT group. In the 19 cases described, the need to convert laparoscopy into laparotomy was due to difficulty in accessing the peritoneal cavity. Moreover, we recorded 12 cases (1.5%), in which a change in location or entry technique was required due to difficulty accessing the peritoneal cavity, a situation that was more common in the PT group, although the differences were not statistically significant ( $P = 0.384$ ). Lastly, the multivariate analysis using a logistic regression model showed that the PT group presented 3.91 times the risk of complications than the NPT group (odds ratio (OR): 3.91; 95% confidence interval (CI): 1.80 - 8.50), a result that was statistically significant. Furthermore, patients with a history of previous laparotomy had a 2.42 times greater risk of suffering any complication than those without such a history (OR: 2.42; 95% CI: 1.22 - 4.81). Overweight or obese patients presented 2.66 times the risk of complications than patients with normal BMI (OR: 2.66; 95% CI: 2.26 - 9.05). Finally, patients in whom two or more attempts were made to access the peritoneal cavity showed 4.5 times the risk of complications than those in whom access to the cavity was made on the first attempt (OR: 4.52; 95% CI: 2.26 - 9.05). The multivariate analysis can be observed in Table 4.

## Discussion

Our study's results show that implementing Palmer's test appears not to be useful for determining the correct positioning of the Veress needle when compared with the isolated reading

**Table 3.** Complications and Adverse Effects During Laparoscopic Access Maneuvers

Complications	PT	NPT
Total number of patients without complications	358	381
Subcutaneous emphysema	15	4
Minor wall vascular injury	7	0
Need for conversion to laparotomy due to inability to access	5	0
Anesthesia intolerance	1	2
Intestinal perforation	3	0
Eiploic emphysema	0	3
Major vascular injury	1	0
Need to change localization or access technique	8	4
Need for conversion to laparotomy due to complications during access	19	0

PT: Palmer test; NPT: non-Palmer test.

**Table 4.** Multivariate Analysis

	Adjusted OR	95% CI
PT	3.91	1.80 - 8.50
BMI $\geq$ 25 (kg/m <sup>2</sup> )	2.66	1.13 - 6.26
History of previous laparotomy	2.42	1.21 - 4.80
$\geq$ 2 access attempts	4.52	2.26 - 9.05

BMI: body mass index; CI: confidence interval; OR: odds ratio; PT: Palmer test.

of intraabdominal pressure. Given the group's higher percentage of failed access attempts in our sample, there was a greater risk of complications and adverse effects during the access maneuvers in this patient group.

Despite the safety of laparoscopic surgery, the incidence rate of complications is 3 - 4 cases per 1,000 surgical procedures, more than 50% of which are related to the initial abdominal access maneuvers [6]. Nevertheless, the literature reports situations that can act as risk factors for their onset. Firstly, a previous history of abdominal surgery clearly represents a risk factor for the formation of adhesions. Brill et al reported a 28% rate of cases of direct injury to the intestine and omentum in a series of 360 patients who underwent laparoscopic surgery following a previous laparotomy [7]. Similarly, a study by Rafii et al showed a significantly higher complication rate during access maneuvers in the patient group with a previous history of laparotomy [8]. Secondly, obesity impedes access to the peritoneal cavity because the thickness of the abdominal wall and the presence of preperitoneal fat precludes the accurate assessment of the Veress needle's location, with the onset of subcutaneous emphysema being more frequent [6, 9]. Lastly, the surgeon's training and experience are essential for minimizing the risk of complications [10]. The present study's design ensured homogeneity between the two groups, as can be seen in Table 1, to ensure that none of the previously mentioned conditions acted as confounding factors in the statistical analysis. Additionally, the study only included surgeries in which gynecologists with experience in this approach route participated.

Various authors have related the number of attempts to access the abdominal cavity with the surgical complication rate. Krishnakumar et al compiled the rate of correct placement of the Veress needle as a function of the number of attempts published in various studies, with rates of 85.5-86.9% after the first attempt, 8.5-11.6% after the second attempt and 2.9-4.6% after three or more attempts. The authors also observed that the complication rate increased as the number of attempts needed to access the abdominal cavity increased [11]. Similarly, Richardson et al indicated that the higher the number of attempts, the greater the likelihood of associated complications, reporting a complication rate of 0.8-16.3% for a single attempt and up to 84.6-100% for four or more attempts [12]. When compared with our results, optimal access to the abdominal cavity was achieved after the first attempt in 87.2% of the patients. However, the proportion of first-attempt episodes was higher (and statistically significant) in the NPT group (88.7% vs. 85.6%) ( $P < 0.05$ ). These data demonstrate the scarce util-

ity of Palmer's test in determining the correct positioning of the Veress needle compared with the isolated reading of the intraabdominal pressure when starting the insufflation (which should be  $< 10$  mm Hg). Moreover, the patients with two or more attempts to access the peritoneal cavity showed a 4.5-fold higher risk of complications compared with the patients in whom the access was achieved in the first attempt (OR: 4.52; 95% CI: 2.26 - 9.05).

The complication rate recorded during the peritoneal cavity access maneuvers in our study was 5.3%. This proportion coincides with that of other publications on the same topic such as those of Magrina [13], Yoong et al [14] (7%) and Brenner-Anidjar et al [15] (5.13%). The most common complication was subcutaneous emphysema, representing 46.3% of all adverse effects. The proportion of patients with subcutaneous emphysema was higher in the PT group (3.8% vs. 1%), a difference that was statistically significant ( $P < 0.05$ ). Preperitoneal insufflation was also the most common complication recorded in the study by Teoh et al [16] that aimed to assess the usefulness of safety maneuvers. These studies highlight the lack of usefulness of safety tests prior to the insufflation, including Palmer's test, due to their low sensitivity and scarce positive predictive value. Similarly, these studies establish the pressure test as an effective safety maneuver with a sensitivity rate of 79% for detecting complications, and a sensitivity close to 100% for diagnosing preperitoneal insufflation. In our study, the proportion of patients who had no complications of any type was significantly higher in the NPT group (97.7% vs. 91.8%), a difference that was statistically significant ( $P < 0.001$ ). Similarly, no major complications were recorded in the NPT group (intestinal perforation or major vascular injury). Therefore, the use of Palmer's test does not translate into a reduction in access complications. Instead, its theoretical reasoning provides the surgeon a false sense of security that can result in a larger number of failed attempts, major complications, need to change the entry technique or conversion to laparotomy.

Although the safety maneuvers have been the object of study by other authors, the results in certain cases are controversial. Brenner-Anidjar et al [15] compared the PT and NPT groups of a previous study and found no statistically significant differences in the complication rate or in the need for conversion to laparotomy due to access difficulties. The disparity between the results of Brenner-Anidjar et al [15] and those of the present study might be explained by our larger sample size, which provides the present study with greater statistical, and the intergroup homogeneity, which decreases the likelihood of bias. Yoong et al [14] also compared Palmer's test with the pressure test as safety techniques during laparoscopic access in a cohort of 100 patients. The authors concluded that the pressure test was more reliable than Palmer's test in preventing adverse effects during laparoscopic access, based on calculations of sensitivity and specificity. Similarly, the Clinical Practice Guidelines of the Society of Obstetricians and Gynaecologists of Canada postulates that the pressure test is the only truly reliable safety maneuver [17]. In the results of this study, no specific situations have been identified in which the use of the Palmer test can be recommended.

Our study is not exempt from limitations, the primary of which lies in the fact that the patients were not randomly as-

signed to one of the two groups.

Our workgroup performed a survey for this study in the gynecology units of 17 public university hospitals of Andalusia (8,518,053 inhabitants), a region to which the study sample belongs. We observed that 64.7% of the units used the Veress needle as the most frequent method for insufflation/laparoscopic access. Of these, 90.9% systematically employed Palmer's test to verify the needle's correct positioning, which contrasts with the published evidence on the subject. It is therefore important to implement multicenter studies with larger sample sizes and randomized clinical trials on this topic and publish its conclusions to avoid unnecessary practices.

## Conclusions

Our study's results indicate that the systematic use of Palmer's test in addition to reading the intraabdominal pressure is not justified, given that Palmer's test has not been shown effective in preventing failed accesses to the abdominal cavity or the complications associated with the insufflation/entry maneuvers. The theoretical reasoning behind Palmer's test can also provide a false sense of security to surgeons, which can result in a larger number of failed attempts, major complications, the need to change entry technique and conversion to laparotomy. Scientific evidence shows how the pressure testing is the only truly reliable safety maneuver. We consider that these results are not applicable to other surgical discipline or other entry techniques since the results have been obtained by performing in all cases a close laparoscopic access with Veress needle. The lack of randomization of patients between the intervention group and the control group is the main limitation of our study. It is therefore important to implement multicenter studies with larger sample sizes and randomized clinical trials on this topic and publish its conclusions to avoid unnecessary practices.

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## Conflict of Interest

The authors declare that there is no conflict of interest.

## Informed Consent

We have followed our workplace protocols regarding the publication of patient data.

## Author Contributions

Ana Redondo Villatoro: conception and design; acquisition of data; analysis and interpretation of data; drafting of the manuscript; critical revision of manuscript for important intellectual content; supervision. Maria Pineda Mateo: acquisition of data; analysis and interpretation of data. Zoraida Frias Sanchez: acquisition of data; analysis and interpretation of data. Manuel Pantoja Garrido: conception and design; acquisition of data; analysis and interpretation of data; critical revision of manuscript for important intellectual content; statistical analysis; supervision. Sara Rojo Novo: acquisition of data; analysis and interpretation of data. Juan Jesus Fernandez Alba: conception and design; analysis and interpretation of data; critical revision of manuscript for important intellectual content; statistical analysis; supervision.

## Data Availability

The authors declare that data supporting the findings of this study are available within the article.

## Abbreviations

BMI: body mass index; NPT: non-Palmer test; PT: Palmer test

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