


# Systematic review and meta-analysis of Veress needle entry versus direct trocar entry in gynecologic surgery

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## ABSTRACT

**Objective** Although many studies have been performed, no consensus exists as to the ideal entry for laparoscopic gynecologic surgery. We sought out to compare the safety of direct trocar insertion with that of the Veress needle entry technique in gynecologic laparoscopic surgery.

**Design** Systematic review with meta-analysis.

**Setting** We searched Medline, ClinicalTrials.gov, PubMed, Cochrane CENTRAL, SCOPUS, and Web of Science from their inception through 31 July 2021 for relevant studies. We included only controlled trials and ultimately seven trials were included in our meta-analysis.

**Participants** Inclusion criteria included women undergoing gynecological laparoscopic surgery.

**Intervention** The intervention of direct trocar insertion technique compared with Veress needle entry technique.

**Main outcome measures** We compared five different outcomes associated with the efficacy and complications of laparoscopic entry.

**Results** The pooled analysis showed that Veress needle entry was associated with a significant increase in the incidences of extraperitoneal insufflation (RR=0.177, 95% CI (0.094 to 0.333),  $p<0.001$ ), omental injury (RR=0.418, 95% CI (0.195 to 0.896),  $p<0.001$ ), failed entry (RR=0.173, 95% CI (0.102 to 0.292),  $p<0.001$ ), and trocar site infection (RR=0.404, 95% CI (0.180 to 0.909),  $p<0.029$ ). There was no significant difference between the two groups regarding the visceral injury (RR=0.562, 95% CI (0.047 to 6.676),  $p<0.648$ ).

**Conclusions** When excluding all data apart from gynecologic surgery, the Veress needle entry technique may have an increased incidence of some, but not all complications of laparoscopic entry. It may also have a higher incidence of failed entry compared with direct entry techniques. Care should be taken in extrapolating these general results to specific surgeon experience levels.

**Trial registration number** CRD42021273726

## INTRODUCTION

Laparoscopic surgery is a recent diagnostic and therapeutic technique to treat different gynecologic pathologies.<sup>1</sup> Laparoscopy can be used to treat many gynecologic conditions, including ovarian, uterine, and fallopian tube pathology and to perform hysterectomy. It may be used in cases of abdominal pain with

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Veress needle and direct trocar entry are two commonly used techniques for entering the abdomen to begin laparoscopic gynecologic surgery. Although both techniques are widely used, there is no consensus as to which technique may be superior.

## WHAT THIS STUDY ADDS

⇒ Our meta-analysis shows that Veress needle entry may be associated with a higher rate of some complications and more failed entries.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE, OR POLICY

⇒ Although unlikely to warrant changes in the practices of experienced surgeons, this data may be of value to residency program staff and other teaching surgeons when deciding how to instruct fledgling gynecologic surgeons.

unknown origin or other different diseases to diagnose and classify the various gynecological pathologies.<sup>2</sup> Advantages of laparoscopy such as shorter hospital stay, less postoperative pain and blood loss, and improved recovery lead surgeons to favor laparoscopic surgery in many cases over standard open surgery.<sup>3</sup> In addition, it is known that there is up to a 40% reduction in the incidence of complications with laparoscopy compared with standard open surgery.<sup>1</sup> The incidence of laparoscopic complications, including visceral and vessel injuries, ranges from 0.4% to 3%.<sup>4</sup> It has been noted that there is an increase in the frequency of complications in cases of complex surgery, obese patients or prior abdominal surgery.<sup>5,6</sup>

The first and arguably most important critical step in the laparoscopic procedure is the insertion of surgical instruments through small abdominal incisions and the creation of pneumoperitoneum.<sup>7,8</sup> In this first step, trocar insertion accounts for about 40% of all laparoscopic complications and fatalities.<sup>9</sup>

These complications may result in perforation of the bowel or bleeding from major vessel injury. There are various entry techniques, such as direct trocar insertion (DTI), Veress needle (VN) entry, optical trocar, and open laparoscopy. DTI and VN are the two most common and widely used methods for laparoscopic needle entry in the abdominal wall.<sup>10</sup> Both techniques have generally favorable complication profiles. Possible complications for both DTI and VN include surgical site infection, omental injury or extraperitoneal insufflation.<sup>11</sup> Recent studies have suggested that DTI is safer and faster than the VN entry technique, but the largest meta analyses to date have not found clinical significance between these two techniques.<sup>12-14</sup>

While many analyses have examined the data relating to laparoscopic entry in detail, In this study, we aim to be the first to compare the DTI technique with VN technique using all controlled trials that have included only gynecologic surgeries.

## METHODS

This meta-analysis was performed in strict accordance to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)<sup>15</sup> and the guidelines reported in the Cochrane Handbook for Systematic Reviews of Interventions.<sup>16</sup>

### Eligibility criteria

The inclusion criteria were the following: female patients undergoing gynecological laparoscopic surgery using the DTI technique or the VN entry technique. There were no restrictions on language. We included only controlled trials and their outcomes of extraperitoneal insufflation, failed entry, vascular injury, visceral injury, and omental injury. All secondary research, such as meta-analyses and reviews, were excluded along with all animal studies, conference abstracts, and incompletely reported studies. We also excluded any studies that expressly stated or otherwise seemed to include non-gynecologic surgeries in their data sets.

### Information sources

We searched Medline, ClinicalTrials.Gov, PubMed, Cochrane CENTRAL, SCOPUS, and Web of Science databases from their inception until 31 July 2021 for articles that matched our inclusion criteria.

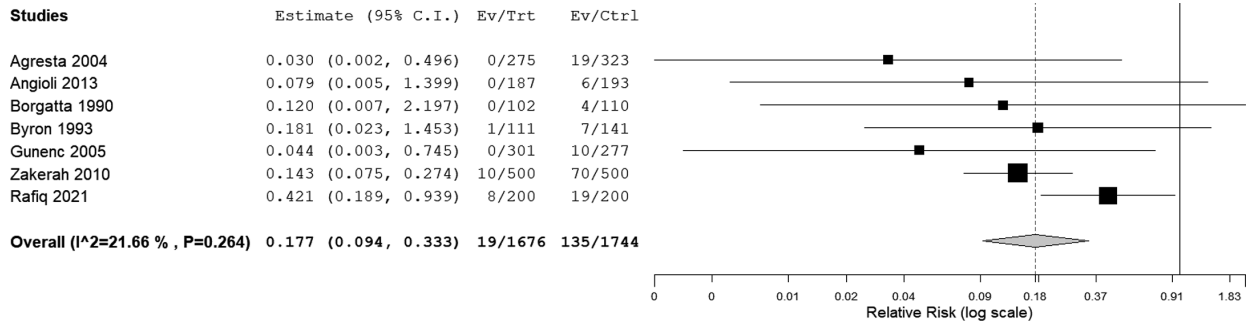
### Search and study selection

We used the following search strategy in our investigation: (Veress needle) OR (Veres needle) OR (pneumoperitoneum) AND (direct trocar insertion). We screened the included articles in three steps. The first step involved importing the results from electronic databases to an electronic spreadsheet using Endnote X V.8.0.1 (Build 1044). The second step was performed by two independent authors with a third author used to solve any conflict. This included a title and abstract screening of

**Table 1** Shows a detailed summary of the included participants, and their demographic data

Study	Year	Sample size		Age, years		BMI		Previous surgery		Laparoscopy		LAVH	
		DTI	Veress	DTI	Veress	DTI	Veress	DTI	Veress	DTI	Veress	DTI	Veress
Agresta et al <sup>20</sup>	2004	275	323	40.2±17.8	41.1±15.6	21.6±4.4	21.2±5.3	113 (41%)	156 (48%)	NR	NR	NR	NR
Angioli et al <sup>19</sup>	2013	187	193	36.1±10.5	33.9±10.3	22.8±6.0	25.1±5.6	NR	NR	31 (16%)	42 (21%)	30 (16%)	26 (13%)
Borgatta et al <sup>24</sup>	1990	102	110	35.6	36.4	26.3	27.3	38 (37%)	32 (29%)	NR	NR	NR	NR
Byron et al <sup>23</sup>	1993	111	141	NR	NR	NR	NR	31 (28%)	48 (34%)	NR	NR	NR	NR
Gunenc et al <sup>12</sup>	2005	277	301	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Zakherah <sup>22</sup>	2010	500	500	25.9±4.2	25.7±4.17	26.6±3.1	26.5±2.8	47 (29%)	53 (31%)	NR	NR	NR	NR
Rafiq et al <sup>21</sup>	2021	200	200	35.7±8.38	35.8±8.5	NR	NR	NR	NR	49 (24.5%)	56 (28%)	42 (21%)	50 (21%)

Data are reported as mean±SD or n (%) unless otherwise specified.  
BMI, body mass index; LAVH, laparoscopic assisted vaginal hysterectomy; NR, not reported.



**Figure 1** Shows a Forest plot of the incidence of extraperitoneal insufflation.

the articles imported to the Excel sheet. The third step was the full-text screening of the included citations from step 2. Additionally, we manually searched the references of the included papers for possible missed studies.

**Data collection**

We collected three categories of data from each included study. The first category was the baseline and demographic characteristics of the included participants, such as the author, year, sample size, age, body mass index (BMI), kg/m<sup>2</sup>, previous operations, and type of surgery performed. The second category included the outcomes of analysis, focusing on extraperitoneal insufflation, failed entry, vascular injury, visceral and omental injury, solid organ injury, and trocar site infection. The third category included data for the risk of bias assessment. The process of data collection was done using an electronic spreadsheet.

**Risk of bias assessment**

Since only controlled trials were included, we evaluated the quality of this systematic review and meta-analysis using the Cochrane Risk of Bias tool.<sup>17</sup> The tool depends on seven domains for assessment of the risk of bias: (1) randomization, (2) blinding allocation of the patients into each group, (3) blinding of patients and personnel, (4) attrition bias, (5) selection bias, (6) awareness of the outcome assessor and (7) other bias. Finally, we extracted the total risk of bias for these studies.

**Analysis**

We performed the meta-analysis of this study using open meta-analyst software. Our study included dichotomous outcomes and we analyzed the dichotomous data using

risk ratio (RR) and 95% CI. The fixed-effects model was used when data were homogeneous, while heterogeneous data were analyzed under a random-effects model. To measure the presence among the studies, we used the I<sup>2</sup> and the p value of the  $\chi^2$  tests.<sup>18</sup> Values of p<0.1 or I<sup>2</sup>>50% were significant indicators of the presence of heterogeneity.

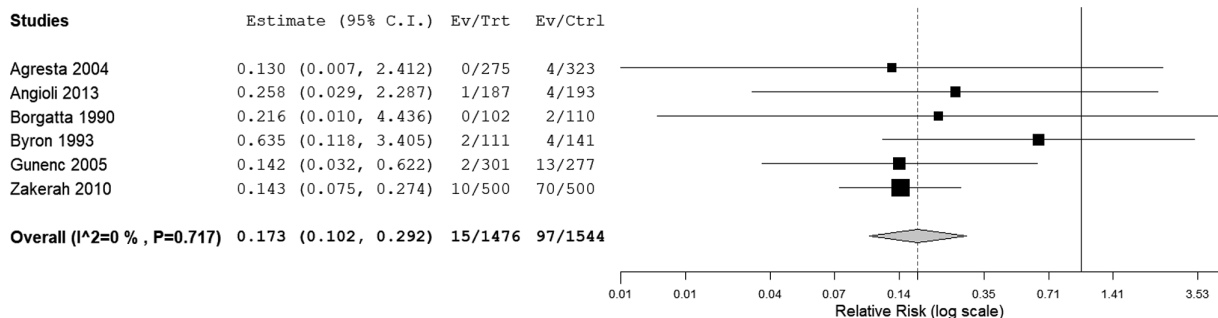
**RESULTS**

**Summary of included studies**

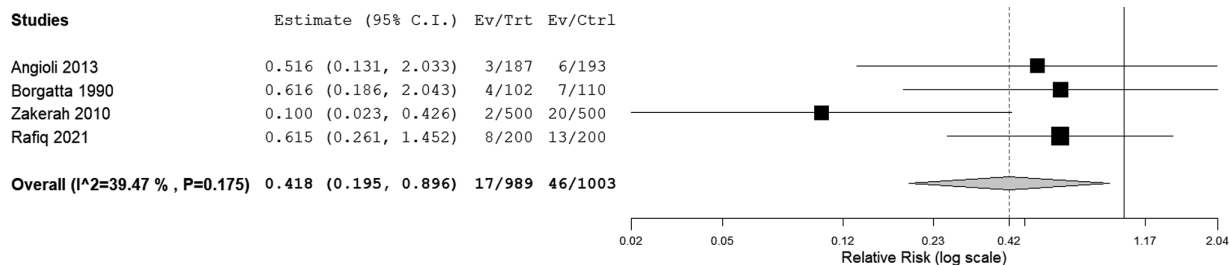
The PRISMA flow diagram in online supplemental figure 1 shows the included studies of our literature search. In our study, we performed an analysis of data from patients of seven different studies.<sup>12 19–24</sup> The total number of patients allocated to receive the DTI technique was 1652 patients. The number of patients allocated to the Veress needle group entry group was 1768 patients. The mean age of the DTI group was 34.6±7.7 years, while that of the Veress needle group was 34.4±6.8. A summary of the participants and their demographic data, including pregnancy BMI, previous operations, and current operation performed, is shown in table 1.

**Results of risk of bias assessment**

The result of the risk of bias assessment of the randomized controlled trials yielded an overall low risk of bias, according to Cochrane’s tool. According to randomization, four studies<sup>19 21–23</sup> were at low risk and three studies<sup>12 20 24</sup> reported inadequate data relating to randomization. According to allocation concealment, three studies<sup>19 20 22</sup> were at low risk, and four studies<sup>12 21 23 24</sup> reported inadequate data. One study<sup>23</sup> was blinded to



**Figure 2** Shows a Forest plot of the incidence of failed abdominal entry.



**Figure 3** Shows a Forest plot of the incidence of omental injury.

the participants and personnel and six studies<sup>12 19–22 24</sup> reported inadequate to determine. All seven studies<sup>12 19–24</sup> were blinded to outcome assessment. The remaining domains of the Cochrane tool were at low risk of bias for all studies. A summary of the risk of bias of all included trials is demonstrated in online supplemental figure 2.

### Analysis of outcomes

#### 1. Extraperitoneal insufflation

All the included trials reported data on extraperitoneal insufflation.<sup>12 19–24</sup> The pooled analysis showed that the rate of extraperitoneal insufflation was higher in the Veress needle entry group compared with the direct access entry group (RR 0.177 95% CI (0.094 to 0.333),  $p < 0.001$ ). The analysis of included studies was homogenous ( $I^2 = 21.656\%$ ,  $p = 0.264$ ), as shown in figure 1.

#### 2. Failed entry

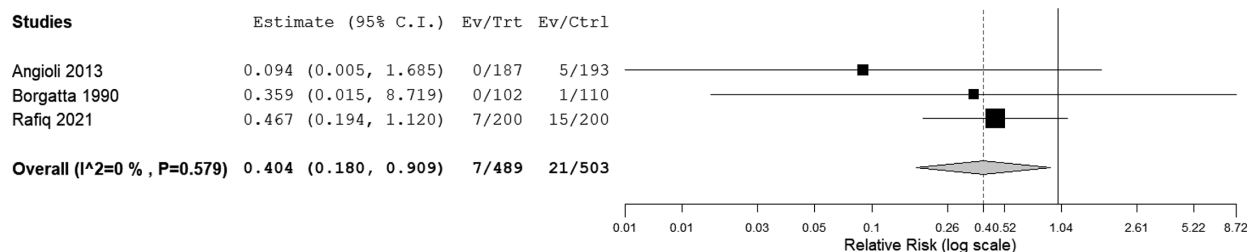
Six studies reported the rate of failed entry as an outcome.<sup>12 19 20 22 24</sup> Failed entry was significantly higher in the Veress needle group compared with the direct access entry group (RR 0.173 95% CI (0.102 to 0.292),  $p < 0.001$ ). The pooled analysis was homogenous ( $I^2 = 0\%$ ,  $p = 0.717$ ), as shown in figure 2.

#### 3. Omental injury

Four studies<sup>19 21 22 24</sup> reported the omental injury outcome. The data showed a marked increase in the incidence of omental injury in the Veress needle group (RR 0.418 95% CI (0.195 to 0.896),  $p < 0.001$ ). The pooled analysis was homogenous ( $I^2 = 39.472\%$ ,  $p = 0.175$ ), as shown in figure 3.

#### 4. Trocar site infection

Trocar site infection was reported by three studies.<sup>19 21 24</sup> The incidence of site infection was significantly higher in the Veress needle group (RR 0.404 95% CI (0.180 to 0.909),  $p < 0.029$ ). The pooled analysis of included studies was homogenous ( $I^2 = 0\%$ ,  $p = 0.579$ ), as shown in figure 4.



**Figure 4** Shows a Forest plot of the incidence of trocar site infection.

#### 5. Visceral injury

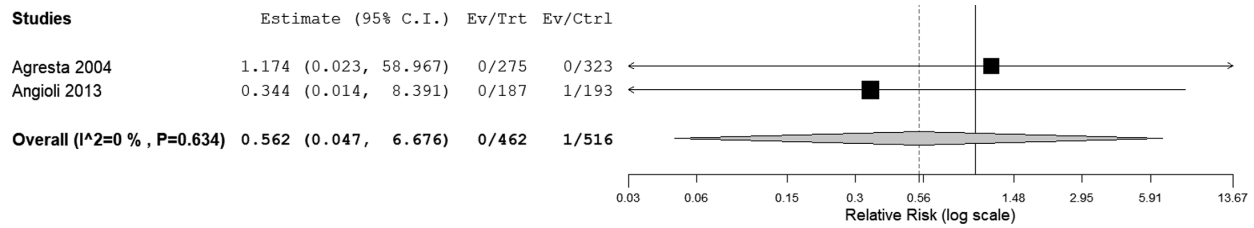
The visceral injury rate was only reported by two studies.<sup>19 20</sup> The pooled analysis showed no difference between both groups (RR 0.562 95% CI (0.047 to 6.676),  $p < 0.648$ ). The pooled analysis was homogenous ( $I^2 = 0\%$ ,  $p = 0.634$ ), as shown in figure 5D.

### DISCUSSION

We present a meta-analysis comparing Veress needle entry with direct trocar entry in gynecologic surgery. Our results demonstrate that the use of Veress needle entry is associated with a significantly higher incidence of extraperitoneal insufflation compared with direct trocar entry. Veress needle has significantly higher incidences of complications, including failed entry, omental injury, and insertion site infection. These results demonstrate that there is no difference between both groups regarding visceral injury.

The small diameter of the Veress needle contributed to the hypothesis that the Veress needle could have a less significant injury to intra-abdominal structures, such as blood vessels and bowel.<sup>25</sup> However, this meta-analysis revealed that the Veress needle actually may have an association with higher risk of omental and vessel injury in addition to a higher incidence of failed entry. Ultimately, injuries to major vessels at the time of laparoscopy are still a leading cause of death in laparoscopic surgeries.

In our assessment, incorrect placement of the needle seemed to be the major cause of these injuries.<sup>26</sup> In many discussions regarding the tests to determine the correct needle insertion, there seemed to be agreement that the ‘drop’ test (intra-abdominal pressure vs saline within the Veress needle) seemed to be the most reliable. Also, one author discussed how preoperative insufflation was associated with subsequent difficulty in primary trocar



**Figure 5** Shows a Forest plot of the incidence of visceral injury.

insertion as well as failed entry, which indicates that these two outcomes were likely related.<sup>27</sup>

One of the largest meta-analyses related to this topic was recently performed including 51 studies, with 134 917 patients in the Veress needle group and 16 739 patients in the direct trocar group. The study identified a total of 10 deaths. Although outnumbering the direct trocar group by about eight to one, the study still found that all entry-related deaths were in the Veress needle group. The other deaths were attributed to non-specified causes such as gas embolism.<sup>26</sup> Another study in 2021 performed an analysis of seven randomized trials, showing that the Veress needle carries a significant risk of minor complications and is associated with a high incidence of failed entry, which is consistent with our results.<sup>28</sup>

A Cochrane review was performed to compare the different laparoscopic entry techniques. This review included 57 randomized controlled trials with a total of 9865 patients undergoing laparoscopy. The study revealed that the DTI was associated with a significant reduction in failed entry compared with Veress needle. There was no significant difference between the two groups regarding the other minor complications.<sup>29</sup> The review also compared direct visualization entry versus Veress needle, but the evidence was insufficient to show a difference between the groups. Another meta-analysis by Merlin *et al* demonstrated that there is a reduced risk of minor complications in open entry compared with the Veress needle entry. This may be a reason why many authors have reported an increase in open laparoscopy technique in recent years.<sup>30</sup>

When observing the incidence of extraperitoneal insufflation, the 2013 trial by Angioli<sup>19</sup> *et al* demonstrated that this complication was reported more often following Veress needle entry. These conclusions match earlier findings by Günenç *et al* and Zakherah.<sup>12 22</sup> It was also found that both open entry and direct access entry were associated with fewer incidences of minor complications than Veress needle entry.<sup>19</sup> These findings were later corroborated by another study in an obese only population from Kassir *et al*.<sup>31</sup>

### Strengths

This study represents the most recent and conclusive evidence about the safety of direct access entry versus Veress needle entry for laparoscopy. We performed a large-scale analysis of all the recent published literature, including 3420 patients undergoing laparoscopic

surgery. In addition, we have included only controlled trials to ensure the most precise evidence according to Cochrane guidelines. Another strength of this analysis was the homogeneity between the measured outcomes, which eliminated the need to solve for heterogeneity in all outcomes.

### Limitations

Four of the included studies reported inadequate data about allocation concealment. Unclear allocation concealment in controlled trials may bias the results of subjectively determined outcomes in favor of a beneficial effect. Another limitation is that one study was blinded to the participants and personnel, while six studies did not report adequate data to determine blinding. Finally, our study did not consider surgeon experience or the learning curve involved in these techniques. As a result, our conclusions apply across the field generally and may not be applicable for individual experience groups, such as beginners or high-volume experts, for whom different complication rates may apply.

### CONCLUSION

Our meta-analysis aimed to provide high level evidence in the use of Veress needle laparoscopic entry in gynecologic surgery. It is the first to examine all controlled trials on this subject that pertained solely to gynecologic surgery. The results demonstrate that within gynecologic surgery, the Veress needle entry technique seems to have both a higher complication rate and a higher incidence of failed entry compared with direct trocar techniques. Although, care must be taken with interpreting this data as it may not be applicable to all subgroups of surgeon experience, ranging from trainee to expert.

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**Contributors** GJM and AM conceptualized the study, wrote the initial draft, and supervised work. TA, MG, JP, AC collected data, wrote the final draft, and assisted with production of figures and tables. AK, CC, SG, and AA analyzed the gathered data and performed the formal analysis using the meta-analysis software. GB, HU, and CM wrote the final draft and performed the requested revisions. GJM is responsible for the overall content as guarantor.

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**Competing interests** None declared.

**Patient and public involvement statement** Although we were influenced by the questions of our patients to theorize this analysis, no patients or members of the public were involved in the study as the protocols described in the Cochrane Manual and PRISMA and MOOSE checklists were meticulously followed.

**Patient consent for publication** Not applicable.

**Ethics approval** This Manuscript has been reviewed by the institutional IRB board at Marchand Institute and was found to be exempt from IRB review. (June 2021).

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** All data relevant to the study are included in the article or uploaded as supplementary information.

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