

Laparoscopy and laparoscopic surgery

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Abstract

Laparoscopic surgery is an essential component of modern gynaecology. It has rapidly evolved from a simple diagnostic technique to a complex therapeutic surgical option for many gynaecological problems, both in emergency and elective settings. A sound knowledge of pelvic anatomy, equipment, entry methods and operative techniques is essential for safe and effective laparoscopy. Patient selection, pre-operative evaluation and counselling are important with good communication between surgeons, patients, anaesthetists and theatre staff. Application of optimal laparoscopic ergonomics will reduce risks to the surgeon. Prompt recognition and management of complications is vital with involvement of other surgical specialities when required. Regular training in minimal access surgery is essential to ensure safe and efficient laparoscopic surgery. A combination of operative experience in theatre and simulation learning is ideal.

Keywords ergonomics; gynaecology; laparoscopy; laparoscopic surgery; minimal access surgery; simulation; skills acquisition; theatre layout; training

Introduction

Laparoscopy is a surgical method by which the peritoneal cavity may be visualised in the absence of a large abdominal incision. The role of laparoscopy in modern gynaecology has expanded rapidly over the last 25 years, from an initial diagnostic test to one that involves complex therapeutic techniques. The first recorded endoscopic procedure was performed by Kelling in 1901, in Germany. The first laparoscopy in gynaecology was a sterilisation procedure performed by Bösch in 1936, in Switzerland. With the development of equipment, including electrosurgery, increasingly complex surgery has become possible. Development has been particularly rapid since the mid 1980s.

Surgical practice in gynaecology has been revolutionised by the use of laparoscopic techniques, many of which are now considered routine. Between 2014 and 2015, more than 72,000 procedures were coded as having been performed laparoscopically by gynaecologists in England. Both recovery times and length of hospital stays are shorter whilst post-operative pain is reduced. There are, however, associated risks to be considered.

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These can be reduced by thorough pre-operative evaluation. The learning curve for acquisition of laparoscopic operative skills is steep and appropriate training in this area is therefore essential.

Laparoscopy versus laparotomy

The benefits of laparoscopy are well known and many gynaecological procedures may now be performed via the minimal access route. There are a number of advantages to the patient with laparoscopic surgery versus open surgery including the utilisation of smaller skin incisions, reduced post-operative pain and reduction in post-operative scarring. Less pain leads to the use of less post-operative analgesia, shorter hospital stays and faster recovery and return to normal activities. Such procedures are also associated with less intra-operative haemorrhage and less use of blood transfusions. With a reduction in exposure of internal organs to the external environment, infection rates are also reduced. The cost of complex laparoscopic surgery such as hysterectomy compared to open surgery is often greater. This, however, is off set by shorter hospital stays, quicker recovery and return to work.

Whilst laparoscopic surgery demonstrates clear advantages to women, a different set of surgical skills is required when compared to those necessary for open surgery. Laparoscopic procedures may be technically more challenging for surgeons with limitation of range of motion at the surgical site, resulting in potential loss of dexterity, less perception of depth and less tactile sensation. Visiospatial awareness is essential for laparoscopy and motor skills may be technically more challenging to learn when compared to open surgery. Laparoscopy may be more advantageous in obese women where laparotomy may yield extremely poor views of the intra-abdominal cavity.

Pre-operative evaluation and patient preparation

Optimal pre-operative evaluation is vital prior to undertaking laparoscopic surgery in order to reduce both anaesthetic and surgical complications and improve surgical outcomes. Risk factors such as obesity, a low body mass index (BMI), previous surgery, previous intra-abdominal infection, inflammatory bowel disease and medical conditions must all be considered. A good history and accurate pre-operative counselling of women are essential.

Box 1 highlights some relative contraindications to laparoscopy. Few, however, are absolute.

Relative contraindications to laparoscopy

- Significant cardiorespiratory compromise
- Obesity
- Diaphragmatic hernia
- Significant intra-abdominal adhesions
- Large pelvic mass
- Haemodynamic instability or hypovolaemic shock
- Intestinal obstruction
- Some malignant disease
- Pregnancy

Box 1

Adequate discussion between anaesthetic and surgical teams is essential for women with co-morbidities. The cardiovascular changes associated with laparoscopy may be particularly unacceptable for women with significant cardiac and/or respiratory compromise. In women with previous surgery, the possibility of intra-abdominal adhesions should be considered.

Whilst haemodynamic instability is a relative contraindication, laparoscopy may provide a number of advantages to open surgery if performed by a gynaecologist with the appropriate skills. These include better visualisation of the abdominal cavity, reduced intra-abdominal bleeding secondary to compression from the pneumoperitoneum and the ability to control bleeding effectively with minimal tissue handling.

In pregnancy, open surgery has been the tradition for removal of adnexal cysts. Whilst many still prefer this surgical option, there is growing evidence that laparoscopic surgery is safe in all trimesters, the safest time being the second trimester when miscarriage and pre-term labour rates are lowest.

Laparoscopic ergonomics

The benefits of gynaecological laparoscopic surgery are well established, but the effects on the surgeon of performing such surgery is rarely reported. Minimisation of risk to the surgeon may be achieved with optimisation of theatre layout, correct positioning of the surgeon and assistant and use of appropriate instruments.

Ergonomics is the science of making the environment favourable for the surgeon. Rates of musculoskeletal injury have increased amongst gynaecologists as the utility of laparoscopic techniques has increased. Development of more advanced and prolonged procedures has also contributed to the situation. Areas such as the back, neck, shoulders, proximal upper limbs and thumbs have been particularly implicated. It is therefore essential that the surgeon is as comfortable as possible throughout the procedure. With appropriate knowledge and training, the operating theatre may be adapted to facilitate optimal operative ergonomics. **Box 2** outlines key factors in optimising laparoscopic ergonomics.

Consent

Women should be fully informed of the risks and benefits of laparoscopic surgery compared to open surgery. Risks directly related to the entry technique used, visceral damage (damage of bowel, urinary tract and major blood vessels), infection and thromboembolism rates, blood transfusion and port site complications (e.g. haematoma formation and post-operative hernia formation requiring further surgery) should be discussed. Outcomes associated with surgery including the surgeon's experience in the procedure are also relevant.

All patients undergoing laparoscopic procedures should be made aware of the risk of conversion to laparotomy and the associated longer hospital stay and recovery period.

Equipment

In order to achieve safe and effective surgery, the surgeon must have a sound understanding of the basic and specialised equipment required.

Key factors in optimising laparoscopic ergonomics

- Placement of a gel mat under the surgeon's feet
- Attention to the number and duration of cases within each theatre session
- Optimal positioning of patient to maintain surgeon in a comfortable operating posture
- Position theatre assistants appropriately
- Maintain operating instruments at elbow height with shoulders relaxed
- Lower table height after insufflation to maintain ergonomic operating surface height
- If using a step, ensure balance is achieved with easy access to foot diathermy controls
- Ensure correct positioning and height of the video monitor to avoid neck and eye strain. A downward viewing angle of 15 degrees is recommended with the distance between surgeon and monitor dependent on the monitor screen size.
- Utilise instruments with maximum ease of manipulation
- Consider arm rests for prolonged procedures

Box 2

Cameras are usually high definition (HD) providing very clear images with good resolution. The camera incorporates the camera head, its cable and the camera control unit (CCU). The lens, also known as a coupler, screws on to the camera head and magnifies the image. Typically, the camera head includes a colour bar button, white balance, focus and image capture buttons. With improving technology, the use of 3D systems is now more widespread, facilitating improved depth perception.

Laparoscope diameters vary from 2 to 12 mm whilst the angle of view varies from 0 to 90 degrees. The shaft of the telescope contains a quartz lens system with high clarity.

The light source is an important component of basic laparoscopic equipment. A fiberoptic cable transmits light via the telescope into the abdomen. All light sources use xenon, halogen or mercury bulbs. Xenon sources produce optimal illumination. For standard laparoscopy, a 5 mm diameter cable with a length of 240 centimetres should be utilised. Light cables should be checked at each use to ensure the fibres remain intact thus ensuring optimum light transmission.

The insufflator is an essential part of equipment necessary for the delivery of carbon dioxide (CO₂) and subsequent observation of abdominal and pelvic cavities. The latest insufflators incorporate a gas-heating system to avoid lowering of body temperature. They should have a variable flow rate setting with a range of 0–40 litres per minute. Machines have an automatic cut off when the set pressure is reached with an alarm sounding at this point. Carbon dioxide (CO₂) is the gas of choice as it is inert, non-flammable, non-toxic, readily absorbed into the patient's circulation with low solubility in body tissues, non-combustible and odourless. It is also inexpensive and excreted by the lungs and kidneys.

All laparoscopic procedures use cannulae to support the laparoscope/instruments and facilitate access to the peritoneal cavity. They consist of a hollow cannula and an internal removable obturator. Most modern trocars are disposable and

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