Review of Literature
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Histological aspects

The first laparoscopic examination of the abdominal cavity was performed by Kelling in 1901 in a dog(1). Kelling created a pneumoperitoneum by injecting the abdominal cavity with air and inserting a cystoscope through the abdominal wall. Since Kelling was able to view the peritoneal cavity and its contents through the endoscope, he termed this new procedure ‘Celsiuscopy’. In 1911, Jacobaeus performed the first endoscopic examination of abdominal cavity in human and introduced the term “Laparoscopy”(2). In addition, Jacobaeus first described the diagnosis of cirrhosis, metastatic tumors and tuberculosis peritonitis, using the laparoscope. During the next two decades, laparoscope was introduced into the United States by Bernheim. Later Ruddock advocated “peritoneoscopy” and demonstrated improvement in diagnostic accuracy(4). In 1929, Kalk reported the use of a dual trocar technique which allowed simultaneous insertion of operative instruments and improve the diagnostic and therapeutic capabilities of laparoscopy(3). The safety of pneumoperitoneum was improved when Fervers advocated the use of oxygen or carbon dioxide rather than room air in 1930’s. Greater safety in the installation of gas was achieved by Veress, who developed a spring loaded needle, that could safely be introduced into the peritoneal cavity in patient with tuberculosis in 1938(10). In 1966, the Hopkins rod system was developed for rigid endoscope that greatly improved image clarity and brightness. In 1960, Kurt Semm, a German gynecologist and engineer contributed the development of an automatic insufflator that precisely controlled gas flow and monitored intra-abdominal pressures during laparoscopy. Semm also performed the first laparoscopic appendectomy in 1983(5,50). In 1987, Phillipe Mouret, in France, performed the first laparoscopic cholecystectomy in human(55).
Milestones in Laparoscopy

Bazzani (1805) first attempt to visualize the interior of a body cavity. He visualized human urethra by candle light and a tube as an endoscope.

Segalas (1826) refined the technique of uretheroscopy.

Desomeaox (1853) developed first serviceable uretheroscope and cystoscope using mirror to reflect light of a kerosene lamp.

Nietze (1877) added lens system to the endoscopic tube\(^{60}\).

George Kelling (1901) was first to perform laparoscopy using cystoscope in a dog\(^{1}\).

D.O.Ott (1901), Russian gynaecologist used ventroscope by using culdoscopy\(^{41}\).

- Jacobaeus (1910) termed laparoscopy. He performed 1\(^{st}\) laparoscopic examination of human peritoneal cavity\(^{2}\).
- Nordenloef (1911) introduced pneumoperitoneum and trendelenberg’s position for visualization of female pelvis.
- (1913) there was widespread use of laparoscopy in Europe and Scandinavia.
- Richard Zollikofer (1924) established CO\(_2\) as the gas of choice for insufflation.
- H. Kalk (1929) wrote “Experience with laparoscopy together with the description of a new instrument.” He also presented the role of angled laparoscope in diagnostic laparoscopy\(^{3}\).
- Frevers (1933) gave the perfect concept of pneumoperitoneum.
- Hope USA (1937) use of laparoscopy in ectopic pregnancy.
- Anderson USA (1937) performed tubal ligation through laparoscope.
- Janos Veress (1938) introduced an obturator needle for pneumoperitoneum known as Veress needle\(^{10}\).
- Donaldson (1942) performed uterine suspension through laparoscope.
- France (1944) used biopsy forceps through laparoscope.
Fourestier, Gladu and Valmiere (1952) developed high intensity remote light source.

(1956) Colour photographs through laparoscope were taken.

Prof. Kurt Semm (1960) automatic gas insufflator and importance of constant intra abdominal pressure\(^5\).

Neumann and Frick (1960) invented tentaculum clips across tube for sterilization.

(1964) First International symposium on laparoscopy held.

Steptae (1967) 1\(^{st}\) textbook on laparoscopy.


Dekok (1977) laparoscopic assisted appendectomy.

(1977) laparoscopy in general surgery was first used for liver biopsy under direct vision.

Warshaw (1986) used laparoscopy for staging of pancreatic cancer.

Mouret (1987) performed first laparoscopic cholecystectomy.


<table>
<thead>
<tr>
<th>Year</th>
<th>Investigator</th>
<th>Contribution</th>
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<tr>
<td>1901</td>
<td>Kelling</td>
<td>1(^{st}) laparoscopic examination of the abdominal cavity</td>
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<tr>
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<tr>
<td>1929</td>
<td>Kalk</td>
<td>Dual trocar technique</td>
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<td>1938</td>
<td>Veress</td>
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<td>1966</td>
<td>Hopkins</td>
<td>Development of rod lens optical system</td>
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<tr>
<td>1960's</td>
<td>Semm</td>
<td>Development of automatic CO(_2) insufflator and numerous laparoscopic instruments</td>
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<tr>
<td>Early 1980's</td>
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<td>Development of miniature TV camera chips</td>
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<tr>
<td>1987</td>
<td>Mouret</td>
<td>1(^{st}) laparoscopic cholecystectomy</td>
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THE ROLE OF DIAGNOSTIC LAPAROSCOPY IN NON-ACUTE ABDOMINAL CONDITIONS

Klingensmith ME et al (1996) in their retrospective study suggested that laparoscopy can identify abdominal pathology and improve outcome in a majority of selected cases\(^ {24}\).

Schiotroma M. et al, (1996) found laparoscopy is an effective tool for the evaluation of the patients with chronic abdominal pain and laparoscopic adhesiolysis cures or ameliorates chronic abdominal pain in more than 80% of patients\(^ {23}\).

Bronstein JA et al (1996) concluded in their study that difficulty and delay in diagnosis of abdominal tuberculosis can be minimized by laparoscopic or laparotomy biopsy. It is found far better than mantoux test or culture of ascitic fluid\(^ {30}\).

Miller K et al (1996) reported that laparoscopy provided diagnosis on 53 of 59 patients (89.8%). 5 out of 59 patients (8.5%) revealed no improvement of pain post-operatively and 6 out of 59 (10.7%) still suffer from pain at the time of the follow up\(^ {25}\).

Yu Sy et al (1997) reported that diagnostic laparoscopy benefits patients by avoiding unnecessary surgery, avoiding unnecessary delay in diagnosis and treatment and shortening the operative and hospitalized period. However, it provides only an alternative, not a substitute for traditional diagnostic procedures and never lessens the importance of conventional laparotomy\(^ {21}\).

Chas K. et al (1997) found diagnostic laparoscopy worthwhile for patients with right iliacfossa pain. Concurrent appendectomy should be considered in young patients with episodic, well localized symptoms associated with systemic malaise while adhesiolysis may be beneficial for visceroparietal adhesion beneath abdominal wall scar\(^ {22}\).

Bauma BJ. Et al (1997) reported that abdominal tuberculosis is often diagnosed in a late stage because symptoms are aspecific. Two
patients with intestinal tuberculosis and tuberculosis peritonitis respectively, both from endemic countries presented with long standing fever, abdominal pain and weight loss. Acid fast bacilli were present in aspirate and biopsy specimens obtained by colonoscopy and laparoscopy respectively. PCR was positive for M. tuberculosis complex and later M. tuberculosis was cultured. Both patients responded to anti-tubercular therapy\textsuperscript{32}.

Molanghin S. et al (1998) documented three diagnosed cases of abdominal tuberculosis over 12 months period in Melbourne Western Suburbs teaching hospital, which services a large migrant population. If migrants present with diffuse abdominal symptoms, the diagnosis of abdominal tuberculosis should always be considered. Laparoscopy should replace diagnostic laparotomy as a definitive diagnostic tool\textsuperscript{31}.

Levonius et al (1999) concluded from his retrospective study that laparoscopy is a safe and useful procedure in the diagnosis and treatment of chronic abdominal pain. He found adhesiolyis good or beneficial in his seventy seven percent of patients. Sixty percent of all patients reported a beneficial outcome after laparoscopy\textsuperscript{20}.

Stringel C. et al (1999) reported that diagnostic laparoscopy is a valuable procedure in the management of children with chronic recurrent abdominal pain. Based on their experience they recommended diagnostic laparoscopy early in the course of debilitating chronic abdominal pain in children. Appendectomy should be done when no other significant cause of abdominal pain has been identified even if appendix looks normal\textsuperscript{19}.

Lam KN. Et al (1999) has found that laparoscopic examination of the abdominal contents and the peritoneum is an effective way to obtain a conclusive diagnosis of abdominal tuberculosis\textsuperscript{29}.

Tison et al (2000) reported a case of 21 years old women suffering from abdominal pain and fever of 39 degrees, was hospitalized. Ultrasonography and CT-scan showed a large amount of ascitic fluid and one hepatic node. The serum Ca 125 level was
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elevated. PCR searching tuberculosis antigen in ascitic fluid was normal. A diagnosis of peritoneal tuberculosis was supposed and exploratory laparoscopy was done. Peroperative observation of the ascites with multiple sites of adhesion and pathological examination of hepatic nodule and peritoneum confirmed initial diagnosis. ATT was given for one year. A second laparoscopic procedure was performed and found no disease remaining\(^{(33)}\).

**Bromors AJ et al (2000)** reported that laparoscopic adhesiolysis has not yet passed the stage of clinical trial and requires objective evaluation, including detailed information on recurrence and de novo adhesions in correlation with clinical outcome\(^{(17)}\).

**Wipfli-Funke A. et al,** reported his study of 154 patients, who were operated because of chronic abdominal pain, in the lower abdomen 27(17.5\%), suspicion of adhesion 43(27.9\%), of an adnexal tumor 56(33.8\%), of endometriosis 5(3.2\%), sterility 11(10\%) or irreversible contraception 16(7.2\%). 112 patients had to be laparotomized once or several times, 105 women had only adhesion, 22 women had adhesion and endometriosis. In the last group there was the greatest number of laparotomies. 95 patients answered the questionnaires six months later. 35(36.8\%) were free from pain, 18(13.3\%) states a clear improvement, 38(40\%) were temporarily free from pain and 9(8.2\%) stated unchanged pain. One woman complained postoperatively about clear aggravation of pain\(^{(35)}\).

**BASIC PRINCIPLES OF LAPAROSCOPY**

**Indications**

Laparoscopy (peritoneoscopy) is a procedure, which allows direct examination of large portions of the surface area of the liver, gallbladder, spleen, peritoneum and pelvic organs. The addition of direct biopsy increases diagnostic accuracy. Laparoscopy is simple, safe and well tolerated under local anesthesia. General anesthesia is
neither necessary nor desirable, except in special circumstances. While sterile conditions are required, laparoscopy need not be performed in an operating room, also routine backup by a surgical or anesthesia team is usually not required. The procedure may be performed on an outpatient basis, although more commonly it is an inpatient procedure. Despite the advent of newer imaging techniques (e.g. computerized tomography, ultrasonography, magnetic resonance imaging), with fine needle biopsy capability, laparoscopy remains a valuable tool when appropriately applied in a thoughtful diagnostic plan. In the final analysis, local experience and results will determine the preference for each of these diagnostic modalities.

Although diagnostic laparoscopy has an associated mortality and morbidity, problems can be limited by careful selection of patients. Several studies have documented adverse cardiopulmonary effects of pneumoperitoneum\(^{(39)}\) and therefore, it is important to carefully screen patients who have underlying pulmonary and cardiac disease. Since many older patients with potential neoplasm's have associated chronic obstructive pulmonary disease and coronary artery disease a full work-up including appropriate laboratory and imaging studies should be done prior to diagnostic laparoscopy. Similarly laboratory evaluation for coagulation defects is extremely important. It is also important to assess the platelet count preoperatively and to achieve platelet levels of atleast 20,000 to 30,000 per mm\(^3\) prior to diagnostic laparoscopy\(^{(16)}\).

While the determination of the etiology of ascites is usually straightforward by history, physical examination, and analysis of ascitic fluid, the diagnosis of tuberculous or carcinomatous ascites may be elusive. In such cases, laparoscopy with biopsy is highly accurate.

Blind percutaneous liver biopsy is often used to confirm the diagnosis of cirrhosis. When this approach yields inconclusive results, laparoscopy should be considered. Since percutaneous liver biopsy may be more difficult and hazardous in patients with small livers or in those with large volume ascites, laparoscopy is preferable to blind
biopsy. While it is believed that laparoscopic guided liver biopsy is safer in cirrhotic patients with borderline coagulation defects, this point has not been verified\(^9\).

The surgeon endoscopist who undertakes laparoscopic examination should also have available accessories needed for biopsy or cytologic studies. Acquaintance with two or three approaches will also be helpful, depending on the information to be obtained. A percutaneous core biopsy needles should be available if directed biopsy is anticipated. The primary accessory instruments required for diagnostic laparoscopy are non-crushing biopsy forceps, atraumatic graspers for manipulation of bowel and omentum, intra-abdominal retractors for lifting hepatic lobes or if the retrogastric area is entered, the stomach and the usual array of equipment for controlling bleeding resulting from biopsy. It is also important to position the feet at 90\(^\circ\) angle on a foot board to avoid neurologic injury during prolonged laparoscopic examination.

Although abdominal assessment for cancer may be achieved without laparoscopy, this technique will be helpful when studies have been unrevealing or equivocal. Patients with unexplained ascites, abdominal pain, weight loss, or palpable masses would be better treated with early laparoscopy and directed biopsies than with multiple scans and blind biopsies.

Laparoscopy may be useful in the evaluation of suspected hepatic malignancy either primary or metastatic\(^{63}\). Eighty to ninety percent of these lesions are present on the hepatic surface and upto 2/3\(^{rd}\) of liver surface may be inspected. Blind percutaneous liver biopsy or image-guided needle aspirate biopsy is frequently employed as the initial diagnostic modality for suspected hepatic malignancy. Laparoscopy is appropriate when hepatic tumor is suspected but not proven by percutaneous biopsy techniques. Laparoscopy is also useful in detecting small (less than 2 cm) neoplasm's not seen by imaging modalities. When laparoscopy is utilized in the diagnosis and staging of
lymphoma and pancreatic or esophageal cancer, exploratory laparotomy may be averted in a significant percentage of cases.

**Contraindications to Laparoscopic Surgery**

**Absolute contraindications**
1. Uncorrectable coagulopathy.
2. “Frozen” abdomen from adhesions.
3. Intestinal obstruction with massive abdominal distension.
5. Severe cardiac dysfunction.
6. Concomitant disease requiring laparotomy.

**Relative contraindications**
1. Abdominal sepsis/peritonitis.
2. Pregnancy.
3. Morbid obesity.
4. Multiple previous abdominal operations.
5. Severe chronic obstructive pulmonary disease.

Pregnancy once was considered as absolute contraindication to laparoscopy because of the unknown effects of CO₂ pneumoperitoneum on the fetus. However several reports have demonstrated successful laparoscopic cholecystectomy in patients with severe biliary symptoms during the second trimester of pregnancy, without untoward effects in either the fetus or mother.  

The management of patients with severe COPD remains problematic. In some case, it may be possible to carry out the procedure under regional or local anesthesia. However the increased diaphragmatic pressure and CO₂ absorption from the pneumoperitoneum and intravenous sedation required may further compromise the pulmonary condition of the patient. However, the
advantage of a minimally invasive approach in such patients is that there is less impairment of post-operative pulmonary function that there is with conventional open surgery\(^{(37, 43, 44)}\).

If tense ascites is present, large volume paracentesis can be performed as the preliminary step in the laparoscopy. Previous laparotomy incisions may necessitate alteration of the usual trocar insertion site, or may represent a contraindication to the procedure\(^{(48)}\).

Laparoscopy is typically performed under general anesthesia, and thus exposes patients to certain risk. Staging laparoscopy can also be performed under local anesthesia with conscious sedation\(^{(38)}\). This approach avoids the risk and exposure of general anesthesia but limits extensive manipulation, particularly blunt dissection into the lesser sac and the use of laparoscopic ultrasound (LUS), due to potential discomfort to the patient.

Monitoring during laparoscopy should include electrocardiographic monitoring, end tidal CO\(_2\) monitoring, blood pressure evaluation using either a cuff or an indwelling arterial line, and a bladder catheter that allows the urine output to be evaluated and decompression of the bladder for trocar insertion. A nasogastric tube should be routinely passed, in order to facilitate gastric emptying during the procedure\(^{(36)}\).

**LAPAROSCOPIC COMPLICATIONS**

**Pneumoperitoneum Related Complications**

1. CO\(_2\) embolism.
2. Hypercarbia.
3. Respiratory acidosis.
4. Subcutaneous emphysema.
5. Pneumothorax.
6. Pneumomediastinum.
7. Transient dysrhythmias.
Insertion Related Complications
1. Major vascular injury.
2. Gastrointestinal injury.
4. CO₂ embolism.
5. Abdominal wall hemorrhage.

Post-insertional Complications
1. Gastrointestinal perforation (acute or delayed).
2. Laceration/bleeding from solid organs (liver, spleen, kidney).
3. Hernias of abdominal wall.
   In most reported series, complications are minor and occur with a frequency of 1.5 % and mortality rate is approximately 0.05%.