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## Gasless Laparoscopic Surgery Using a New Intra-abdominal Fan Retractor System: An Experience of 500 Cases

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### Abstract

**Aim:** The aim of this study is to report the feasibility of a newly developed intra-abdominal fan retractor system for use in gynecologic laparoscopic surgery.

**Methods:** Five hundred women undergoing gasless laparoscopic surgery using the abdominal wall lifting device were included in the study. The intraoperative and postoperative courses, and complications were examined.

**Results:** The intra-abdominal retractor system provided adequate exposure in all cases, except for one patient with morbid obesity. Neither the presence of the intra-abdominal retractor blades nor the mechanical arm interfered with the placement of instruments during surgery. No complications related to the use of gasless laparoscopy were encountered in this study period.

**Conclusion:** The new intra-abdominal fan retractor system is feasible in gynecologic laparoscopic surgery.

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**Key words:** complications, gasless laparoscopy, laparoscopic surgery, pneumoperitoneum, abdominal wall lifting device

### Introduction

Laparoscopic surgery is rapidly replacing laparotomy for many gynecologic procedures. The advantages of laparoscopy are clear and include reduced recovery time, less postoperative pain, shorter hospital stay, and decreased cost. However, induction and maintenance of carbon dioxide pneumoperitoneum can have some serious adverse hemodynamic effects<sup>1</sup>. In addition, pneumoperitoneum can induce gas embolism<sup>2</sup>.

Gasless laparoscopic surgery using an abdominal

wall lift system has been established. Nagai et al described a technique in which long surgical wires placed in the subcutaneous tissue of the abdomen were used to winch the abdominal wall anteriorly for exposure in cholecystectomy<sup>3</sup>. Smith et al first reported the feasibility of a gasless system consisting of an intra-abdominal fan retractor and an electrically powered mechanical arm using conventional surgical and laparoscopic instruments in the evaluation of 27 patients with abdominal trauma<sup>4</sup>. This system has several advantages over carbon dioxide-based systems. First, it eliminates all complications associated by insufflation with carbon

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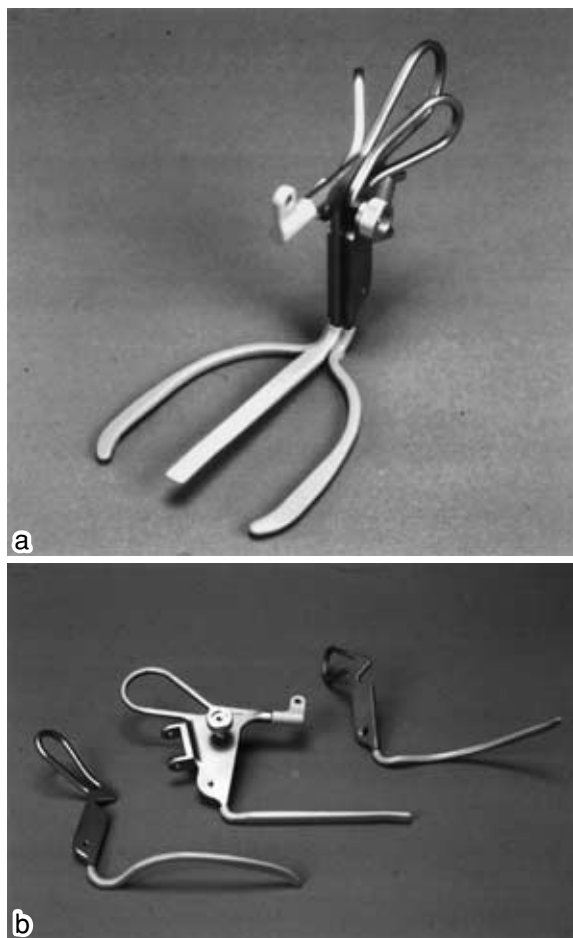


Fig. 1a, 1b Three intra-abdominal fan retractors. They are assembled with screws.

dioxide and the resultant high intra-abdominal pressure. Second, it enables laparoscopic surgeons to perform sophisticated procedures using conventional instruments, which makes laparoscopic surgery easier and less expensive<sup>4</sup>. In this paper, results using a recently developed retractor system<sup>5</sup> for gasless laparoscopy in gynecologic surgery are reported.

### Materials and Methods

The abdominal wall lifting device (Mizuho Ika, Tokyo, Japan) consists of three intra-abdominal fan retractors (**Fig. 1a, 1b**), a winching device, and a lifting bar (**Fig. 2**). All of them are reusable. Between January 1, 1999 and November 30, 2004, all women having a gasless laparoscopic surgery using the abdominal wall lifting device were included in the study. Informed consent was obtained for



Fig. 2 Winching device and lifting bar. The retractor system is attached to a lifting bar and pulled upward with a winching device.

gasless laparoscopic surgery and for possible conversion to insufflation with carbon dioxide or laparotomy. In all patients, a 1.5-cm periumbilical incision was made using an open technique. The laparoscope was introduced into the abdominal cavity through this incision, and exploration was conducted. Next, the three intra-abdominal fan retractors were introduced separately through the same incision and assembled in the abdominal cavity with screws. The retractor system was then attached to a lifting device, which was attached to the side rail of the operating table (**Fig. 3**). The abdominal wall was pulled upward with a small winching device. As two of the retractors are curved, the abdominal cavity took on a domelike configuration when elevated (**Fig. 2**). The laparoscope was then introduced behind the crotch of the fan retractor through the same periumbilical incision. Since an airtight trocar was unnecessary, both conventional surgical instruments and laparoscopic instruments could be introduced through the abdominal wall via 0.5- to 1-cm valveless trocars (**Fig. 4**).

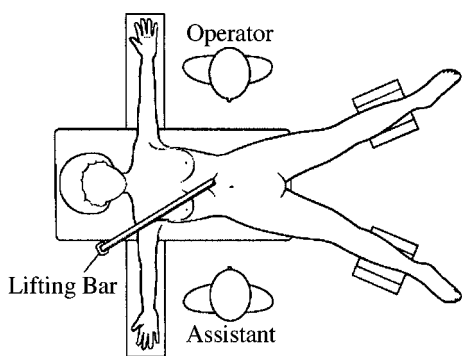


Fig. 3 Arrangement of gasless laparoscopic system. The lifting bar is attached to the side rail of the operating table.



Fig. 4 Abdominal view and valveless trocars. The laparoscope is introduced through the periumbilical incision.

### Results

Five hundred laparoscopic procedures were performed with the gasless technique in this study period, and patient characteristics are listed in **Table 1**. Ovarian cystectomy/oophorectomy was the most frequent indication for laparoscopy (n=205) (**Table 2**).

The mechanical abdominal distention system provided adequate exposure in all cases, except for one case of morbid obesity (BMI=38) that led to conversion to insufflation with carbon dioxide. The presence of intra-abdominal retractor blades and the mechanical arm did not interfere with the placement of instruments and usually did not obstruct movements of the surgeon and assistants.

No complications related to the use of gasless

Table 1 Patient characteristics of gasless laparoscopic surgery

Characteristic	
No. of Patients	500
Age (y)	34.2 ± 7.3
Body Mass Index (kg/m <sup>2</sup> )	23.4 ± 3.5

Jan. 1, 1999 ~ Nov. 30, 2004  
values are mean ± SD

Table 2 Details of gasless laparoscopic surgery during the study period

Operation	No.
Ovarian Cystectomy/ Oophorectomy	205
Endometriosis	32
Ectopic Pregnancy	82
Lysis of Adhesions	21
Myomectomy	113
LAVH	23
Others	24

LAVH: Laparoscopically Assisted Vaginal Hystrectomy

laparoscopy were encountered in this study period. The majority tolerated mechanical abdominal lift well; however, a small number of patients complained of mild upper quadrant abdominal wall tenderness that appeared to be secondary to abdominal wall distention. This symptom usually disappeared within a few days and did not require an extended hospital stay. Right shoulder pain, an occasional finding following pneumoperitoneum, was not observed in this series.

### Discussion

A clear intra-abdominal view is essential for laparoscopic surgery. While pneumoperitoneum is effective in providing exposure, significant metabolic and hemodynamic alterations are associated with the intraperitoneal insufflation of carbon dioxide. The arterial partial pressure of carbon dioxide and the endotidal carbon dioxide levels increase in a consistent manner. This phenomenon may seriously complicate the perioperative course of patients with obstructive pulmonary disease<sup>6</sup>. In addition, carbon dioxide pneumoperitoneum causes decreased cardiac

output and stroke volume, elevates central venous pressure, increases systemic vascular resistance and acidosis<sup>1</sup>. Additionally, pneumoperitoneum may have some detrimental effect on the fetus because of the pressure effect and chemical effect of absorbed carbon dioxide making it unsafe in pregnant patients<sup>7</sup>. Because of these hemodynamic and metabolic adverse effects, a combination of low pressure pneumoperitoneum and abdominal distention via a trocar placed through the abdominal wall was advocated in patients with a history of myocardial ischemia of obstructive pulmonary disease<sup>8</sup>.

The subcutaneous lift system (Mizuho Ika, Tokyo, Japan), in which a long surgical wire is placed in the subcutaneous tissue of the abdomen and used to winch the abdominal wall anteriorly for exposure, was invented to facilitate gasless laparoscopic surgery. The advantage of the subcutaneous lift system over the full-thickness wall lift system from inside the peritoneal cavity, as used in our patients, is its applicability in all patients regardless of dense adhesion in the peritoneal cavity or an enlarged gravid uterus. However, the intra-abdominal view with the subcutaneous lift system is limited compared to the full-thickness wall lift system, especially in obese patients. Therefore, the surgeon can choose the mechanical abdominal-wall lifting system according to the patient's body habitus, surgical and gynecologic history. Indeed, the subcutaneous lift system was chosen in 20 pregnant patients due to enlarged gravid uterus, and in 6 patients with dense adhesions in this study period.

Operative exposure provided by the three intra-abdominal fan retractors is somewhat different from that provided by carbon dioxide insufflation. This

exposure was usually adequate but was marginal in morbidly obese patients. Therefore, it is recommended to choose the pneumoperitoneum system in obese patients, whose BMI exceed 35.

In conclusion, the new retractor system is safe, easy to handle devices for use in gynecologic gasless laparoscopic surgery.

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