

Major and minor injuries during the creation of pneumoperitoneum

A multicenter study on 12,919 cases

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Abstract

Background: Lap Group Roma was established in 1999 to promote and control the development of laparoscopic surgery in the area of Rome and its province. Complications during the creation of pneumoperitoneum were given a high priority of investigation, and a retrospective enquiry was immediately carried out.

Methods: A questionnaire about all laparoscopic surgical practice performed from January 1994 to December 1998 was sent to the supervisors of 28 centers of general surgery in the area of Rome and its province participating to the Lap Group Roma, requesting demographics, type of procedure for the creation of pneumoperitoneum, type and timing of operation, and major vascular, visceral, and minor vascular injuries related to the creation of pneumoperitoneum.

Results: The questionnaire was returned by 57% of the centers, for a total of 12,919 laparoscopic procedures. The type of procedure used to create the pneumoperitoneum involved a standard closed approach (Veress needle + first trocar) in 82% of the cases, an open (Hasson) approach in 9% of the cases, and the use of an optical trocar in 9% of the cases. There were seven major vascular injuries (0.05%), eight

visceral lesions (0.06%), and nine minor vascular lesions (0.07%), for an overall morbidity of 0.18%. There was no death related to these complications. The rate of complications differed significantly ($p < 0.0001$) depending on the type of approach used. It was 0.27% with the optical trocar (3 of 1,009 cases), 0.18% with the closed approach (20 of 10,664 cases), and 0.09% with the open approach (1 of 1,135 cases).

Conclusions: There is no foolproof technique for the creation of pneumoperitoneum, and this inquiry confirms the need of a constant search for prevention and early treatment of complications encountered during this obligatory phase of any laparoscopic approach. A well-conducted and prolonged prospective audit of clinical practice could help in identifying the risk factors that can make an alternative approach (open or video controlled) preferable to the widely used closed approach.

Key words: Complications — Laparoscopy — Major vascular injuries — Pneumoperitoneum — Visceral injuries

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Some laparoscopic surgery complications occur during the creation of the pneumoperitoneum, and are not encountered during traditional open surgery. There are three main procedures for obtaining a laparoscopic approach: the closed technique (Veress needle and first trocar), the open technique (Hasson's blunt trocar), and direct trocar insertion without pneumoperitoneum. Whereas the latter, although very effective and safe in experienced hands [4, 7, 9], failed to gain a widespread acceptance because of its high risk for major injuries during the learning curve, the others are currently used. Recently, disposable Veress needles [27] and optical trocars [1, 11, 18] became available for clinical use. Their positioning in the abdominal cavity with or without previous pneumoperitoneum can be controlled by means of a lens-camera complex inserted within their shaft. Preliminary results with the use of such devices seem to be promising, although their use is not totally safe [27].

Despite the theoretical advantages of the open technique, closed laparoscopy remains more popular. A survey by the American Association of Gynecological Laparoscopists in 1982 showed that 96% of the laparoscopic procedures were performed by the closed technique and only 4% by the open approach [24]. A more recent review showed that among 500,179 laparoscopic procedures, only 2.5% of them were performed by open laparoscopy [3]. No large prospective randomized trials have compared the safety of the two techniques and, considering the high number of cases required to demonstrate very small differences significantly, they probably will never exist.

Apart from specific surgical complications associated with the type of operation performed, most complications related directly to the laparoscopic approach occur during the creation of pneumoperitoneum. This initial phase of any laparoscopic procedure has a mortality rate that ranges from 0.05% to 0.2% [21]. Nevertheless, the actual figures probably are higher because of the tendency toward not publishing such complications. The most feared and catastrophic complications are injury to major retroperitoneal vessels and hollow viscus perforation [17], especially when missed at the operating table. Actually, only about 60% of such injuries are promptly diagnosed and treated during the same operation [25].

Lap Group Roma was established in 1999 to promote and control the development of laparoscopic surgery in the area of Rome and its province. Safety during the creation of pneumoperitoneum was given a high priority. Therefore, a retrospective study among its 28 surgical centers was rapidly carried out as a basis for a prospective audit.

Methods

All the supervisors of the 28 Lap Group Roma surgical centers received a questionnaire concerning a period of 5 years (January 1994 to December 1998). They were asked to report the following details about all the laparoscopic procedures performed during this period: gender, age, type of operation, conversion to laparotomy, type of procedure for the creation of pneumoperitoneum, previous abdominal surgery, and whether surgery was elective or urgent. Specific questions were aimed at disclosing any kind of injuries to major retroperitoneal vessels, to hollow viscus, and to minor vessels. Each case of iatrogenic injury had to be detailed concerning the presumed dynamics of the injury as well as its diagnosis, treatment, outcome and sequelae. Details about other minor complications such as omental insufflation, wound infection, and incisional hernia were not requested, because of the obvious limitations associated with the retrospective retrieval of such data.

Results

The questionnaire was returned by 16 of the 28 centers (57.1%), representing a total of 12,919 laparoscopic procedures (mean, 807.4 procedures per center; median, 504; 95% confidence interval [CI], 443.4–1,171.4). The male to female ratio was 0.62 (mean, 0.57; median, 0.60; 95% CI, 0.46–0.68). The elective to urgent procedure ratio was 13.3 (mean, 13.2; median, 17.5; 95% CI, 11.6–21.6). Previous laparotomies were present in 10.6% of the cases (mean, 9.5%; median, 8.5%; 95% CI, 5.5%–13.5%). The rate of conversion to open surgery was 4.9% (mean, 5.3%; median, 5.5%; 95% CI, 3.9%–6.6%). The types of operation performed are illustrated in Fig. 1, and the procedures used to

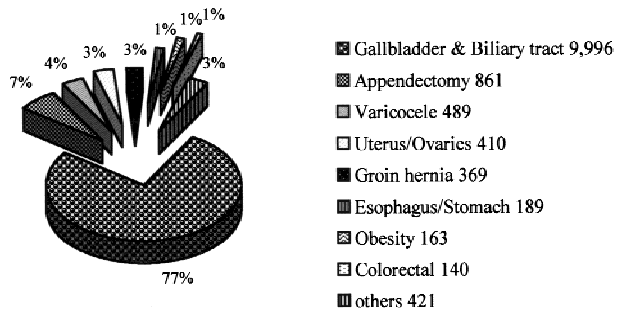


Fig. 1. Type of operation (total number and percentage) in 12,919 cases.

create the pneumoperitoneum are listed in Fig. 2. There were seven major vascular injuries (0.05%), eight visceral lesions (0.06%), and nine minor vascular lesions (0.07%), yielding an overall morbidity rate of 0.18%. These injuries were diagnosed and treated during performance of the same procedure in 19 cases (79.1%), and during the postoperative period in the remaining 5 cases (20.9%). No death related to these complications was recorded.

Major vascular injuries were reported by five centers (31.2%), with the incidence rate per single center ranging from 0.07% to 0.4%. Visceral injuries were reported by seven centers (43.7%), with the incidence rate ranging from 0.05% to 0.26%. Minor vascular injuries occurred in six centers (37.5%), with the incidence rate ranging from 0.1% to 1.2%. Three centers (18.7%) did not report any iatrogenic injury related to the creation of pneumoperitoneum.

The overall rate of complications was significantly different ($p < 0.0001$, chi-square test) depending on the type of approach used: It was 0.27% with the optical trocar (3 of 1,009 cases), 0.18% with the closed approach (20 of 10,664 cases), and 0.09% with the open approach (1 of 1,135 cases).

Major vascular injuries

Major vascular injuries occurred always during a closed approach in an elective setting, caused by the first trocar in five patients and by the Veress needle in the remaining two patients. These injuries involved the aorta in two patients, and the right common iliac vessels in two patients. In the remaining three patients they involved the cava vein, the inferior mesenteric artery, and a lumbar artery. Diagnosis and repair were immediate in five patients, and during the first 24 h after the operation in the other two patients. There was no need for further operations, nor were there any sequelae, except only for the lumbar artery injury, which required three reoperations.

Visceral injuries

Visceral injuries were related to a closed approach in six patients, and to the optical trocar in the remaining two patients. The affected viscus was the ileum in three patients, the jejunum in three patients, and the stomach in the remaining two patients. In one of the latter two patients, the transverse colon was injured too. Diagnosis and repair were immediate in all but one patient, who underwent reoperation

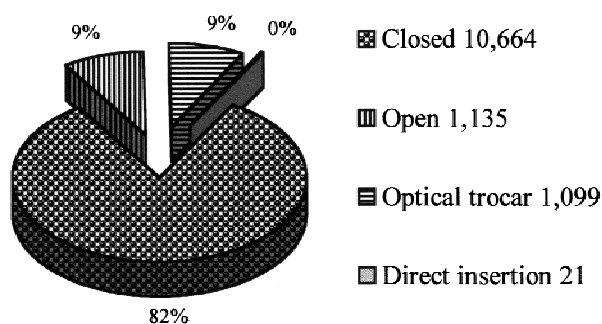


Fig. 2. Type of procedure (total number and percentage) for the creation of pneumoperitoneum in 21,919 cases.

5 days later. There were no sequelae. One patient with jejunal injury, already diagnosed and treated at the first operation, needed to undergo reoperation 5 days later to remedy dehiscence of the intestinal suture.

Minor vascular injuries

Minor vascular injuries occurred during a closed approach in seven patients, during the placement of an optical trocar in one, and during an open approach in the right lower quadrant in the remaining patient. Branches of the epigastric vessels were affected in four patients, omental vessels in three patients, and vessels of small bowel mesentery in two patients. Diagnosis and repair were immediate in seven patients, and delayed to the fifth and seventh postoperative days, respectively, in the other two patients, without any sequela or reoperation.

Discussion

Multicentric and retrospective studies can be affected by a selection bias (in this case 16 of 28 centers participated to the study) and by a recall bias (more serious complications are recalled better than minor ones). Although these limitations should be considered, this inquiry stemmed from the need to acquire a basis for a prospective audit of laparoscopic practice in the area of Rome and its province. The sample of data obtained was well representative for this purpose. The first finding was that during the study period there was a growing seek for an alternative approach to the closed technique, reaching approximately 18% (Fig. 2). This rate was higher than those already reported [3, 24]. The rate of major injuries, both vascular (0.05%) and visceral (0.06%), were within the range commonly reported. The rate of major retroperitoneal vessel injuries with the closed technique varied from 0.02% to 0.24% (Table 1), most commonly involving the aorta (42%) and the common iliac artery (37%). Until 1997, no case of major retroperitoneal vessel injury had been reported with the use of a blunt Hasson's cannula, which therefore was considered to be absolutely safe (Table 2). It should be underscored, however, that two of such extraordinary lesions had been reported recently [12]. The rate of hollow viscus injuries with the closed technique varied from 0.03% to 0.15%, with prevalence of injury to the gastroenteric tract (80%) greater

Table 1. Incidence of major complications with the closed technique

Author(s)	Year	No. of cases	% Visceral injuries	% Major vascular injuries
Mintz [19]	1977	99,204	0.03	0.04
Penfield [23]	1985	56,106	0.15	0.03
Deziel et al. [8]	1993	77,604	0.14	0.24
Ballem & Rudomanski [2]	1993	150	1.3	—
Querlou & Chapron [25]	1995	17,521	0.04	0.02
Saville & Woods [26]	1995	3,591	—	0.11
Hashizume et al. [13]	1997	15,422	0.07	0.06

Table 2. Incidence of major complications with the open technique

Author(s)	Year	No. of cases	% Visceral injuries	% Major vascular injuries
Hasson [14]	1978	800	0.12	0
Penfield [23]	1985	10,840	0.05	0
Sigman et al. [28]	1993	247	0	0
Ballem & Rudomanski [2]	1993	150	0	0
Bonjer et al. [3]	1997	438	0	0
Nuzzo et al. [21]	1997	330	0	0
Zaraca et al. [30]	1999	1,006	0.1	0
Lafullarde et al. [16]	1999	803	0	0

than that for urinary tract (20%). With the open technique, the same figure varied from 0% to 0.12%.

The absence of mortality related to major injuries could be surprising. This finding probably was related to the high rate (80%) of immediate diagnosis and repair of such lesions and to the composition of the study group by general surgeons. High rates of mortality related to major vascular injuries (10–50%) actually were reported in gynecologic series [5, 29] and were associated mainly with delayed diagnosis and treatment [10]. The distribution of the lesions in different centers confirmed that approximately one-third of them experienced at least one major vascular lesion [29].

Considering the different techniques used, all of the major vascular injuries occurred during a closed approach, whose overall rate of complications (0.18%) was significantly higher than that recorded with the open approach (0.09%). The higher rate of complications (0.27%) recorded with the use of the optical trocar probably resulted from the learning curve associated with the use of this device, whose introduction to clinical practice occurred late during the period of this study [1, 11, 18, 27].

There is growing evidence that routine use of the open approach can effectively lower the operative time needed to achieve pneumoperitoneum while protecting from major vascular injuries. Therefore, the open technique was suggested as the standard of practice [6, 21, 22, 30]. Considering that evidence favoring the routine use of an open technique probably will never be reached because of the aforementioned lack of large randomized trials, it probably would be better to consider the legal liability issues that strongly arise around these complications encountered exclusively during the laparoscopic approach [20].

This study confirms the need of a constant search for prevention and early treatment of complications encoun-

tered during this obligatory phase of any laparoscopic operation, because there is no “foolproof” technique for the creation of pneumoperitoneum [15]. Only a well-conducted and prolonged prospective audit of clinical practice can give clear indications as to when an alternative approach (open or video-controlled) should be preferable to the widely used closed approach.

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