

# Effect of body habitus and parity on the initial Veres intraperitoneal CO<sub>2</sub> insufflation pressure during laparoscopic access in women

Angelos G. Vilos, BSc, George A. Vilos, MD, Basim Abu-Rafea, MD, Jackie Hollett-Caines, MD, and Mohammad Al-Omran, MD

From the St. Joseph's Health Care Department of Obstetrics and Gynecology, The University of Western Ontario (Mr. Vilos, and Drs. Vilos, Abu-Rafea, and Hollett-Caines), London, Ontario, Canada and the Department of Surgery, University of Toronto (Dr. Al-Omran), Toronto, Ontario, Canada.

## KEYWORDS:

Laparoscopy;  
Access;  
Pneumoperitoneum;  
Body habitus;  
Body weight;  
Parity

## Abstract

**STUDY OBJECTIVES:** Since most gynecologists use the Veres/trocar entry, and because the Veres intraperitoneal (VIP) pressure appears to be the most reliable indicator of correct Veres needle placement, the objective of this study was to determine the effect of height, weight, body mass index (BMI), parity, and age on the initial Veres intraperitoneal CO<sub>2</sub> insufflation pressure during laparoscopic access in women.

**DESIGN:** Prospective observational cohort study (Canadian Task Force classification II-1).

**SETTING:** University affiliated teaching hospital.

**PATIENTS:** We prospectively collected data on 356 women undergoing laparoscopy for a variety of indications by the senior author (G.A.V.). The median and (range) for height, weight, BMI, parity, and age were 1.64 m (1.45–1.85 m), 65 kg (40–120 kg), 24.3 kg/m<sup>2</sup> (16–47 kg/m<sup>2</sup>), 1 (0–5) and 34 years (18–87 yrs), respectively.

**INTERVENTION:** Under general endotracheal anesthesia including muscle relaxants and with the patient in appropriate stirrups in the horizontal position, a nondisposable Veres needle was inserted at the umbilicus or left upper quadrant (Palmer's point) with CO<sub>2</sub> flowing at 1 L/min. The initial Veres intraperitoneal insufflation pressure was recorded once the Veres needle was believed to be in the peritoneal cavity.

**MEASUREMENTS AND MAIN RESULTS:** The mode and the median VIP pressure was 4 mm Hg with a range of 2 to 10 mm Hg. With multivariate analysis, the VIP pressure correlated positively with the weight ( $r = 0.518$ ,  $p < .001$ ) and BMI ( $r = 0.545$ ,  $p < .001$ ) and negatively with the parity ( $r = -0.179$ ,  $p < .001$ ) of women. The correlation of the VIP pressure with height and age was  $r = 0.029$  ( $p = .591$ ) and  $r = -0.044$  ( $p = .411$ ), respectively.

**CONCLUSION:** A VIP pressure  $\leq 10$  mm Hg indicates intraperitoneal placement of the Veres needle. The VIP pressure correlates positively with the weight and BMI and negatively with the parity of women. There is no correlation of the VIP pressure with women's height and age.

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Corresponding author: Dr. George A. Vilos, Department of Obstetrics and Gynecology, St. Joseph's Health Care, 268 Grosvenor St, London, Ontario, Canada N6A 4V2.

E-mail: george.vilos@sjhc.london.on.ca

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There is clear evidence that laparoscopic surgery provides significant benefits compared with laparotomy for patients, providers, and surgeons.<sup>1</sup> Furthermore, a meta-analysis of 27 randomized controlled trials that compared laparoscopy and laparotomy for benign gynecologic procedures concluded that the risk of minor complications after gynecologic surgery is 40% lower with laparoscopy than with laparotomy, although the risks of major complications are similar.<sup>2</sup> The overall risk for any complication was 8.9% with laparoscopy, compared with 15.2% with laparotomy<sup>2</sup> (RR 0.6, CI 0.5-0.7) Therefore laparoscopy is safer and more beneficial than laparotomy.

One study reviewed 15 publications including 1 549 360 patients undergoing laparoscopy and reported an overall complication rate ranging from 0.2% to 10.3%.<sup>3</sup> It has been established that more than 50% of laparoscopic complications occur during the initial entry into the abdomen; most of which are due to the umbilical trocar.<sup>3-7</sup> This complication rate has remained the same during the last 25 years.<sup>7</sup> Major entry-related complications include bowel and major vessel injuries occurring at rates of 0.04% to 0.5% and 0.01% to 1.0%, respectively.<sup>3,7-11</sup> Entry-related complications carry significant morbidity and mortality rates<sup>8</sup> and frequently lead to malpractice litigation.<sup>12-14</sup>

To minimize entry-related injuries, several techniques and instruments have been explored and reviewed.<sup>7-11,15,16</sup> It has been shown that all modes of entry cause injury, and there is no clear evidence as to the optimal method of laparoscopic entry in the patient at low risk.<sup>1,8,10</sup>

Among gynecologists, the Veres needle-pneumoperitoneum-trocar insertion, so-called "classic" or "closed-entry technique," remains the most commonly used method.<sup>7,8,14,16-20</sup> During the closed-entry technique the 2 key steps of successful laparoscopy are (1) correct intraperitoneal placement of the Veres needle and (2) avoidance of injury with the primary trocar.<sup>21-26</sup> In fact, one study reported that the initial gas pressure ( $\leq 9$  mm Hg) was the only valuable measure reflecting correct intraperitoneal placement of the Veres needle.<sup>23</sup> The use of initial Veres intraperitoneal insufflation pressure (VIP pressure),  $<10$  mm Hg, indicating correct placement of the Veres needle, has been proposed by several authors.<sup>23-28</sup> Since most gynecologists practice the use of the Veres/trocar entry technique, and since the VIP pressure is the most reliable indicator of correct Veres needle placement, the objective of this study was to determine the effect, of height, weight, body mass index (BMI), parity and age of women on the VIP pressure during laparoscopic access.

## Materials and methods

This is a prospective observational study. Operative laparoscopy was performed for various indications on 365 con-

**Table 1** Median and range of patient characteristics (n = 365)

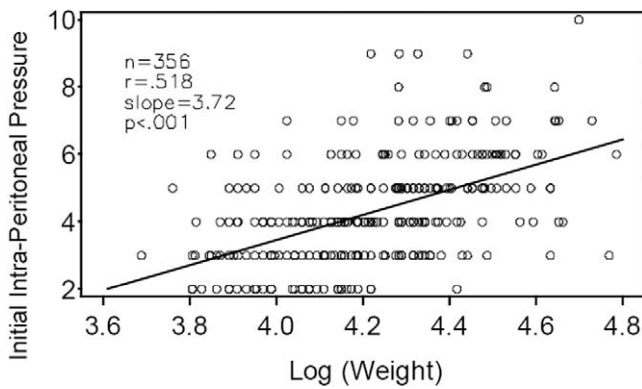
Variable	Median	Range
Age (yrs)	34	18-87
Height (m)	1.64	1.45-1.85
Weight (kg)	65	40-120
BMI (kg/m <sup>2</sup> )	24.3	16.3-46.9
Parity	1	0-5

secutive healthy women by the senior author (G.A.V.) over a period of 18 months. The median and range of patient characteristics are shown in Table 1.

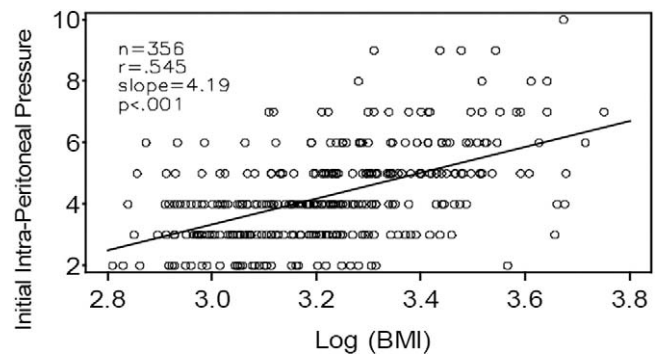
All patients underwent surgery under general endotracheal anesthesia including muscle relaxants, in appropriate stirrups, and in the dorsolithotomy position. With patients horizontal, a nondisposable Veres needle (Karl Storz, Tuttlingen, Germany, 1.7-mm outside diameter) was first tested for proper function under CO<sub>2</sub> flow of 1 L/min open to room air (pressure 0 mm Hg).

Before the insertion of the Veres needle, the pressure on the insufflator was set at 15 mm Hg. The Veres was then inserted infraumbilically or at the left upper quadrant (Palmer's point) into the abdomen under continuous flow of at least 1 L/min. The insufflation pressure was recorded from a Storz insufflator as the needle traversed slowly various layers of the abdominal wall (fat, fascia-muscle, preperitoneal space). Pressures through the various abdominal wall layers have been previously published.<sup>21</sup> The anatomy under the umbilicus was palpated, and in thin patients the umbilicus was elevated, pulled caudally, and stabilized by hand concomitantly with needle insertion. In obese women the Veres needle was inserted at 45 to 90 degrees to the horizontal plane. In the initial 259 patients, the initial intraperitoneal pressure was  $\leq 8$  mm Hg. In the subsequent 97 patients, we measured initial pressures of 9 mm Hg in 4 women with BMI  $> 30$  kg/m<sup>2</sup> and 10 mm Hg in 1 woman with a BMI of 45 kg/m<sup>2</sup>. When the initial pressure was noted to be stable at  $\leq 10$  mm Hg, the pressure on the insufflator was reset at 25 to 30 mm Hg from the initially setting of 15 mm Hg. Although the insufflation rate was set at maximum on the insufflator (up to 30 L/min), the CO<sub>2</sub> flow rate never exceeded 2.5 L/min because it was limited by the Veres needle dimensions.

If the initial intraperitoneal pressure was  $>10$  mm Hg, the Veres needle was slowly withdrawn, and if the pressure did not drop below 10 mm Hg, it was completely withdrawn and reinserted at a different angle and/or site. After three failed attempts the Veres needle was inserted at the left upper quadrant following the same pressures as described above. After 1 to 2 L of insufflated CO<sub>2</sub>, pneumoperitoneum was confirmed by quick depression of the left or right lower quadrant abdominal wall using one's extended fingers. This succussion splash has been previously described,<sup>21</sup> and it is invariably present in all patients confirming correct placement of the Veres needle.



**Figure 1** Scatterplot and correlation coefficient of initial VIP pressure (mm Hg) and weight (kg) of women.



**Figure 2** Scatterplot and correlation coefficient of initial VIP pressure (mm Hg) and BMI (kg/m<sup>2</sup>) of women.

At a preset pressure of 25 mm Hg (n = 259) or 30 mm Hg (n = 97), the primary trocar was inserted at the same site, following roughly the same direction and angle of the Veres needle, as previously described.<sup>21</sup> In 50 of the latter 97 women, randomly allocated, entry was achieved using the EndoTIP trocarless cannula (Karl Storz, Tuttingen, Germany) under direct vision after CO<sub>2</sub> insufflation.<sup>29</sup>

After visual confirmation of safe entry, the pressure was immediately reduced to the standard operating pressure of 15 mm Hg before the patient was placed in the Trendelenburg position.<sup>30</sup> Results were analyzed using descriptive statistics and multivariate regression using the SAS software package (SAS Institute Inc., Cary, NC).

**Results**

The number of Veres needle attempts was recorded in 324 women. Pneumoperitoneum was established after one, two, and three attempts at the umbilical site in 267 (82.4%), 35 (10.9%), and 13 (4.0%) women, respectively. In seven women (2.2%) pneumoperitoneum was established at the left upper quadrant during a fourth attempt, and in two women laparoscopy was abandoned for failure to establish pneumoperitoneum after a second attempt at the left upper quadrant. No postoperative complications were noted in these patients.

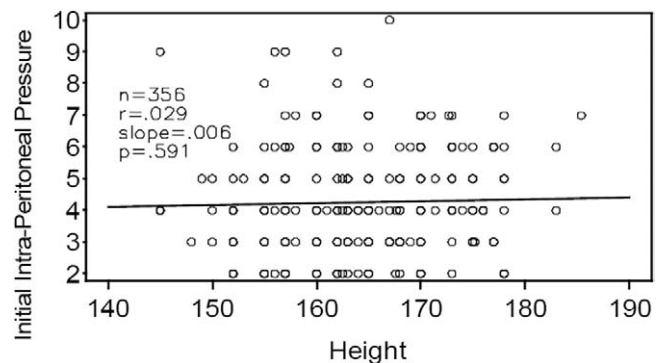
The median of the VIP pressure was 4 mm Hg, with a range of 2 to 10 mm Hg. Initial intraabdominal pressures and patient statistics in the first 259 women were previously published.<sup>21</sup>

Multivariate regression analysis of the VIP pressure and patient statistics from 356 women demonstrated the following: There was a positive correlation between the VIP pressure and the women’s weight and BMI (Figure 1, r = 0.518, p < .001, and Figure 2, r = 0.545, p < .001, respectively); there was no correlation between the VIP pressure and the women’s height (r = .029, p = .591, Figure 3); the VIP pressure correlated negatively with the

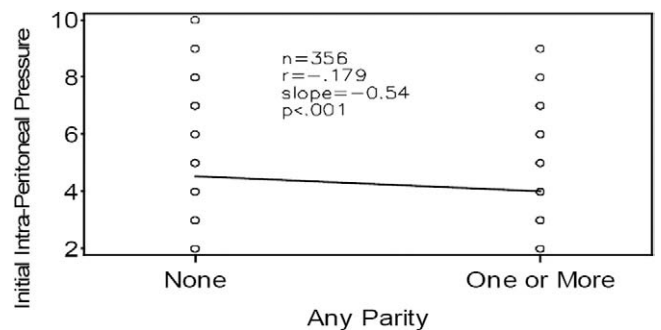
women’s parity (Figure 4, r = -0.179, p < .001); and there was no correlation between the VIP pressure and women’s age (Figure 5, r = -0.044, p = .411).

**Discussion**

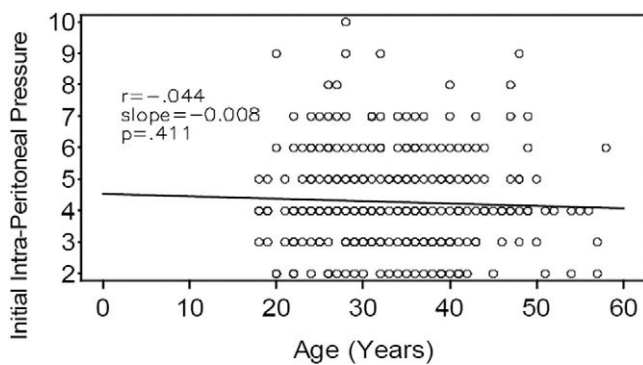
There are at least eight techniques and variations (four blind and four visual entry) to achieve access into the abdomen for laparoscopic surgery. This is a testament that the foolproof method remains elusive and no one method is superior to the others in avoiding entry-related injuries.<sup>1,7-11,15</sup>



**Figure 3** Scatterplot and correlation coefficient of initial VIP pressure (mm Hg) and height (cm) of women.



**Figure 4** Correlation coefficient of initial VIP pressure (mm Hg) and parity of women.



**Figure 5** Scatterplot and correlation coefficient of initial VIP pressure (mm Hg) and age (years) of women.

There is evidence that most gynecologists, worldwide, use the Veres/trocar so-called “closed” or “classic” entry technique.<sup>7,8,14,16–20</sup> One study reported on complications of laparoscopy based on a questionnaire analysis of members of the Dutch Society for Gynecological Endoscopy and Minimal Invasive Surgery combined with a MEDLINE literature search from 1975 through 2002. The authors concluded: “In contrast to published data of general surgeons’ findings, the number of entry-related complications in the open technique was significantly higher than the closed-entry technique. There is no evidence to abandon the closed-entry technique in laparoscopy. However, the selection of patients for an open- or alternative-entry procedure is still recommended.”<sup>7</sup>

During the closed-entry technique, both the Veres needle and the primary trocar have been implicated in causing injuries.<sup>6,8,12,31,32</sup> In general, needle-related injuries are rare and account for less than 20% of cases,<sup>8,10,12–14,33,34</sup> with an estimated incidence of 0.05 and 0.17 (range 0.03–0.04) per 1000 cases for vascular and visceral complications, respectively.<sup>6,10,34–37</sup> Although Veres needle injuries are infrequent, significant morbidity and even deaths have been reported.<sup>38–40</sup> It has been reported that Veres needle punctures to the bowel are less significant and may require no treatment whereas punctures to major vessels are significant but less catastrophic when compared with larger trocar-induced punctures and lacerations.<sup>21,27,41</sup>

Extraperitoneal insufflation is one of the most frequent complications of the closed-entry technique.<sup>42,43</sup> After three or more attempts to achieve pneumoperitoneum, the procedure is usually abandoned since further attempts are frequently futile and are associated with significantly higher frequency of complications.<sup>23,28</sup> We have previously reported the Veres needle insufflation pressure may be used as an interactive guide as it traverses the various layers of the abdominal wall. In this study we confirmed our previous findings<sup>21</sup> and those reported by others<sup>23,27,28,40</sup> that an initial Veres needle pressure  $\leq 10$  indicates intraperitoneal placement. In our practice when the VIP pressure is  $> 10$  mm Hg, the Veres needle is slowly withdrawn rather than being waggled from side to side. If the VIP pressure does not drop below 10 mm Hg, we reinsert it at a different angle,

and after three attempts we insert it at the left upper quadrant. In this study, we abandoned insufflation in only two women with VIP pressure  $> 10$  mm Hg. These women were known to have extensive intraperitoneal adhesions, and even the open technique failed to gain access into the abdomen.

It has been suggested that the very thin and obese patients are at a higher risk during laparoscopy.<sup>41</sup> However, evidence to support this notion is limited.<sup>44</sup> One study reported on 138 laparoscopies in women (weighing 250–400 lb). The failure rates to establish pneumoperitoneum was 28.6% for open laparoscopy, 13.9% for transumbilical Veres insertion, 8.3% for subcostal insertion, and 3.6% for transuterine Veres insufflation.<sup>45</sup> In contrast, another study found that women with BMIs greater than the median (23.0 kg/m<sup>2</sup>) were 60% less likely to have operative injuries than women with BMIs less than the median.<sup>46</sup> However, the study did not separate the injuries into entry related from those occurring during surgery. Following the VIP pressure  $\leq 10$  as an interactive guide to determine intraperitoneal placement, we did not have any insufflation failures in obese women (weight up to 120 kg).

One study reported that women 35 years or older had five times the risk of operative injuries or bleeding than women less than 35 years of age, whereas parity had no significant effect on the risk of operative complications or conversions to laparotomy.<sup>46</sup> We found no correlation of the VIP pressure with the age of women and negative correlation with women’s parity. We did not find any correlation between risk of operative injuries and body habitus, age, and parity in our group of women. The negative correlation with parity, most likely, reflects decreased abdominal wall tone whereas the positive correlation with weight and BMI reflects the weight of the abdominal panus.

Since the Veres needle insufflation access is practiced by most gynecologists, efforts to increase its safety by modifying the Veres needle or its insertion into the peritoneal cavity have been explored. Such modifications include a pressure sensor-equipped Veres needle<sup>47</sup> and at least two, so-called “optical Veres” needles.<sup>48</sup> Variations in the location or insertion of the Veres needle include transuterine,<sup>45,49</sup> Palmer’s point,<sup>50</sup> the left ninth intercostal space,<sup>51,52</sup> and finally intraumbilically after the umbilicus is lifted by towel clips.<sup>53</sup> Serious complications with the above-mentioned techniques have been reported.<sup>54</sup>

The safety tests used to determine correct intraperitoneal placement are not always reliable.<sup>23</sup> It is of interest to note that in malpractice litigation, experts frequently raise the issue whether any or all of these safety checks were carried out. It must be emphasized that absence of these tests can no longer be considered as substandard care or negligence since the literature clearly indicates that these tests provide no useful information and that the VIP pressure is the most reliable indicator of correct intraperitoneal placement of Veres needle.



## Conclusions

An initial intraperitoneal insufflation pressure  $\leq 10$  mm Hg indicates correct intraperitoneal placement of the Veres needle. The VIP pressure correlates positively with the patients' weight and BMI and negatively with parity. There is no correlation between the VIP pressure and the women's height and age.

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