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Needle and trocar injury during laparoscopic surgery in Japan

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Abstract

Background: With the growth and sophistication of laparoscopic surgery, increased attention is now being focused on safety and complications.

Methods: In an attempt to address questions regarding the safety of laparoscopic surgery, a retrospective study of the time period from January 1991 to December 1995 was conducted by the Study Group of Endoscopic Surgery in Kyushu, Japan.

Results: The response rate was 84.4% (152 of 180 hospitals). During the last 5 years 17,626 patients underwent endoscopic operations and 87.5% (15,422 patients) had laparoscopic surgery while 12.5% (2,204 patients) underwent thoracoscopic surgery. In 96.6% of the hospitals a minimal open laparotomy was used. Among the various operations, a cholecystectomy was performed in the largest number of patients (13,787). The total number of complications was 415 (2.7%), of which 156 (37.6%) were related to needle or trocar insertion. Visceral injury was found in 22 patients (0.14%): major vessel injury in 10, gastrointestinal tract injury in 11, and liver injury in one patient. Abdominal wall injury was seen in 79 patients (0.52%), bleeding in 70 (0.46%), and a hernia in 9 (0.06%). Extraperitoneal insufflation occurred in 55 patients (0.36%). There was no mortality. The complication rate significantly decreased year by year after the use of laparoscopic surgery began.

Conclusions: The most common complications of laparoscopic surgery are related to needle and trocar insertion. These are preventable by placement under direct vision with verification of the intraperitoneal location of the needle and trocar.

Key words: Trocar injury — Complication — Laparoscopic surgery

Having achieved vast acceptance following its pioneering phase, minimally invasive surgery is now exerting a substantial impact on the world of medicine. The use of laparoscopy as an alternative to open surgery continues to grow dramatically. Along with its growth and sophistication, however, has also come an intensified focus on the need to prevent laparoscopic complications [3, 5, 6, 21].

The potential complications of laparoscopic surgery include those resulting from the insertion of the needle and trocar, the creation of the pneumoperitoneum, the positioning of the patient, and the insertion and manipulation of the instruments [2, 18, 22].

In an attempt to address questions regarding the safety of laparoscopic surgery, a retrospective study of the time period from January 1991 to December 1995 was conducted by the Study Group of Endoscopic Surgery in Kyushu, Japan.

Materials and methods

In November 1995, we mailed a questionnaire to 180 hospitals that are members of the Study Group of Endoscopic Surgery in Kyushu, Japan. The respondents involved in the collection of data were chiefs of departments of the hospitals and the data were collected from medical records. The questions referred to the frequencies with which laparoscopic procedures were carried out during the period of January 1991 to December 1995 and also to the frequency of complications. The analysis of complication related to needle and trocar insertion was conducted on patients who underwent laparoscopic surgery. The patients who underwent thoracoscopic surgery or transanal endoscopic microsurgery (TEM) were excluded from this study. In addition, the preventive measures taken to avoid complications were evaluated.

Results

The Study Group survey generated a response rate of 84.4% (152/180). In five (3.3%) of the 152 hospitals that participated in the survey, only thoracoscopic operations were performed. Between January 1991 and December 1995, 17,626 patients were registered; 87.5% (15,422 patients) of the total number of patients underwent laparoscopic surgery while 12.5% (2,204 patients) had thoracoscopic surgery. In all of the hospitals except three, the total number of lapa-

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Table 1. Type of laparoscopic operations

Cholecystectomy	13,787
Repair of inguinal hernia	541
Colectomy	197
Choledochotomy	150
Transanal endoscopic microsurgery (TEM)[a]	143
Partial gastrectomy	113
Release of ileus	99
Splenectomy	80
Repair of duodenal perforation	57
Appendectomy	44
Drainage of hepatic cyst	14
Hepatectomy	8
Vagotomy	6
Resection of pancreas	5
Repair of esophageal hernia	5
Esophagectomy	2
Others	171
Total	15,422

[a] In this study, 143 patients who underwent TEM were excluded from the analysis of complication related to needle and trocar insertion.

roscopic operations performed was under 500 cases. In three hospitals more than 1,000 cases were reported.

Table 1 shows the type of operations performed. The great majority of these operations were laparoscopic cholecystectomies (13,787, 89.4%). The mortality rate was zero. TEM was performed in 143 patients and was excluded from this study. The total complication rate was 2.7% (415/15,279). The insertion of needle or trocar was responsible for 156 injuries during laparoscopy (Table 2). Of these complications, 79 patients had early and late abdominal wall injuries, 22 patients had visceral injuries, and 55 patients experienced extraperitoneal insufflation.

In 142 (96.6%) of the 147 hospitals in the Study Group open laparoscopy was performed (except during the 1st year, when endoscopic surgery had just started); only five hospitals still used the Veress needle to establish a pneumoperitoneum.

Vascular injury

Vascular injury occurred in 152 patients (Fig. 1), but major vascular injury related to needle and trocar insertion occurred in only 10 patients (0.07%). The aorta was injured in one patient, the left common iliac artery in one patient, right common iliac artery in three patients, the gastroepiploic artery in one patient, the epigastric artery in one patient, the retroperitoneal vessel in one patient, and the superior mesenteric artery in two patients. The mechanism of injury involved insertion of the primary trocar in seven patients (70%) and insertion of the Veress needle in two patients (20%). Injury was due to placement of the secondary trocar in one patient. A laparotomy was required in nine of 10 patients with vascular injury. Suturing was done in five patients, ligation in two patients, electrocoagulation in one patient, and tamponade in one patient. Only one patient required no treatment for the bleeding. Figure 1 shows the complication rate of vascular injury every year after starting endoscopic surgery. The incidence of vascular injury was the highest in the 1st year but thereafter gradually decreased.

Table 2. Complications related to needle and trocar insertion

Complication	*n*	%
Abdominal wall injury	79	0.52
Bleeding	70	0.46
Hernia	9	0.06
Visceral injury	22	0.14
Major vessel	10	0.07
Gastrointestinal tract	11	0.07
Liver	1	0.01
Extraperitoneal insufflation	55	0.36
Total	156/15,279	1.02

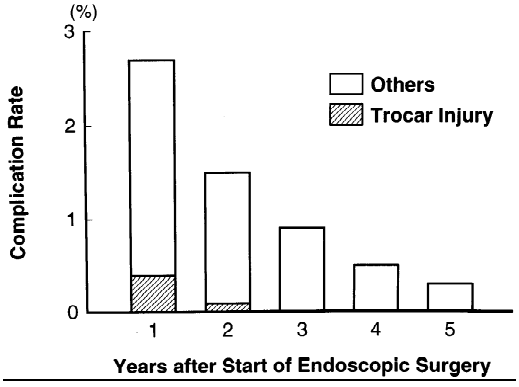

Fig. 1. Rate of vascular injury.

Gastrointestinal tract injury

Gastrointestinal tract injury occurred in 23 patients. The incidence of gastrointestinal tract injury related to trocar insertion was 0.07% (11 patients) (Fig. 2). The small intestine was injured in 10 patients and the large intestine in one patient. Injury was caused by insertion of the primary trocar in seven patients (63.6%) and the secondary trocar in four patients. No intestinal injuries were related to insertion of the Veress needle. A laparotomy was required in two patients and all injuries were successfully sutured. Figure 2 shows the rate of gastrointestinal tract injury each year after starting endoscopic surgery. The incidence of gastrointestinal tract injury decreased over time.

Bleeding from the abdominal wall

Bleeding from the abdominal wall, which was the most common complication, was always caused by trocar insertion and occurred in 70 patients (0.46%). The most frequent sources of hemorrhage were the superficial epigastric, inferior epigastric, and muscular abdominal wall vessels. In 69 patients the bleeding was from the secondary trocar sites. A laparotomy was required in four patients. Suture ligature of the bleeding vessels was done extracorporeally in 20 patients and intracorporeally in three patients. Electrocoagulation was done externally in 14 patients and laparoscopically in two patients. Tamponade with the use of a Foley balloon catheter was successfully applied in one patient. Bleeding from the abdominal wall spontaneously ceased during operation without any specific treatment in 30 pa-

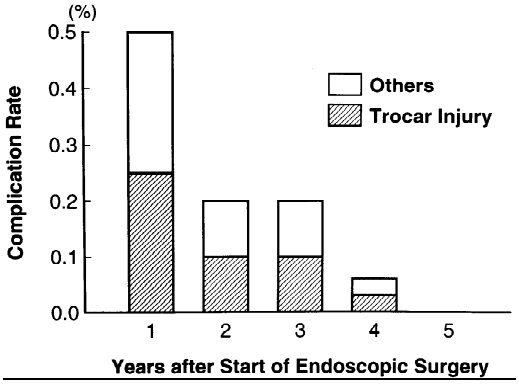

Fig. 2. Rate of gastrointestinal tract injury.

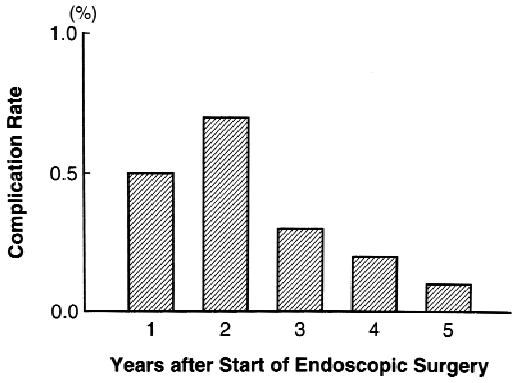

Fig. 3. Rate of bleeding from the abdominal wall.

tients. The rate of bleeding from the abdominal wall decreased with experience (Fig. 3).

Primary late abdominal wall complications

Hernia formation occurred as a late abdominal wall complication in nine patients (0.06%). Hernias were found at the umbilical site of the primary trocar in seven patients and at an extraumbilical site in two patients. All hernias were associated with a port site larger than 10 mm in size. A laparotomy was required in five patients and suture repair was performed in nine patients. One hernia was repaired laparoscopically with the use of a mesh. The incidence of postoperative hernia by each year is shown in Fig. 4.

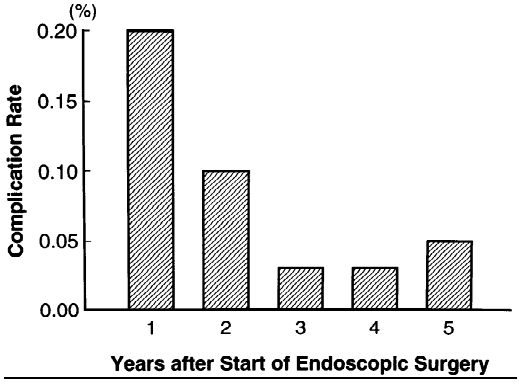

Fig. 4. Rate of postoperative hernia.

Complications related to pneumoperitoneum

The complication rate related to the pneumoperitoneum was 0.48% (Table 3). Subcutaneous emphysema was the most common of these complications. In 54 of 55 patients in whom subcutaneous emphysema was found no specific treatment was necessary. In the remaining patient, evacuation of the gas by manual pressure on the abdominal wall was done.

Table 3. Complications related to pneumoperitoneum

Complications	*n*	%
Subcutaneous emphysema	55	0.36
Right shoulder or back pain	6	0.04
Pneumothorax	4	0.03
Hypercarbia	3	0.02
Vagotonia	2	0.01
Oliguria	1	0.01
Pulmonary infarction	1	0.01
CO_2 gas embolism	1	0.01
Total	73/15,279	0.48

Discussion

The insertion of the Veress needle or trocars is responsible for a substantial number of injuries during laparoscopy. It has been reported that the complication rate of Veress needle or trocar insertion during closed laparoscopy is approximately 0.2–0.3% [14]. The modern technique of open laparoscopy was first popularized by Hasson in 1974 [8]. The primary advantage of this technique is that access to the peritoneal cavity is gained under direct vision. Therefore, bowel and vascular injuries should be virtually nonexistent [4, 13, 16]. However, bowel injuries still occur at the same rate using this technique.

Of our Study Group members, 96.6% changed their method of establishing a pneumoperitoneum from the closed method to an open laparoscopic technique in order to increase patient safety during endoscopic surgery. The rate of complications related to needle and trocar insertion subsequently decreased as the surgeon's experience performing endoscopic surgery increased.

Vascular injuries, which occur in 0.1–0.6% of all patients, may involve abdominal wall vessels, major retroperitoneal vessels, or other intraabdominal vessels [1, 14, 15]. Injury to the major retroperitoneal vessels such as the aorta, inferior vena cava, and iliac artery or vein has a mortality rate of 9% [4].

Major vascular injuries occur in about 0.03–0.06% of the patients [17, 18, 20]. Injury to a major vessel is the second most common cause of death during laparoscopy, following anesthesia. A delayed diagnosis is common in such fatalities. The mechanism of injury involves the Veress needle in approximately two-thirds of all such cases and the insertion of the primary trocar in one-third of cases. Our study also showed that in nine of 10 patients the major

vascular injury was associated with the Veress needle and the primary trocar. In nine of 10 patients an open laparotomy was required to control bleeding. The best management of major vascular injury is prevention. The proper technique of Veress needle insertion and verification of an intraperitoneal location are the two most important steps [4]. If an injury occurs, the Veress needle should be left in place and an immediate laparotomy should then be performed to obtain vascular control.

Injuries to the vessels of the abdominal wall are a frequent source of morbidity, occurring in 0.25–6.0% of cases [14, 15]. Bleeding from abdominal wall vessels is usually manifested by troublesome oozing around the trocar, either internally or externally. In 30 of the 70 patients with bleeding from the abdominal wall, the bleeding spontaneously ceased during the operation after merely applying pressure with the trocar on the abdominal wall. Other initial methods of management include tamponade with a Foley balloon catheter or a lever to apply pressure to the posterior aspect of the anterior abdominal wall. Coagulation or ligation of the bleeding point externally or internally with a laparoscopic approach is an alternative method. Finally, if all such methods fail, a laparotomy should be done to stop the bleeding. Injuries to the abdominal wall vessels may also be avoided in thin patients by transillumination and by inspection of the abdominal wall prior to trocar insertion.

The complications of gastrointestinal injury are second only to hemorrhage in frequency. Half of the gastrointestinal tract injuries during operation are due to trocar insertion. The incidence in large series has been reported to range from 0.06 to 0.4% [7, 9–12, 15, 19, 20] and has been associated with a relatively high mortality rate of 5%. The injuries most frequently involve the small intestine, followed by the colon, duodenum, and stomach [6]. These injuries are often unrecognized at the time of the laparoscopic procedures and are usually only detected later when the patient presents with peritonitis, sepsis, or intraabdominal abscess. The incidence of gastrointestinal tract injury was the highest in the 1st year after starting endoscopic surgery, but the incidence of such injuries has substantially decreased as the experience of the surgeons performing endoscopic surgery has increased.

The predominate late abdominal wall complication following laparoscopic surgery is hernia formation. Herniation through laparoscopic entry sites is uncommon, with an incidence of less than 0.1% [2]. It is possible that this complication has been underreported. Boike et al. [2] offered several guidelines that may reduce the occurrence of this complication. The surgeon should use smaller trocars (5 mm), if possible. The use of trocar anchoring devices such as fascial screws may increase the risk of herniation by widening the fascial defect. When ports larger than 10 mm are used an attempt should thus be made to suture the defect. If the surgeon elects not to close these incisions, then recommendations include the use of Z-track placement of trocars and the slow release of the pneumoperitoneum with direct visualization of the trocar removal to ensure that the bowel is not drawn into the abdominal wall. Selected cases of herniation may also be managed laparoscopically.

In conclusion, the complications related to needle and trocar insertion are preventable by placement under direct vision. Laparoscopic surgery is safe and effective when proper techniques are utilized.

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