

# The Pulsatile Sign Confirms Intraperitoneal Entry During Closed Laparoscopic Surgery

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**OBJECTIVE:** To test the hypothesis that palpable pulsations lasting at least 60 seconds confirm intraperitoneal placement of the Veress needle.

**STUDY DESIGN:** A prospective clinical trial of 109 consecutive women undergoing laparoscopic surgery for benign gynecological disorders. A positive pulsatile test was defined as the presence of palpable pulsations in the insufflation tubing lasting at least 60 seconds on connect-

ing to an inserted Veress needle. Absence of pulsations or pulsations lasting <60 seconds was considered a negative test.

**RESULTS:** Overall, the sensitivity of the pulsatile test was 100%, with a specificity of 100% and positive predictive values and negative predictive values of 100%.

**CONCLUSION:** Our data demonstrate that the Pulsatile test is reliable in determining both the correct and incorrect position of the Veress needle, at least in this low-risk group. (J Reprod Med 2018;63:407–410)

**Keywords:** abdominal wall, anatomic landmarks, body mass index, gynecologic surgical procedures, iatrogenic disease, insufflation, laparoscopy, peritoneal cavity, pneumoperitoneum, probability, prospective studies, umbilicus, vascular system injuries, Veress needle.

Entry into the peritoneal cavity is one of the biggest challenges encountered in laparoscopic surgery. Despite recent advances in laparoscopic

surgery, no clear consensus has emerged as to the most ideal method of entry into the peritoneal cavity. While complications associated with laparoscopic surgery are rare, a significant number of them occur at the time of abdominal wall entry

into the peritoneal cavity.<sup>1</sup> Intraperitoneal entry is associated with both gastrointestinal and vascular injuries, with 50% of the complications occurring before the commencement of the intended surgery.<sup>2</sup> Despite improvements in laparoscopic equipment and techniques, this complication rate has remained static for the past 25 years.<sup>3</sup> Two laparoscopic entry methods are used in principle to create a pneumoperitoneum: a closed technique and an open Hasson technique.<sup>4</sup> The closed method requires the use of a Veress needle to create a pneumoperitoneum. The open Hasson method is safer in terms of reducing both vascular and bowel injuries. It also has the advantage of certainty of establishing a pneumoperitoneum.<sup>4</sup> It does, however, have drawbacks. It requires a larger incision to accomplish peritoneal entry, necessitating the

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**Financial Disclosure:** The authors have no connection to any companies or products mentioned in this article.

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need for fascia closure. The larger incision also results in a greater difficulty in maintaining a pneumoperitoneum. It is technically more demanding, particularly in obese patients and in patients with prior abdominal surgery. Finally, it takes longer to gain entry into the peritoneal cavity using the open Hasson technique. For these reasons, there is still a place for closed entry laparoscopy, which allows for relatively rapid and easy access into the peritoneal cavity. Closed entry laparoscopy is generally accomplished through a 5 mm port without the need for fascia closure. While the use of the Veress needle is generally felt to be safe and quick, tests still must be performed to confirm proper intraperitoneal position. Currently available methods include palpation of the aorta prior to surgery,<sup>5,6</sup> angling of the Veress needle,<sup>5,7</sup> the saline drop test,<sup>5,8</sup> the spinal needle test,<sup>5,9</sup> CT and MRI imaging,<sup>5,10</sup> the aspiration test,<sup>11</sup> the injection test,<sup>11</sup> and the recovery test.<sup>11</sup>

In this study we describe a novel technique to confirm intraperitoneal entry, which we describe as the pulsatile technique. To create a pneumoperitoneum, the Veress needle is connected to the Thermoflator (Karl Storz–Endoskope) using plastic tubing. The Thermoflator has a pressure-sensing device independent of the gas flow that automatically decreases gas flow if overpressurization occurs and increases flow if underpressurization occurs. This mechanism also shuts down the flow if the set intraabdominal pressure is achieved. The creation of the pneumoperitoneum is generally performed in the intermittent flow mode, i.e., in a pulsatile fashion. It is this pulsation that the surgeon can palpate by placing the index finger and the thumb on the tubing immediately above and adjacent to its attachment to the Veress needle. These pulsations are generally easily palpable within the first 60 seconds of creating the pneumoperitoneum. This study aimed to test the hypothesis that palpable pulsations lasting at least 60 seconds confirm intraperitoneal placement of the Veress needle. Extraperitoneal placement of the Veress needle into a closed space would cause a rapid rise of pressure, triggering the shutdown of intermittent gas flow and resulting in an absent or a shortened pulsatile sign.

### Materials and Methods

We studied 109 consecutive women undergoing laparoscopic surgery for benign gynecologic disorders. Institutional Review Board approval was

obtained prior to the study and each patient received extensive preoperative counseling and signed an informed consent prior to enrollment in the study. The patient's age, height, weight, BMI, and the reason for the laparoscopic intervention were recorded. We excluded patients with a BMI >30 kg/m<sup>2</sup>, patients with a history of malignancy or suspected malignancy, patients with a prior history of pelvic inflammatory disease or peritonitis, and patients who had undergone previous pelvic or peritoneal surgery (Table I). The patients were prepped and draped in a sterile fashion in the usual way. After insertion of the Veress needle into Palmer's point (left hypochondrium) and connecting the Veress needle to the Thermoflator, the Thermoflator was placed on an intermittent inflation mode. The surgeon immediately palpated for the presence of the pulsations lasting for at least 60 seconds for it to be considered a positive test. Absence of or pulsations lasting <60 seconds were considered a negative test. Effective creation of the pneumoperitoneum was confirmed by insertion of the laparoscope into the peritoneal cavity, indicating that the Veress needle was positioned correctly. All patients with a negative pulsatile test underwent an open laparoscopy. All the laparoscopic procedures were performed by the same surgeon, Dr. Mushayandebvu. The Karl Storz–Endoskope Thermoflator was used in all the patients.

### Data Analysis

The results of the tests described (positive and negative) were used to calculate the sensitivity, specificity, positive predictive value (PPV), and negative predictive value of the test. Sensitivity was defined as the proportion of cases in which the test was able to confirm that the Veress needle

**Table I** Characteristics of Study Patients

Patient demographic	N=109
Age, mean (SD)	42.7 (12.3)
BMI (kg/m <sup>2</sup> ), mean (SD)	27.3 (2.5)
Intervention	
Ovarian cystectomy	37
Fulguration of endometriosis	31
Tubal ligation	18
Laparoscopic myomectomy	13
Lysis of adhesions	4
Diagnostic	3
Ectopic pregnancy	3

was correctly positioned, according to the following formula:

$$\text{Sensitivity} = [\text{true positives} / (\text{true positives} + \text{false negatives})] \times 100.$$

Specificity was defined as the proportion of cases in which the test was able to confirm that the Veress needle was incorrectly positioned, according to the following formula:

$$\text{Specificity} = [\text{true negatives} / (\text{true negatives} + \text{false positives})] \times 100.$$

The probability of the needle being correctly positioned among the positive test results was considered the positive predictive value (PPV). The probability of the needle being incorrectly positioned among the negative test results was considered the negative predictive value (NPV). The PPV and NPV values were used to calculate the validity of the test results, according to the formulas:

$$\text{PPV} = [\text{true positives} / (\text{true positives} + \text{false positives})] \times 100;$$

$$\text{NPV} = [\text{true negatives} / (\text{true negatives} + \text{false negatives})] \times 100.$$

## Results

A single attempt was made on each patient to achieve insufflation with a Veress needle. Failure to achieve a pneumoperitoneum resulted in an open laparoscopy. Of the 7 patients with a negative pulsatile test (Table II), none had proper placement of the Veress needle. All underwent open laparoscopy, which confirmed incorrect placement. Overall, the sensitivity of the pulsatile test was 100%, with a specificity of 100% and PPVs and NPVs of 100% (Table II).

## Discussion

Current data clearly demonstrate the superiority of minimally invasive surgery versus conventional open surgery when it comes to reducing postoperative pain, duration of hospitalization, blood loss, scarring, and infections. Despite new technologies that have been developed over the past 30 years, access to the peritoneal cavity remains as one of the greatest challenges in laparoscopic surgery. The vast majority of major vascular injuries occur during insertion of the Veress needle and especially of the trocars at the beginning of the procedures.<sup>12-14</sup> In closed laparoscopic surgery,

**Table II** Data Used to Calculate Sensitivity, Specificity, Positive Predictive Value, and Negative Predictive Value of the Pulsatile Test

Pulsatile test	Position of the needle	
	Incorrect No. (%)	Correct No. (%)
Negative (failure)	7 (100.0)	0 (0.0)
Positive (success)	0 (0.0)	102 (100.0)
Total	7 (100.0)	102 (100.0)

Sensitivity = 100%, specificity = 100%, PPV = 100%, NPV = 100%.

factors contributing to vascular injury include inexperience of the surgeon,<sup>12,15</sup> inadequate assessment of anatomic landmarks,<sup>15</sup> physical characteristics of the patient, patient position on the operating table,<sup>16-18</sup> and incorrect technique on insertion of the Veress needle with failure to perform the appropriate techniques to confirm proper needle position. Proper preoperative and intraoperative evaluation of the patient, supported by proper training to improve surgical skills and a good knowledge and usage of instrumentation used in laparoscopic surgery, are key to minimizing entry-related injuries.

In our study we specifically assessed the validity and efficacy of a single novel technique, which we called the Pulsatile test. Our data demonstrate that the Pulsatile test is reliable in determining both the correct and incorrect position of the Veress needle, at least in this low-risk group. It can be an additional tool to the various tests used to avoid iatrogenic injury in closed laparoscopic surgery.

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