Veress needle insertion into the left hypochondrium for creation of pneumoperitoneum: diagnostic value of tests to determine the position of the needle in unselected patients

Punção com agulha de Veress no hipocôndrio esquerdo para a criação do pneumoperitônio: valor diagnóstico das provas de posicionamento da agulha em pacientes não selecionados

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A B S T R A C T

Objective: To assess the effectiveness of the Veress needle puncture in the left hypochondrium and the accuracy of the tests described for the intraperitoneal correct positioning of the tip of the Veress needle in an unselected population. **Methods:** Ninety-one patients consecutively scheduled for Videolaparoscopy had the abdominal wall punctured in the left hypochondrium. There were no exclusion criteria. The patients received general anesthesia and mechanical ventilation according to the protocol. After puncturing five tests were used to confirm the positioning of the needle tip within the peritoneal cavity: aspiration test – AT; resistance to infusion – *Pres*; recovery of the infused fluid – *Prec*, dripping test - DT, and test of initial intraperitoneal pressure – IIPP. The test results were compared with results from literature for groups with defined exclusion criteria. The results were used for calculating sensitivity (S) specificity (E), positive predictive value (PPV) and negative predictive value (NPV). Inferential statistical methods were used to analyze the findings. **Results:** There were 13 failures. AT had E = 100% and NPV 100%. *Pres* had S = 100%, E = 0; PPV = 85.71%; NPV does not apply. *Prec*: S = 100%, E = 53.84%, PPV = 92.85%, NPV = 100%. DT: S = 100%, E = 61.53%, PPV = 93.97% NPV 100%. In IIPP, S, E, PPV and NPV were 100%. **Conclusion:** The puncture in the left hypochondrium is effective and the performed tests guide the surgeon regardless of sex, BMI, or previous laparotomy.

Key words: Pneumoperitoneum, Artificial. Biopsy, Needle. Surgical Procedures, Minimally invasive. Surgical Procedure, Laparoscopy. Adverse effects, Laparoscopy.

INTRODUCTION

The creation of pneumoperitoneum is the first step for realization of laparoscopy. Most complications associated with this procedure occur during its most critical stage, the access to the peritoneal cavity[1], due to the significant risk of vascular and visceral lesions[2].

Vascular injuries represent the most common causes of death in laparoscopic procedures (15 to 75%)[3,4], followed by unnoticed intestinal lesions (25%). Damage to major vessels and to the bowel may occur when the Veress needle is blindly inserted into the abdomen, before inflation, as occurs in the closed technique[3]. Reports of malpractice suits related to laparoscopy informed that 18% of the complaints occurred as a result of accidents in the establishment of pneumoperitoneum and it is estimated that about half of all laparoscopic complications were attributed to technical problems in this phase[4].

Although there is no consensus regarding the best method for accessing the peritoneal cavity[5], the Veress needle puncture[6] is the most commonly applied[2,7]. In a study with 155,987 laparoscopic procedures, there was an 81% rate of Veress needle usage[7].

The classic site of puncture is the midline of the abdomen, near the umbilical scar[8]. In this region, the puncture presents with risks of large vessels injury due to the short distance from the anterior abdominal wall to these vascular retroperitoneal structures[9]. In thin people, this

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distance may be less than two centimeters[3]. The abdominal aorta and vena cava, as well as the common iliac vessels, are particularly prone to injury during Veress needle puncture in the vicinity of the umbilical scar[10]. Despite the low prevalence of this occurrence (0.05% to 0.5%), mortality rates range between 8% and 17%, reaching 21% when there is unnoticed associated intestinal lesions[4-11]. The severity of this type of iatrogenic injury is minimized when the punctures are made in locations away from the midline[12 15].

Additionally, patients with previous abdominal surgery are at increased risk of visceral lesions by Veress needle because of adhesions that typically occur at the level of healing of surgical incision of the anterior parietal peritoneum. Autopsy studies have found adhesions in 74% to 95% of patients with abdominal previous surgeries[3]. Midline incisions are those that present the greatest risk of adhesions around the umbilicus. Nevertheless, even abdominal incisions away from the umbilical scar may determine the formation of adhesions in the periumbilical region[3].

The puncture in the left upper quadrant has been mentioned as being safe, without major risk of iatrogenic injury[12-16]. It should be noted that in the left upper quadrant the occurrence of internal adhesions is very rare, as it is known that the respiratory movements of the diaphragm constantly mobilize structures in this region and hamper the adherence to the anterior abdominal wall. Hence, the puncture in the left hypochondrium is preferred by some surgeons in patients with previous laparotomy[13]. There are also surgeons who perform bariatric surgeries and prefer the left upper quadrant for the creation of pneumoperitoneum in their patients[14]. This preference is due to the fact that in obese patients the open technique presents additional difficulties due to excess weight and puncture in the midline is dangerous because of the thickness of the fat tissue and the high position of the umbilicus in the abdomen. These characteristics make the puncture difficult and can cause injury, interesting mainly the large retroperitoneal vessels[15].

In clinical trials involving selected patients[16-18] the efficacy of the puncture in the left hypochondrium for the creation of pneumoperitoneum was equivalent to the puncture in the midline[16 17] (considered by many the gold standard), and its safety has been demonstrated[18].

Additionally, the tests recommended for confirming the intraperitoneal position of the tip of Veress needle proved to be appropriate in this specific population, with selected demographic and anthropomorphic features[16-18]. Similarly, in relation to the samples of those researches[16-18], it was demonstrated that the intraperitoneal pressure and the volumes of injected gas in the various predetermined moments of the study are useful and sufficient parameters to guide the surgeon as to the correct positioning of the Veress needle tip in the several moments of the insuflation procedure[16-18].

In that sense, it remains to be determined whether in the general population, with diverse demographic and anthropomorphic characteristics, evidence of the needle puncture in the left upper quadrant can be universally adopted as necessary and sufficient parameters of safe pneumoperitoneum instalation.

There are variations on the initial intraperitoneal pressure indicating the correct positioning, between 5[20] and 8[16] mmHg, considering that higher values indicate poor positioning (wall or solid viscera).

This study aimed to verify the efficiency in the creation of pneumoperitoneum by Veress needle puncture in the left hypochondrium in an indiscriminately extracted sample of the population of patients undergoing laparoscopy.

METHODS

This research was approved by the Ethics in Research of the University of Taubaté (No. 0039/07) and by the Ethics in Research of the Federal University of São Paulo (No. 1310/07). All patients signed a consent form.

Ninety-one patients, without any considered exclusion criteria, consecutively scheduled to undergo Videolaparoscopy in the Department of General Surgery, Hospital Municipal José de Carvalho Florence, had the abdominal wall punctured in the left hypochondrium with a Veress needle to establish artificial pneumoperitoneum by insufflation of carbon dioxide. The needle used was of permanent use, 12-cm long and had a 2-mm outside diameter (Storz®). The sample consisted of 69 women (75.8%) and 22 men (24.2%), with a mean age of 47.92 years (SD +-15.06, median = 46, 16 to 86 years). The average Body Mass Index (BMI) was 26.16 (+-4.97), with a median of 25.71 and range between 18.37 and 48.11. Forty patients (44%) were considered healthy by BMI (<25), whereas 34 (37.4%) were overweight (BMI between 25 and 30) and 17 (18.7%) were obese (BMI> 30). Sixty patients (65.9%) had previous abdominal surgery. No exclusion criterion was adopted.

The patients underwent general anesthesia with tracheal intubation and mechanical ventilation. They received 0.1mg/kg midazolam 30 minutes before anesthesia, which was later achieved with 2 mg/kg propofol and 0.5 mcg/kg fentanyl, and paralysis with 0.5 mg/kg atracurium. Soon after intubation, an orogastric tube was introduced and stomach contents aspirated.

The puncture technique in the left hypochondrium was held with the patients in supine position, with a 30 degree proclivity. We made a 2-mm incision in the skin of

the costal border, about 8 cm left from the midline, in which the needle was introduced perpendicularly to the anterior abdominal wall (Figure 1).

After puncturing, the five tests were used to confirm the positioning of the needle tip within the peritoneal cavity (Figure 2).

The tests were carried out in the following sequence: aspiration test – AT; resistance to infusion - Pres; recovery of the infused fluid – Prec; dripping test – DT; and initial intraperitoneal pressure test (IIPP) (Figure 2).

The aspiration test (AT) used a 10 ml syringe containing 5 ml of saline solution that was infused through the Veress needle, followed by attempted aspiration of the same fluid. It was considered positive when any type of material was present in the syringe and labeled as negative when no material were aspirated.

Resistance to infusion test (Pres): injection of 5 ml of saline through the needle, finding moderate resistance to liquid flow (positive test) or, conversely, noticing a significant increase in resistance (negative test).

Recovery of infused fluid test (Prec): after infusion of 5 ml saline, aspiration was attempted, the test being considered positive when no injected liquid was recovered, and negative when all or part of the infused fluid was recovered.

Dripping Test (DT): after dripping saline into the needle reservoir, we observed the immediate disappearance of the drops (positive test) or, conversely, accumulation of fluid in the reservoir (negative test).

The initial intraperitoneal pressure test (IIPP) was considered positive (needle in proper position within the peritoneal cavity and outlet of gas free of obstruction) if the pressure were equal to or less than 8 mmHg in the first 10 seconds, and negative (needle in inadequate position or with clogged orifice) if the pressure were greater than this value and so remained for 10 seconds.

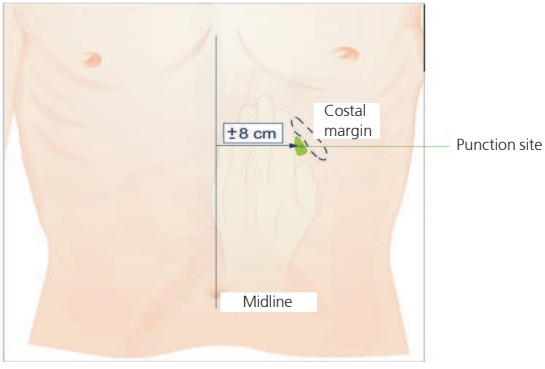

Figure 1 - *Representation of the location of the Veress needle puncture in the left upper quadrant, near the costal margin, 8 cm from the midline of the abdomen. The point where the puncture should be performed is depisted, noting the distance of the major retroperitoneal vessels (aorta, vena cava, primitive iliac arteries and veins) and vessel caliber of the upper abdominal wall (left superior epigastric artery and vein).*

The Pres, Prec and DT tests were performed and registered according to the pre-determined protocol, one after the other, whether they would be positive or negative. After these tests, the insuflator was set to deliver a flow of 1.2l/min and maximum intraperitoneal pressure was set to 12 mmHg. After the insuflator hose was connected to the needle and after the maneuver known as "shaking" (little jolt to release the tip of the needle from the omentum) it was activated, the IIPP test being carried out. If the IIPP was above 8 mmHg and remained that way, it was considered negative, the procedure was labeled a failure, the Veress needle was withdrawn and the whole procedure restarted.

Should the IIPP be positive, we proceeded with the insufflation of carbon dioxide until the pressure reached 12 mmHg, recording the procedure as successful once the laparoscopic trocar and the optics were inside the peritoneal cavity.

The sensitivity (S) of the tests was defined as the proportion of patients with the condition investigated that were detected by the test, according to the formula: S = [true positives / (true positives + false negatives)] x 100 %. Verification that the patient was in fact positive was made by the effective creation of pneumoperitoneum, diagnosed by direct visualization through a laparoscope introduced into the peritoneal cavity.

The specificity (E) of the test was defined as the proportion of patients without the condition who were correctly diagnosed as such, according to the formula: E = [true negatives / (true negatives + false positives)] x 100%. Verification that the patient did not in fact have the condition was given by the inability to effectively inflate the peritoneal cavity.

The positive predictive value (PPV) was regarded as the probability of the needle to be well positioned, given a positive result of a test. The negative predictive value (NPV) was the probability of the needle to be in fact poorly positioned when the test was negative. Both figures aid in evaluating the reliability of the tests' results and were calculated using the following equations: PPV = [true positives / (true positives + false positives)] x 100%; NPV = [true negatives / (true negatives + false negatives)] x100%.

We studied the correlation between the variables pressure and intraperitoneally injected volume in the group as a whole, within a confidence interval of 95%.

Qualitative variables were represented by absolute and relative frequency, and quantitative ones as mean, standard deviation and minimum and maximum values. The equivalence or not between the study groups was established by studying the occurrence or not of overlapping confidence intervals (95%).

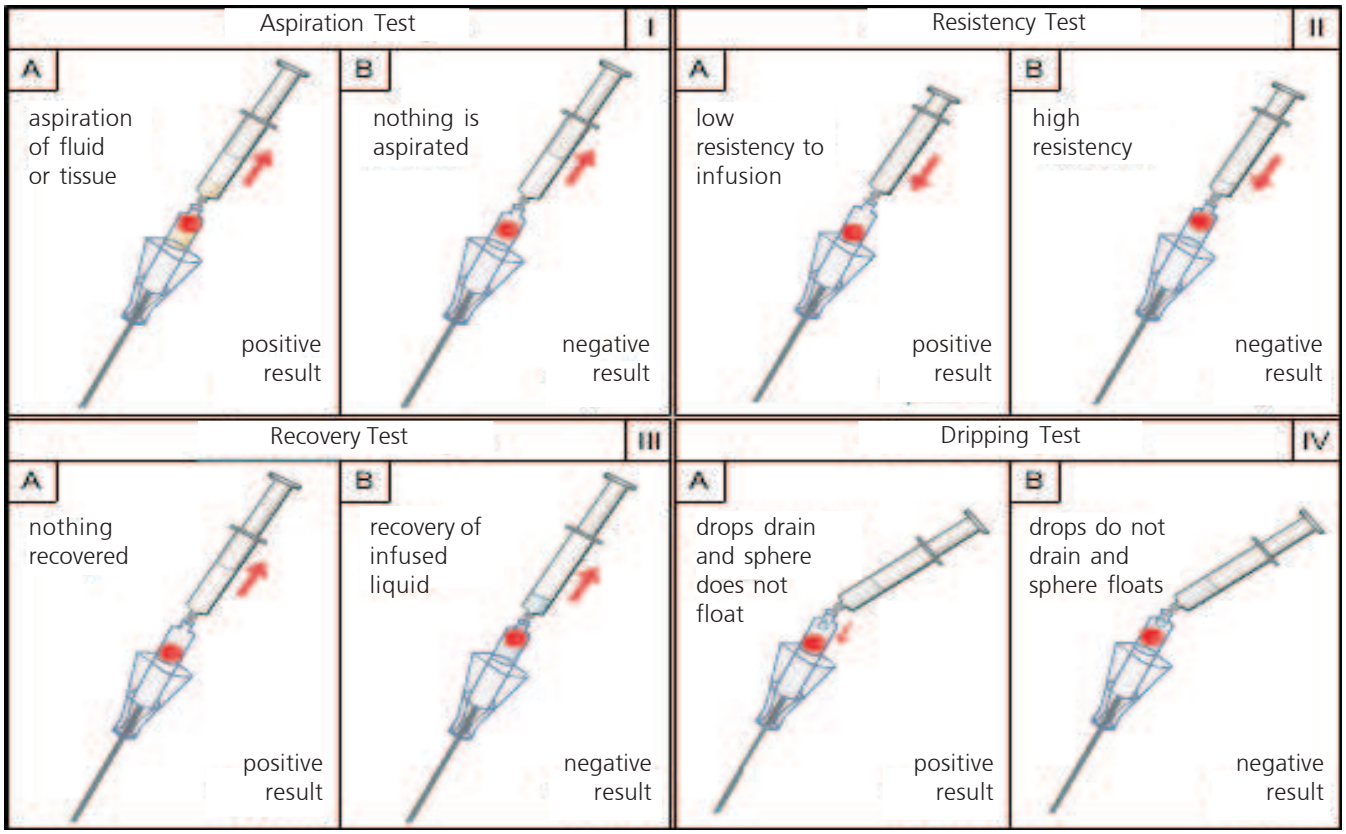

Figure 2 - *Tests of positioning of the tip of the Veress needle - Proof of aspiration (AT): aspiration with a 5 ml syringe through a Veress needle. Considered positive when any type of material was present in the syringe (IA), and negative when no material was present in the syringe (IB). Resistance test (Pres): 5 ml injection of saline through the needle and there is moderate resistance to the flow (II-A: positive test) or, alternately, an increase in resistance (II-B: negative test). Recovery test (Prec): after infusion of 5 ml saline, aspiration is attempted, considering a positive test when not recovering the injected liquid (IIIA), or negative when all or part of the liquid infused is recovered (III-B). Dripping test (DT): dripping saline into the needle reservoir, we observed the immediate disappearance of the drops (IV-A: positive test) or, conversely, the accumulation of fluid in the reservoir, with floating of the needle ball (IV-B: negative test).*

RESULTS

There were no complications in this study punctures.

There were 13 failures to establish pneumoperitoneum in the first puncture attempt. These failures were all identified by the initial evidence of intraperitoneal pressure test (IIPP). No other test had the 100% efficiency demonstrated by IIPP in the detection of failures that actually occurred (Table 1).

In general, the sensitivity (S), specificity (E), positive predictive value (PPV) and negative predictive value (NPV) of the intraperitoneal positioning tests of the Veress needle tip used in this study were as follows: aspiration test: S = not applicable, E = 100%, PPV = not applicable; NPV = 100%; injection test: S = 100%, E = 0%, PPV = 85.71%, NPV = not applicable; recovery test S = 100%, E = 53.84%, PPV = 92.85%, NPV = 100%; dripping test: S = 100%, E = 61.53%, PPV = 93.97%, NPV = 100%; initial intraperitoneal pressure test: S = 100% S = 100%, PPV = 100%, NPV = 100% (Table 2).

DISCUSSION

The validity of the evidence for the location of the tip of the Veress needle in the creation of pneumoperitoneum has been well demonstrated[18]. A study comparing the two puncture techniques (umbilical versus left upper quadrant) with a sufficient level of evidence require sampling of more than 100,000 pacients[19] to detect the reduction of accidents (prevalence of 0.05% to 0.5%) and larger complications. Thus, the improvement in identification methods of the needle position and injuries by the test of confirmation after puncture and during the pneumoperitoneum establishment becomes of capital importance[20]. It is also useful to adopt parameters of volume of gas injected into each moment and resultant intraperitoneal pressure during inflation to ensure the correct location of the gas inside the cavity peritoneal[21]. It was also demonstrated that the development of pneumoperitoneum runs as well with the alternative puncture in the left hypochondrium as with the classic one, in the abdomen midline[17].

We should reiterate that to compare the risk of this puncturing technique with the risk of puncture in the midline of the abdomen at the umbilicus (0.05 to 1.8%) it would require a prospective study interesting 100,000 pacientes[19]. However, the greater security of the puncture in the left hypochondrium in comparison to the one in the umbilicus can only be deduced from considerations regarding the topographical relationships of the structures at risk, with special attention to the midline retroperitoneal great vessels[9] and to the preferential topography of the midline adhesions. There are reports of lower risk of iatrogenic injuries[12-15] when the puncture is made in the left hypochondrium because it is out of the midline, where there is greater chance of injury of major retroperitoneal vessels[12-13].

Nonetheless, for the left hypochondrium puncture one must take into account the risk of injury to the superior epigastric vessels and structures immediately posterior to the anterior abdominal wall at the puncture site, such as the gastric body, transverse colon and greater omentum. However, the trunks and branches of larger caliber of the superior epigastric vessels never lie at a distance greater than eight centimeters from the midline of the abdomen, so punctures beyond that distance prevent lesions of those vessels[21-23].

The values of tests and parameters established to assess the safety in the development of pneumoperitoneum has been shown by Azevedo[16-18] in patients without previous abdominal surgeries, previous intra-abdominal inflammatory conditions and with a BMI below 30. The author found sensitivity, specificity, positive and negative predictive values for each test performed and appointed the one that reached 100% in all of these criteria: initial intraperitoneal pressure test (IIPP). Azevedo defined IIPP as not only the pressure measured by the insuflator before starting to inflate, but also the one observed after the first 10 seconds. He established 8 mmHg as a safe upper limit – values that remain above mean poor positioning – and found an average initial value of about 4 mmHg.

In conclusion, the Veress needle puncture in the left hypochondrium for creation of the pneumoperitoneum is safe and effective when sampling is made indiscriminately from patients undergoing laparoscopy. The five tests applied together are adequate to guide the surgeon as to the correct positioning of the needle tip in the beginning of inflation regardless of gender, body mass index or previous operations.

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Tabela 1 - Performance of each test to detect failures at the first attempt to insert the Veress needle into the peritoneal cavity.

Test (n = 91)	Negative tests (incorrect positioning of the tip of the Veress needle)		
	Number	Proportion (%)	95% CI
Aspiration	0	0	—
Injection	0	0	—
Recovery	6	6,59	[0,013; 0,092]
Dripping	5	5,49	[0,011; 0,139]
Initial intraperitoneal pressure	13	14,29	[0,028; 0,1806]
Failed attempts	13	14,29	[0,028; 0,1806]

CI = Confidence interval.

Tabela 2 - Results of tests performed.

Test	Sensitivity	Specificity	PPV	NPV
Aspiration	-	100%	-	100%
Injection	100%	0%	85,71%	-
Recovery	100%	53%	92,7%	100%
Dripping	100%	61,53%	93,97%	100%
Initial intraperitoneal pressure	100%	100%	100%	100%

PPV = Positive Predictive Value. NPV = Negative Predictive Value.

R E S U M O

Objetivo: *Verificar a eficiência da punção com agulha de Veress no hipocôndrio esquerdo, a acurácia dos testes descritos para o correto posicionamento intraperitoneal da ponta da agulha de Veress em população não selecionada.* ***Métodos:*** *Noventa e um pacientes, sem quaisquer critérios de exclusão, consecutivamente agendados para procedimentos videolaparoscópicos, tiveram a parede abdominal puncionada no hipocôndrio esquerdo. Os pacientes receberam anestesia geral e ventilação controlada mecânica segundo o protocolo. Após a punção foram utilizadas cinco provas para testar o posicionamento da ponta da agulha no interior da cavidade peritoneal: prova da aspiração – PA, da resistência à infusão – Pres, da recuperação do líquido infundido – Prec, prova do gotejamento - PG, e a prova da pressão intraperitoneal inicial - PPII. Os resultados foram considerados para cálculo da sensibilidade (S) e da especificidade (E) e valores preditivos positivos (VPP) e valores preditivos negativos (VPN). Métodos inferenciais estatísticos foram utilizados na análise dos achados.* ***Resultados:*** *Ocorreram 13 fracassos. A PA teve E=100% e VPN=100%. Pres teve S=100%; E=0; VPP=85,71% VPN= não se aplica. Prec: S=100%; E= 53,84%; VPP= 92,85%; VPN= 100%. PG: S=100%; E= 61,53%; VPP= 93,97% VPN= 100%. Na PPII, a S, E, VPP e VPN foram de 100%.* ***Conclusão:*** *A punção no hipocôndrio esquerdo é eficiente, as provas realizadas orientam o cirurgião a despeito do gênero, IMC ou operações prévias.*

Descritores: *Pneumoperitônio artificial. Biópsia por agulha. Procedimentos cirúrgicos minimamente invasivos. Laparoscopia. Laparoscopia, Efeitos adversos.*

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