Abdominal access techniques (including laparoscopic access)

Nabeel Merali

Sukhpal Singh

Abstract

This article discusses the safe exposure of intra-abdominal organs using laparoscopy and laparotomy. Newer methods of minimal access surgery including single incision laparoscopic surgery (SILS), and natural orifice transluminal endoscopic surgery (NOTES) are also discussed. Common abdominal incisions are illustrated.

Keywords Laparoscopy; laparotomy; natural orifice transluminal endoscopic surgery; single incision laparoscopic surgery

Introduction

The field of general surgery is evolving and new technologies promise to lead us to an era of less-invasive procedures with the ultimate goal of scar-less surgery with reduced postoperative pain. Within this article, we will discuss the robust preparation and latest techniques on safe exposure and entry into the abdominal cavity and surgical site infection.

Brief history on abdominal access

The word laparotomy has Greek roots, 'lapara' referring to 'the soft parts of the body between the costal margin and hips' and 'tome' meaning 'cutting'. In 1809 Ephraim McDowell performed the first laparotomy on a kitchen table without anaesthetic. An ovarian cyst was removed from a 46-year-old lady who then survived to 78. The first laparoscopy in a human was credited to Hans Christian Jacobaeus of Sweden in 1910. Zollikofer of Switzerland substituted oxygen for carbon dioxide as an insufflator to reduce the risk of explosion and improve rapid absorption in 1924. The Hungarian Janos Veress created the spring-loaded needle in 1938. In 1950, Hopkins designed a rod lens system, which made the laparoscope more rigid and robust, giving a brighter image.

In 1981, a German gynaecologist Kurt Semm published on the first laparoscopic appendicectomy. Eriche Mühe of Böblingen, Germany performed the first laparoscopic cholecystectomy in 1985. This achievement was recognized by SAGES (The Society of American Gastrointestinal Surgeons) in 1999. Laparoscopic cholecystectomy rapidly became the gold standard after Phillipe Mouret performed the first one in France in 1987. Thus therapeutic abdominal laparoscopy had begun and minimally invasive laparoscopic methods are now routinely used in many branches of surgery.

Preparation in the operating theatre

The abdomen of the anaesthetized patient should be examined as further information regarding intra-abdominal pathology may be elicited when the musculature of the abdominal wall is relaxed, influencing the surgical approach. Common abdominal incisions are shown in Figure 1.

Positioning

The main reason for placing a patient in a specific surgical position is to optimize access to the area of interest. The patient must be placed on a non-slip surface. Safe positioning is a critical perioperative component that the surgeon must lead and ensure that the patient is stabilized and protected from injury. Several factors can increase the risk for injury related to positioning, such as type of surgery and anaesthetic, time of surgery, age, weight and nutritional status, comorbidities and the improper use of theatre equipment.

Most often a supine position is used; however, for surgery involving the pelvis or perineum, the Lloyd–Davis or lithotomy ('legs up') positions provide better access. In the latter, so named from the Greek to 'cut for the stone', the patient is supine with the buttocks placed at the lower break in the table and the legs flexed at the hips and knees, with sufficient abduction to allow access to the perineum. The lower legs are placed in attachable pneumatic supports or hanging stirrups. In the Lloyd-Davies position, often used in colorectal surgery, the legs are abducted with slight flexion of the knees and hips. Supports are now usually a cushioned boot design to reduce pressure, especially on the popliteal fossa and common peroneal nerve. Prolonged placement in this position increases the risk of deep venous thrombosis or compartment syndrome and intermittent pneumatic compression can be applied to reduce the former.

The position may be further adjusted to facilitate different steps of the operation; however, this may cause physiological effects, especially with pneumoperitoneum for example:

- Trendelenburg (head-down, to facilitate access to the pelvis) – This position may reduce venous pooling in legs and enhance venous return. However, gravity will impact on pulmonary capillary blood volume and decrease lung compliance creating a greater need for ventilator pressure support. Increased cardiac output would lead to an increased intro-ocular and intracerebral pressure.
- Reverse Trendelenburg (head-up, for better access to the upper abdomen) – This position may be unavoidable in operations like gastric-bypass or fundoplication and improves visualization of upper abdominal structures. However, gravity combined with pneumoperitoneum will increase pooling of blood in legs, decreasing venous return and cardiac output. To minimize the impact of the pneumoperitoneum upon venous return and stasis in the legs, one must only use this manoeuvre when necessary, with calf compression stockings, low intra-abdominal pressures and avoidance of extreme flexion of the hips and knees.
- Left, right tilt or prone position – Decreases the compliance of the lungs and the ability of the thoracic ribcage to expand.

Nabeel Merali *MRCS MSc is a Surgical Research Fellow at Frimley Park Hospital, Frimley, UK. Conflicts of interest: none declared.*

Sukhpal Singh *FRCS (Gen Surg) MS is a General and Upper Gastrointestinal Consultant Surgeon at Frimley Park Hospital, Frimley, UK. Conflicts of interest: none declared.*

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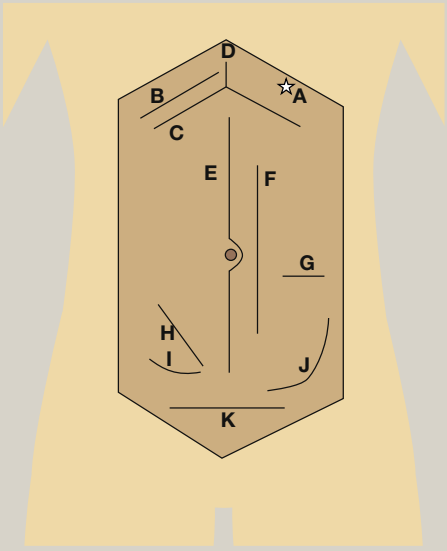
Common abdominal incisions



Name of incision	Commonly used for
A Palmer's point	Insertion of Veress needle
B Kocher's	Open cholecystectomy
C Rooftop	Liver surgery
D 'Mercedes Benz'	Liver transplantation
E Midline	Can be upper, lower – many abdominal operations
F Paramedian	Now less commonly used for laparotomy
G Transverse	Closure of stomas
H Gridiron	Open appendicectomy (now old fashioned)
I Lanz	Open appendicectomy
J Rutherford Morrison	Renal transplant (either on left or right side of abdomen)
K Pfannenstiel	Gynaecological, laparoscopic colectomy

Figure 1

Surgical site infection

Many aspects of perioperative management are aimed at reducing surgical site infections (SSIs). SSI is a large subject area that cannot be covered in its entirety in this article; however, we will cover a number of relevant aspects. For further reading please refer to the 'Infection' issue of *Surgery*.

Preoperative removal of hair

If it is necessary to remove hair then both clipping and depilatory creams in the 24 hours prior to surgery results in fewer SSIs than shaving using a razor.

Skin cleaning preparation

Skin is cleaned with an antiseptic agent, usually povidone-iodine or chlorhexidine in either aqueous or alcoholic solution, progressing from the incision site to the periphery.

Areas of high microbiological counts (groin, axilla, pubis, open wounds) should be prepared last and stoma sites isolated from the prepared area. The antiseptic agent must remain on the skin for sufficient time to achieve maximum effectiveness. This is the time taken to air-dry for alcoholic agents; at least 30 seconds is needed for non-alcoholic agents. Alcohol-based solutions are quick, sustained and durable, with broader spectrum antimicrobial activity. However, they should not be used on mucous membranes or open wounds. Care must be taken to prevent alcoholic antiseptic agents from pooling beneath the patient or around diathermy pads to reduce the risk of diathermy burns or fire.

Drapes

The prepared area of the skin and drape fenestration should be sufficiently large to accommodate extension of the incision, the need for additional incisions, and all potential drain or stoma sites. The passage of bacteria through surgical drapes is a potential cause of wound infection so the drape type should be appropriate for that procedure. Drapes may be linen or impermeable (disposable or non-disposable) materials. Impermeable drapes result in significantly fewer bacteria in the operative field and wound compared with permeable linen drapes (through which bacteria can easily penetrate). Adhesive plastic drapes, with or without iodine impregnation, through which the surgeon makes the incision, are sometimes used.

Diathermy versus scalpel skin incisions

Skin incisions have traditionally been made using a scalpel. Recent literature has shown that skin incisions made by cutting diathermy are quicker, result in less blood loss and have no differences in the rate of wound complications or postoperative pain.

Wound irrigation

Organisms that are formed from the incision of skin or contaminate the wound can theoretically be washed away with wound irrigation. One study compared 283 patients undergoing surgery for acute appendicitis and compared the risk of SSI after saline wound irrigation to no irrigation. A statistically significant difference in wound infection rate favouring saline wound irrigation in appendicectomy was demonstrated.[1] Within the literature, Povidone-iodine may reduce SSI in wound irrigation; however this is only licensed for use on intact skin.

Surgical approach

Colorectal surgery has been associated with a high rate of SSIs. A meta-analysis compared the risk of SSI between open and laparoscopic surgery for general surgical operations in obese patients. Eight randomized controlled trials and 36 observational studies were included and concluded that laparoscopic surgery in obese patients reduces SSI rate by 70%–80%.[2]

Laparoscopy

Diagnostic laparoscopy is a minimally invasive surgical procedure that allows direct inspection of the abdominal cavity as well as surgical intervention in a less traumatic setting. It has the benefits of smaller incisions, better cosmetic results, less postoperative

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