Gasless laparoscopic surgery is basically a laparoscopic procedure in which, instead of pneumoperitoneum, the operational space in the abdomen is created with the help of lifting abdominal wall by using different mechanical devices. Carbon Dioxide has emerged to be most versatile agent used inside the body to create pneumoperitoneum or space while as in Gasless Surgery no such Gas is used (1).

It is an innovation with great potential as Gasless laparoscopic surgery mitigates the problems associated with the traditional laparoscopic surgery (2). However, it has its own limitations.

The first gasless laparoscopy was made by Eruheim in 1911(3). And the first laparoscopic cholecystectomy was performed in 1985 by Muhe, using what he called a "Galloscope". Muhe operated patients using a simplified approach, namely laparoscopic cholecystectomy without pneumoperitoneum and without optical guidance (4). Of the 94 Laparoscopic Cholecystectomies in Mühe's initial series, the first six were done in a "traditional" laparoscopic fashion with pneumoperitoneum and working ports, and the remaining 88 were performed by “LC without pneumoperitoneum and/or without optical guidance (5-8).

Development of Gasless Laparoscopic Surgery

Mechanical support systems have developed over period of time and the earliest mechanics used simple devices which could suffice like the modern pneumoperitoneum. The hinged “T” retractor described by Gazayerli(9) was inserted through a trocar port in a straight configuration with the distal cross-member unfolding to support the abdominal wall. Also, a similar device was used by Semm and Lehman-Willenbrock(10) for abdominal displacement. Then Kitano and coworkers(11) described U-shaped retractor inserted into abdomen in subxiphoid region, passing into falciform ligament and exiting below the right costal margin. And a long 5mm trocar is placed inside the abdomen through the falciform ligament, pulling a guidewire into place. This whole system is supported by winch support on a framework over the patient’s chest.

Fig. 1: Prof. Eric Muhe
Other devices that were used prior to pneumoperitoneum include the Tri-X system described by Francois and Mouret(12) and the Coat-hanger system developed by Maher(13).

The final stage of development in gasless laparoscopy consisted of systems that did not require the initial pneumoperitoneum. Among these is the one described by Nagai and coworkers(14) involving the insertion of multiple Kirschner wires through the supra-umbilical area to lift the abdominal wall for laparoscopic cholecystectomy. Hashimoto(15) from Japan devised a technique that used two wires to define a plane in the subcutaneous space of the right upper quadrant, remaining subcutaneous with no exit incision. Suspension of the suture strands from the curved framework of the Kent retractor formed a cross structure above the patient elevating the abdominal wall by two wires. Chin and co-workers(16) developed a planar elevation system whose lifting surface was just like two legs of a device fanning out into a V-shaped retractor. This Laparofan from Medsystems Inc. (Medsystems Inc. Menlo Park, CA) was connected to a motor driven arm and is the only externally driven gasless lifting device in use today. Tsoi and Organ used this device in 1993 to perform first gasless laparoscopic cholecystectomy. (17)

Fig. 2. Galloscope of Muhe, with light conduction, pneumoperitoneum and instrument channel

**Why Gasless Surgery**
Modern surgery has become complex and technically sophisticated, and more so for minimal invasive surgery. Currently available data suggest that adequate exposure can be achieved using a variety of approaches, so surgeons found a way to get rid of the gas and still have a successful surgical outcome. Also understating the advantages and disadvantages of different approaches and methods is mandatory, for obtaining a viable, successful surgical result.

**Aim and Advantages of Gasless Laparoscopic Surgery**
The main aim of gasless surgery is to avoid the need for introduction of the insufflating gas especially carbon dioxide and reduce the cost of surgery. The various advantages of such a procedure are:

1. No Carbon dioxide is used.
2. No leakage of gas or loss of gas.
3. Since no carbon dioxide is used, the complications associated with the use of this gas are eliminated. There is no alteration of cardiac, pulmonary or renal functions. These parameters do not change even in reverse Trendelenburg position.
4. Usage of a combination of laparoscopic and conventional instruments.
5. Digital palpation and dissection may facilitate the performance of minimally invasive procedures.
6. Very good for pelvic surgeries and hence can be useful in such rural areas where the bulk of the surgeries are pelvic surgeries(2).

**Limitations of Gasless Laparoscopic Surgery**
Gasless surgery is not possible everywhere. It has its own limitations being very difficult in obese patients. It is almost impossible if the abdominal wall thickness is more than two inches and difficult if abdominal wall thickness is over one and a half inches. Although being very good for pelvic surgeries Gasless surgery is very difficult for complex upper abdominal procedures.
While in traditional laparoscopic surgery pneumoperitoneum results in a symmetrical dome shaped elevation of abdominal wall that usually provides excellent exposure of the all quadrants of abdominal cavity along with adequate working space, the mechanical or retraction system in gasless laparoscopic surgery provides a tent-like or a flat-topped pyramid-like working space limited to a specific quadrant of the abdomen.
In addition, there is a possibility of ischemic injury to abdominal wall muscles with intraabdominal lifting devices. Also, the abdominal lifting device can present as an obstacle in certain situations for a surgeon performing surgery.

**Abdominal Wall Lifting Techniques**
The method of abdominal wall lifting is basically based on the fundamentals of minimally invasive surgery combined with the conventional open surgery, thus preventing or minimizing the disadvantages, risks and complications that may arise by using carbon dioxide, while preserving the advantages of laparoscopy like minimal scars, better cosmetic results, less wound pain, rapid recovery, short hospital stay etc.
Insufflation of gas into the abdominal cavity is dispensed with and instead a special lift system which is inserted into the abdominal cavity through a small cut in the lower umbilicus, raising or lifting the abdominal wall mechanically. This technique allows a similar view into the abdominal cavity as that produced by the creation of pneumoperitoneum. To insert the instruments small incisions are made depending upon the area to be operated.
At present two groups of Suspension/Lift systems exist. These include:
1. Intra-abdominal Retraction System
2. Subcutaneous Lifting of Abdominal Wall

There are various modifications of these depending upon the procedure and site involved. Certain lift techniques use subcutaneous wiring while some use hook systems. But the idea of employing these different variations is to get optimal lift and exposure with the method used.

![Fig. 4. Laprolift Abdominal wall Retractor By Medsystems Inc. and Laprofan (Origin Medsystems)](image)

The Mechanical lift of the anterior abdominal wall (Laparolift) usage of LapVision System (Pajunk GmbH, Geisingen, Germany), and Gasless Single port RoboSurgeon Surgery Particularly in retroperitoneum are some of the advanced variations (18).

**Instruments used in Gasless Laparoscopic Surgery**

The various instruments that are used in gasless laparoscopic surgeries are:
1. Retractors
2. Suspension Mechanisms supporting the lift
3. Internal Bowel and organ retractors
4. Dissection Balloons for creating space in Extra-peritoneal spaces
5. Surgical Instruments which are both generic and specific
Applications of Gasless Laparoscopic Surgery
Although initially used and applied in transabdominal procedures, it has also found its usefulness for extra-peritoneal endoscopic procedures, especially for retroperitoneal surgery. In all these mechanical lift is used to gain the requisite working space.

Various procedures that have been performed are: (1)
1. Gasless Laparoscopic Cholecystectomy (7)
2. Bowel Reseaction
3. Both Right and Left Hemicolectomies
4. Abdominoperineal Resection and Hartman’s Procedure
5. Transverse Colectomy
6. Gasless Laparoscopic Nissan Fundoplication The largest series of such procedures has been performed by Benchetrit in Lyon France, comprising of 86 cases.
7. Gasless Laparoscopic Inguinal hernia repair
8. Gasless Laparoscopic Spine Surgery
9. Gasless Laparoscopic Bladder Neck Suspension
10. Gasless Laparoscopic Aorto-femoral Bypass
11. Other gynecological Procedures, like gasless laparoscopic vaginal Hysterectomy, Gasless laparoscopic myomectomy, Ovarian cystectomy etc have been performed (1). Also as reported by Jeffrey M. Goldberg and Tommaso Falcone, there was no significant advantage with Gasless laparoscopic procedures, rather the limited space was found to be difficult to work in(19).
12. Gasless Laparoscopy has also been tried in the management of Acute Abdomen.

Future of Gasless Laparoscopic Surgery
With the advent of newer lift systems and expansions devices or balloons and clip applicators combined with the improved instrumentation facilitating the tissue retraction and creation of better working space we may see new and more complex procedures performed by Gasless Laparoscopic method.

As more complex procedures develop, we see a compounding increase in the technological advance that can benefit the Gasless Laparoscopic Surgery(1). On the other hand, better and “an ideal” form of creating a pneumoperitoneum by way of development of technological innovations may totally change the current scenario.
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