Brazilian Journal of Videoendoscopic Surgery

Original Article

Veress Needle Insertion in the Left Hypochondrium in Creation of the Pneumoperitoneum: Validation of the Technique, Value of Tests and Importance of Intraperitoneal Pressure and Volume of Gas Injected During Insufflations

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ABSTRACT

Objectives: To validate the efficacy of Veress needle insertion into the left hypochondrium, to evaluate the accuracy of the tests used to check the position of the needle, and to establish parameters for pressure and volume at different moments of insufflations. Methods: It was compared thirty-two patients who were punctured into the abdominal midline (ML group), to 30 patients into the left hypochondrium (LH group). Afterwards, 70 patients were also punctured in the left hypochondrium and, together with those of the LH group, comprised a total of 100 patients of the left hypochondrium (TLH) group. Tests were performed and considered positive when: organic material was aspirated in the aspiration test (AT) ; only a small amount of pressure was applied to inject the liquid in the injection test (IT); the injected liquid was not recovered in the recovery test (RT) ; drops drained quickly in the hanging drop test (HDT); pressure levels were 8 mmHg or lower in the initial intraperitoneal pressure test (IIPT). Sensitivity (S), specificity (SP), positive predictive value (PPV) and negative predictive value (NPV) were established for each test. Volume and pressure were recorded at every 20 seconds, until intraperitoneal pressure reached 12 mmHg. Pressure and volume values were correlated with predetermined moments of insufflations. Results: two failed attempts at creating pneumoperitoneum were observed in the ML group and three in the LH group. In the TLH group, ten failed attempts were observed. For the AT, S and PPV could not be determined, SP = 100% and NPV = 100%. For the IT, S = 100%, SP = 0%, PPV = 90%, and NPV could not be determined. For the RT and SDT, S = 100%, SP = 50%, PPV = 94.7% and NPV = 100%. For the IIPT, S, SP, PPV and NPV were 100%. Pressure and volume showed a strongly positive correlation with predetermined moments of insufflations (coefficient of explanation of 0.8011and 0.9604, respectively). Conclusions: Punctures in the left hypochondrium are effective. The tests assessed can guide surgeons. Values of pressure and volume at predetermined moments of insufflations can be predicted.

Key words: Laparoscopy, adverse effects. Surgical procedures, operative. Pneumoperitoneum, artificial. Punctures, adverse effects. Punctures, methods.

Bras. J. Video-Sur, 2008, v. 1, n. 1: 020-028

Accepted after revision: January, 11, 2008.

INTRODUCTION

The access to the peritoneal cavity is the most critical step of laparoscopy, in which the majority of severe transoperative complications occur[17]. Even though there is no consensus with regard to the best method of accessing the peritoneal cavity for creation of the pneumoperitoneum[17]; puncture with Veress needle is the most frequently used technique[16]. A study of 155.987 laparoscopic procedures was performed in which the Veress needle was used in 81%.

However, great vessels and abdominal viscera injuries may occur when Veress needle is blindly inserted into the abdomen before the insufflation[1]. In spite of being rare (prevalence of 0,05%)[24], major vascular injury caused by the Veress needle or by the primary trocar is the most frequent cause of death in laparoscopic procedures(15%)[1]. Additionally, it is difficult to diagnose this complication because of the retroperitoneal vessels position[22]. Under these conditions bleeding seldom occurs in the peritoneum and the retroperitoneal hematoma is not always visible.

The traditional site of the insertion of the Veress needle is the abdominal midline near the umbilicus and puncture is considered a risk due to the close proximity of the anterior abdominal wall to the retroperitoneal vascular structures, inasmuch in thin people, this distance can be less than 2 cm[1]. The abdominal aorta, inferior vena cava and iliac vessels are particularly prone to injuries during the insertion of the Veress needle close to the umbilicus[13]. Due to the great vessels localization, it is assumed that the risk of iatrogenic injury is minimized when the punctures are done away from the midline[20,23].

In addition to that, patients with previous abdominal surgery are at increased risk for visceral injury caused by the Veress needle due to peritoneal adhesions, which typically occur at the level of the scar where the surgical incision of the anterior parietal peritoneum is made[20]. Autopsy studies have found adhesions in 74% to 95% of patients with previous abdominal surgery[1]. Midline incisions present a high risk for adhesions in the umbilical region. Nonetheless, even abdominal incisions performed in a region not close to the umbilicus may be a cause of adhesion in the periumbilical region[1], as it was reported by Audebert and Gomel(2000) [4] who showed the frequency of peritoneal adhesions in the umbilical region and estimated possible risk for visceral lesions in case of insertion of instruments in 814 patients examined through minilaparoscopy of the left hypochondrium. Prevalence of adhesions at the umbilical region and the arbitrated possible risk in patients without previous abdominal surgery was of 0,68% and 0,42% respectively; 1,6% and 0,8% in previous laparoscopy; 19,8% and 6,87% in suprapubic horizontal laparotomy; and 51,7% and 31,46% in patients submitted to midline laparotomy.

On the other hand, puncture of the left hypochodrium have been reported as a safe procedure without a major iatrogenic risk[20,23]. The greater omentum, the stomach and the transverse colon are the closest anatomic structures to the anterior abdominal wall[5]. Small autolimited hematomas and tissular bullous emphysema which are promptly absorbed are the results of the accidental insertion of the needle followed by the insufflation of the greater omentum. The accidental perforation of the stomach by the Veress needle does not mean that its contents will necessarily leak considering the triple muscular layer of the stomach wall which usually obstructs the puncture hole. Additionally, gas extravasations through the orogastric tube contribute to accidental perforation suspicion. In order to minimize the risk for lesions in the colon, before the puncture patients are placed in 20 degrees inclined position to allow the movement of the segments of the large bowel (transverse colon and descending colon) to the inferior part of the abdomen, and therefore avoiding eventual punctures. Punctures caused by the Veress needle in the colon or stomach are easily diagnosed in the initial examination of the peritoneal cavity and puncture injuries may be sutured through laparoscopy.

Besides supporting argument of the left hypochondrium puncture is that peritoneal adhesions (a risk factor for iatrogenic lesions) seldom occur in the abdominal wall, because respiratory movement of the diaphragm constantly holds the left hypochondrium motile structures, thus making adhesions difficult to happen in the anterior abdominal wall site. For these reasons, left hypochondrium puncture is the best choice for some surgeons in patients with previous laparotomy[23].

There are surgeons that perform bariatric surgeries, and prefer the left hychondrium puncture for creation of pneumoperitoneum[29]. This preference is due to the fact that in obese patients midline puncture is a hazardous procedure considering the amount of intra-abdominal fat tissue which may obstruct the tip of the needle making difficult the insufflation control.

In obese patients there is an increased risk of lesions due to the fact that the position of the belly button in the abdomen[13] is higher than in non-obese patients causing a superposition of the puncture site at the umbilicus level to the intra-abdominal prominence of retroperitoneal great vessels.

It is important to notice that injuries caused by blind insertion of the Veress needle into the abdominal midline not only occur in the hands of inexperienced surgeons. Schafer et al.[28] (2001) verified that among 26 injuries analyzed only 4 of them (15%) were caused by inexperienced surgeons (surgeons who had performed fewer than 50 laparoscopic procedures); however 22 injuries (85%) had been caused by experienced surgeons (those who had performed between 51 and 100 laparoscopic procedures) or very experienced surgeons (over 100 laparoscopic procedures performed). In conclusion, it is important to emphasize that recently in a systematic literature review[2] it was established that all the retroperitoneal great vessels injuries by Veress needle were caused by midline puncture performed near to the umbilicus. There were any injuries caused by puncture in the left hypochondrium.

However, in spite of the advantages of the Veress needle insertion in the left hypochondrium in respect to the midline puncture safety there is not in the literature a study comparing the efficacy between the two approaches. Therefore, further researches are necessary in order to demonstrate the effectiveness of the left hypochondrium puncture towards gold standard procedure (midline puncture).

As well as the accuracy of the tests described in textbooks[9,15,18] regarding to intraperitoneal correct position of the tip of the needle after puncture and before insufflation was not properly determined.

On the other hand, objective data for surgeons during insufflation are that they should consider intraperitoneal pressure levels and the amount of volume injected each time of the insufflation and values may be associated or not to the tip of the Veress needle inside the intraperitoneal cavity. These researches have not been done in humans, but in pigs[3].

The objectives of this study are: to evaluate the efficacy of Veress needle insertion into the left hypochondrium – thus validating this technique, to investigate the accuracy of the tests used to check the position of the Veress needle in the peritoneal cavity before the insufflation, and to establish intraperitoneal pressure and the injected volume values at different moments of insufflations which will enable to indicate the correct position of the tip of the needle.

METHODS

This prospective and randomized clinical study was approved by the Research Ethics Committee of the Health Care Institute for the State Civil Servant (nº45/03), and by the Research Ethics Committee of the Federal University of São Paulo (nº1405/03).

A total of 132 non-obese - Body Mass Index (BMI) less than 30 –without previous peritonitis or peritoneal cavity surgery adult patients were included in this study. These patients were submitted to laparoscopic procedures at the Gastroenterology Surgical Service at Hospital do Servidor Público of São Paulo State. A Veress needle was inserted into the abdominal wall of the patients in order to create an artificial peritoneum through carbon dioxide insufflation.

The first 62 patients were randomly distributed in LH group (n=30) – left hypochondrium punctured, and ML group (n=32), midline abdominal puncture at umbilicus level. The two groups were equally distributed regarding to age, sex, BMI, height, weight and clinical condition (p> 0,05) what have motivated the programmed surgical intervention.

Afterwards, seventy consecutively scheduled patients were studied whom were punctured in the left hypochondrium and with the group LH (n=30) comprised the TLH – total left hypochondrium group (n=100).

The mean age in the TLH group was 53,7 years (± 13,1), ranging from 27 to 77 years old. There were 58 women and 42 men in the study. The mean body mass index (BMI) was 25,6 (± 2,4) – ranging from 20,6 to 29,7. There were 80 cholecystectomies, 9 Nissen fundoplication to treat gastroesophageal reflux disease and 11 inguinal hernioplasties.

Thirty minutes before the anesthesia 0,1mg/kg midazolan was administered. Induction of anesthesia was obtained with propofol 2mg/kg and 0,5mcg/kg of phentanyl, and for curatization 0,5mg/kg of atracurium was used. Patients were submitted to general anesthesia with orotracheal intubation and controlled mechanical ventilation. An orogastric probe was inserted thus the stomach contents was aspirated.

Patients placed in 20 degrees inclined position were puncture by a Veress needle in the umbilicus (ML group) or in the left hypochondrium (LH and TLH

groups). In the LH and TLH groups the Veress needle was perpendicularly inserted at the costal margin, 8 cm from the midline (figure 1). Four tests (aspiration, injection, recovery and hanging drop test) were performed to test the intraperitoneal needle positioning after puncture and before insufflation. These tests were considered positive: in the aspiration test when no organic material was aspirated; in the injection test when moderate resistance in the syringe was necessary to liquid flow; in the recovery test when the liquid injected was not recovered and in the hanging drop test when quick drop flow was observed. Following an initial intraperitoneal pressure test (IIPT) was performed with insufflator calibrated at 1,2L/min flow and maximum intraperitoneal pressure at 12mmHg, and the test was considered positive when equal or less 8mmHg in the first ten seconds.

In case of negative and evidence of IIPT preventing the creation of artificial pneumoperitoneum the whole procedure was considered a failure and the Veress needle removed from the abdominal wall. The procedure was then started over again. With positive IIPT, insufflation of carbon dioxide follows until pressure reached 12mmHg, thus the whole procedure was considered a success after the effective creation of artificial pneumoperitoneum was visually confirmed through the insertion of a laparoscope inside the peritoneal cavity. Failed attempts to place the tip of the Veress needle in the peritoneal cavity were recorded.

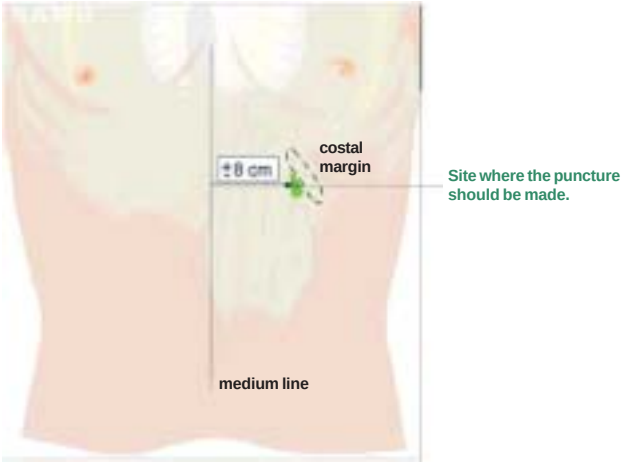

Figure 1 *- Schematic illustration of puncture in the left hypochondrium.*

Note the Veress needle puncture in the left hypochondrium. The instrument should be inserted perpendicularly to the anterior abdominal wall, at the costal margin, 8cm from the midline. Thus, the needle insertion will be distant from the retroperitoneal great vessels (abdominal aorta, inferior vena cava and primary iliac vessels) and from the superior abdominal wall vessels (superior epigastric vessels).

Considering all positive tests, insufflation of carbon dioxide proceeded, and variation of intra-abdominal pressure (IP) and the amount of injected volume (IV) were computed from zero and in each 20 seconds until maximum programmed IP (12mmHg) was reached at that moment the duration of insufflation was reached and registered insufflation time duration, results were compared between LH and ML groups.

In the TLH group the results were considered to obtain the sensibility (S) and the specificity (Sp) of each test that was evaluated as well as the positive predictive values (PPV) and the negative predictive values (NPV). From the independent variables (predetermined moments of insufflation – at 20 seconds intervals), it was also investigated the possibility to estimate dependent variables value (intraperitoneal pressure and amount of injected volume). Polynomial regression models of first, second and third degrees were applied and the best adjustment was determined through residual analysis and coefficient of determination (R^2). Intervals of 95% confidence level were considered to each model coefficient estimated. Qualitative variables were represented by absolute and relative frequencies, and quantitative variables were represented by mean, standard deviation, and minimum and maximum values. Student's t-test and Chi Square test were used to evaluate the homogeneity among the studied groups. The significance level considered was 0,05 (á=5%). The equivalence among the studied groups with respect to intraoperative and postoperative parameters was determined by confidence intervals ($CI_{95\%}$) that are shown to each parameter evaluated in each group. Intervals of 95% confidence level for means and proportions were considered by standard formulas for estimators with normal distribution. Polynomial regression models were applied in order to evaluate the distribution of intra-abdominal pressure and injected volume in the peritoneal cavity parameters regarding to time. The discrepancies (residual) between the values observed at each time and the ones adjusted by the model were studied in order to verify data sets adequacy. Quantities that could not be explained by the regression equation are the eventual discrepancies, as for the effect of the omission of external variables into the model or for the natural variability among individuals. It was investigated through this analysis

an eventual existence of extreme outliers capable to altering the estimated curves. It was also tested the adequacy of the models adjustment comparing to the previous hypothesis formulated in the adopted model. In the positive correlations, it was used the equation to estimate the IP and the IV which was subtracted from the regression curves in the first, second, third and fourth minutes of the duration of the insufflation, in order to establish trustworthy parameters to the dependent variables estimated values (pressure and volume) settled at different moments (independent variables).

RESULTS

Complications were not observed in the punctures performed during the research. The number of failed attempts to positioning the tip of the Veress needle correctly in the peritoneum was similar in the LM and HE groups. Regarding the require time to conclude the pneumoperitoneum(12mmHg) there was not significant statistical differences between the two groups. It was not observed variation between groups with regard to flow and the amount of volume injected during each moment of insufflation values of intraperitoneal pressure.

In the total left hypochondrium(TLH) group the maximum number of attempts to create the pneumoperitonum in each patient was two. Insufflation did not occur in undesired site. Among ten failed attempts half of them were identified either by the Recovery test (RT) or by the hanging drop test (HDT) and by the initial intraperitoneal pressure test (IIPT), and the other half was exclusively detected by the IIPT. Injury absence was correctly detected by the aspiration test. Resistance test was not able to detect any of the 10 failed attempts, and recovery test and hanging drop test was not able to detect 5 out of 10 failed punctures that afterwards were detected by the IIPT. In the AT, Sensitivity (S) and Positive Predictive Value (PPV) were not applied, Specificity (Sp) =100%, and Negative Predictive Value (NPV) = 100%. In the resistance test, S=100%, Sp=0%, PPV= 90% and NPV did not occur. In the recovery test and in the hanging drop test, S=100%, Sp=50%, PPV-94,7% and NPV=100%. In the initial intraperitoneal pressure test, S, Sp, PPV and NPV=100%. There was strong positive correlation of time of insufflations (coefficient of determination 0,8011 and 0,9604) and with pressure and volume. IP and IV estimation in certain moments of insufflation is expressed in the Table 1.

DISCUSSION

The creation of pneumoperitoneum by Veress needle insertion in the left hypochondrium[23] is an easy, quick and effective technique[6]. The primary trocar may be safely and efficiently inserted after the peritoneal cavity insufflation, and while the intraperitoneal pressure is at an adequate level to maintain the intra-abdominal structures distant from the anterior abdomen wall mainly from the retroperitoneal great vessels suppressing gas extravasations during surgery. After creation of pneumoperitoneum through peritoneotomy and insertion of Hasson's trocar[12] extravasations frequently occur. This is very important especially in obese patients[29].

The sites of Veress needle puncture described are the midline of the anterior wall at umbilicus level (considered as standard site [1,10,19]), left subcostal margin[10,23] at the 9th left intercostal space[8], a midpoint in the midline between the xiphoid appendix and the umbilicus[14], and a point identical to McBurney's point

Table 1 - *Intraperitoneal pressure values and injected volumes in preset moments of insufflation, using estimation models. Real means intraperitoneal pressure, estimated means of intraperitoneal pressure and standard deviation of TLH group.*

Time of observation (minutes)	Real Mean of Pressure(mmHg) and Standard deviation	Estimated mean of Pressure (mmHg)	Real Mean of Volume (L) and Standard deviation	Estimated mean of Volume (L)
1	4,34 (1,48)	4,15	1,11 (0,14)	1,12
2	6,05 (1,44)	6,27	2,18 (0,21)	2,07
3	8,44 (1,47)	8,36	3,13 (0,27)	3,01
4	10,43 (1,48)	10,10	3,87 (0,40)	3,95

at the left iliac fossa[10]. There are also reports of transvaginal access to peritoneal cavity through uterine fundus transfixation with the needle inserted into the cervical canal (transfundal technique) [26].

The existence of comparatives studies with alternatives techniques depicted concern with regard the blind insertion safety of the Veress needle into the midline.

In a randomized study, Santala e col. [26] compared the conventional method of midline periumbilical puncture to the transfundal technique; bleeding, infection or injuries of the pelvic organs did not occur. However, the transfundal technique is not indicated to patients with previous pelvic inflammatory disease and to the ones with possible pelvic peritoneal adhesions or infertility diagnoses.

Moreover, this procedure possible increases the risk of endometriosis and adenomyosis besides it is exclusive of female patients. It is also a concern to establish pneumoperitoneum in an injured organ.

Ostrzensky[25] (1999) accomplished a prospective, randomized and blinded study in 200 patients in which it was compared the conventional method of slightly oblique midline periumbilical puncture caudad to a technique in which the Veress needle was inserted forming a very sharp angle with anterior abdominal wall that was almost in parallel. The study did not report any differences between the two techniques effectiveness, thus the author emphasized the advantages of the alternative technique in order to prevent injuries to the retroperitoneal great vessels.

Palmer[8] described the Veress needle insertion into the left hypochondrium 3cm below the costal margin in the mid-clavicular line. Schwartz et col.[29] (2003) established pneumoperitoneum in 600 patients with morbid obesity by inserting the Veress needle into the left hypochondrium. There was a puncture injury in the muscular layer of the transverse colon which was sutured by laparoscopy. There was not perforation of any other hollow viscera, abnormal bleeding of the abdominal or visceral wall, nor even hepatic or splenic injury. Rothagi et col. [29] (2003) performed 344 punctures into the left hypochondrium occurring only two failed attempts. The only complication was a greater omentum hematoma, which was treated by expectant management. The authors conclude that puncture into the left hychondrium is effective for establishing pneumoperitoneum.

In the current research the puncture into the left hypochondrium described by Palmer[20] was modified, and it was established a point to the insertion of the needle 8cm from the abdominal midline in order to avoid the risk for injuries in the superior epigastric vessels[6].

Additionally, in this research the instrument was inserted at the inferior costal margin in order to take advantage of its fixation to the parietal peritoneum due to the cranial shift of the site of the needle insertion from the Palmer's point.

Considering that some surgeons usually perform abdominal midline puncture, they argue that the left hypochondrium technique is more difficult, therefore several attempts are necessary to accomplish it. However, this research depicted that comparing both techniques performed by experienced surgeons it was statistically equivalent regarding either the amount of time to reach pre-established intraperitoneal pressures or the number of successful or unsuccessful attempts to create pneumoperitoneum. Moreover, punctures were equivalent in both sites with regard to the needle positioning tests positive results, and to the progression of values of intraperitoneal pressure and injected volume. As the needle is placed into different sites of the abdomen (umbilicus region or left hypochondrium) there could have been discrepancies in regard to the evaluated parameters due to the abdomen anatomical topography which it did not occur, thus both techniques effectiveness were equivalent.

It should also be considered that in the left hychondriun puncture the Veress needle route is at a distance from the retroperitoneal great vessels and the superior epigastric vessels[6], therefore possible iatrogenic injury is unlikely to occur with puncture approach. Besides neither the small bowel lie beneath the site where the left hypochondrium puncture is performed, nor the normal-sized spleen or liver are in the Veress needle route. On the other hand, the stomach, the omenta and the colon are subjacent to the punctures site and they may be incidentally injured. Nevertheless, they are not considered major injuries and they are easily repaired[17].

As opposed to what occur in the umbilical region adhesions in the left hypochondrium are very rare; however, they may be observed in patients with previous splenectomy or colectomy who need mobilization of the splenic flexure of the colon.

Puncture into the left hypochondrium should not be performed in these patients.

Regarding the approach performed to create pneumoperitoneum with the Veress needle insertion, there is not an adequate evaluation concerning the accuracy of the tests performed to check the position of the tip of the needle in the peritoneum. Besides, there are studies in experimental animals but not in humans[3].

In this research the Resistance Test (RT), the Recovery Test(ReT), the Hanging Drop Test(HDT) and Initial Intraperitoneal Pressure Test(IIPT) were performed to check an appropriate position (tip of the needle into the peritoneal cavity) which was considered positive when through some observed evidences it was assumed that needle was in the correct position. When the tip of the needle was not in the peritoneal cavity these tests were considered negative.

On the other hand, Aspiration Test (AT) was performed to diagnose iatrogenic injuries at the onset of the puncture procedure, that is, AT was considered positive when the tip of the needle was inside the parenchymatous organ, the hollow viscus or the blood vessel which could be confirmed through fluids or organic tissues aspiration. The aspiration test has peculiar characteristics as it is performed to detect the presence or absence of iatrogenic injuries and not to check the correct position of the tip of the needle.

In order to grant a better credibility and accuracy to our conclusions and to provide a better evaluation of the tests, statistical and mathematical criteria were applied to our results. In order to detect the intraperitoneal position of the tip of the Veress needle, the ideal test is considered when positive indicates without a doubt exactly the tip of the needle inside the peritoneal cavity and when negative assures that it is not in the site. Therefore, all the tests were analyzed according to their sensibility (the ability to detect true positives), specificity (the ability to detect true negatives), positive predictive value (the probability of the correct position of needle among the positive results obtained) and negative predictive value (the probability of incorrect position of the needle among the negative results obtained).

Regarding ResT, RecT, SDT, IIPT, true positives were confirmed by inserting a laparoscope after pneumoperitoneum had been established which allowed the tip of the needle inside the peritoneal cavity to be visualized, while true negatives were confirmed either by the impossibility of creating pneumoperitoneum or by insufflation into an inadequate site.

As in this research there was not iatrogenic injuries the AT presented excellent specificity and NPV (100%); therefore, sensibility and PPV were not able to be calculated. In order to have an accurate evaluation of the aspiration a larger sample with the presence of iatrogenic injuries in this study would be necessary.

The ResT was not able to detect the incorrect position of the tip of the needle (Sp=0), due to the subjectivity of the test which depends on the ability of whom perform it. On the other hand it correctly detected when the tip of the needle is into the peritoneal cavity with 100% of sensibility. When the test was positive there was 90% (PPV) probability of the correct position of the tip of the needle. As there was not a negative test it was not possible to calculate the probability of the test being correct (NPV).

Either the RecT or the HDT accurately determined the correct position of the tip of needle in 100% of the cases (S). The correct position of the tip of the needle in 94,7% (PPV) of the cases were confirmed by the positivity of the test. These tests were only able to detect 50% (Sp) of the cases with regard to the wrong positioning of the needle. When tests were negatives there was 100% (NPV) probability for the tip of the needle to be placed outside the abdominal cavity.

The IIPT which is the most reliable tests among the ones studied accurately detect either the wrong or the correct position of the needle (100% sensibility, specificity, positive and negative predictive values).

During the creation of the pneumoperitoneum pre-determined moments of the insufflation were correlated to the intra-abdominal pressure and to the injected volume in order to establish paradigms regarding the dependent variables estimated values (IP and IV), in relation to the independent variable (considered insufflation moment), in order to give mathematical relationship through an equation capable to interconnect the variables.

Correlation coefficient is a pure number used to classify the correlation in perfect (=1), strong (>0,75 and < 1), medium (> 0,5 and < 0,75), weak (< 0,5) and null (= 0)[29]. In this research either the IP or the IV depicted a strong correlation.

The insufflators aim to reach a preset intraperitoneal pressure. It is also set a maximum limit

to the insufflation flow. When the insufflation begins the equipment measure the abdominal pressure through the eye of the needle, and if the actual pressure is less than the preset pressure it will allow gas flow. In this research the flow rate (1,2L/min) was adequate to the creation of pneumoperitoneum; therefore minimizing harmful hyperreflexia of the parasympathetic nervous system and providing exact values to the expected volume in liter per second (0,2L/s). In order to maintain the desirable intraperitoneal pressure the flow decreases, when the actual pressure is close to the preset pressure.

Intraperitoneal pressure or CO_2 injected volume evolution during the creation of pneumoperitoneum have not been described in the literature.

In this study the intraperitoneal pressure and the injected volume allow the researcher to anticipate their values during crucial moments of the insufflation. Therefore, the surgeon could easily monitor the creation of the pneumoperitoneum and check whether the intraperitoneal pressure and the injected volume are accordingly to the estimated values.

If values were not as the estimated, it is necessary to verify if the tip of the needle is inadvertently outside the peritoneal cavity. The muscle tension of the abdominal wall (insufficient anesthetic muscle relaxation) should also be considered a factor. Besides, the tip of the needle may be obstructed by abdominal structures, usually the greater omentum.

CONCLUSIONS

In conclusion the Veress needle insertion in the left hypochondrium for creation of pneumoperitoneum is a safe and effective procedure; in addition to that the 5 tests are adequate to guide the surgeon towards the correct positioning of the tip of the Veress needle, moreover the intraperitoneal pressure and injected volume variables are efficient parameters at certain moments of insufflation in order to confirm the correct intraperitoneal site of the instrument tip.

For this reason, the left hypochondrium puncture technique should be suggested as the method of choice for creation of pneumoperitoneum, instead of the traditional abdominal midline puncture at the level of the umbilicus. It is also recommend the procedure protocol described in this study to be adopted by surgeons. Extensive and accurate literature review clearly reveals the existence of fatal wounds caused by retroperitoneal great vessels and hollow viscera injuries produced by the Veress needle insertion in the abdominal midline, consequently all the laparoscopic surgeons, mainly the new ones should adopt the described protocol of this study.

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