

Various Port-site Closure Techniques in Laparoscopic Surgeries

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ABSTRACT

Introduction: Minimally invasive surgeries are the advantageous and cosmetically better surgical procedures nowadays. But laparoscopic trocars do create wounds. It is necessary to close these wounds with a good technique in order to decrease the complications related to port-site complications, especially hernia.

Aim: This study is to review and list different techniques used for closure of port-site wounds.

Materials and methods: A literature search was performed for the articles related with techniques of closure of trocar sites. For this purpose, the search engines used were Google, HighWire Press, and SpringerLink. Only those techniques that include the usage of suture materials, suture carriers, and various needles were reviewed in this study. Special devices made for port-closure are not reviewed here.

Results: The study describes many techniques, including classical closure using curved needles, such as the Grice needle, Maciel needles, spinal needles, dual hemostat, suture carrier, modified Veress needle with a slit made in retractable blunt tip, dental awl with an eye, prolene 2/0 on straight needle aided by Veress needle, straight needle armed with suture, modified Veress needle bearing a crochet hook at tip; Foley catheter threaded through port-hole for elevation of fascial edge upon traction; fish-hook needle improvised out of a hypodermic needle by bending it to 180°; U-shaped purse-string suture placed in the fascia around port-hole.

Conclusion: There are plenty of techniques for closure of trocar-site wounds, all of them are effective in closing the fascial defect of abdominal wall.

Keywords: Laparoscopic surgeries, Port-site closure techniques, Trocar-site hernia.

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INTRODUCTION

In 1996, the modern era of laparoscopy started with the invention of Hopkin-Rod system by Professor Hopkins.¹

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Minimally invasive surgeries are the advantageous and cosmetically better surgical procedures nowadays. But laparoscopic trocars do create wounds. So any surgeon, whether a neophyte or an expert, needs a systematic approach to exit the abdomen after any laparoscopic procedure. It is necessary to close these wounds with a good technique in order to decrease the complications related to port-site complications, especially hernia. Precise anatomical closure of abdominal wall fascia of port sites 10 mm or larger is mandatory. Because larger ports can cause increase in possibility of complication following surgery.² These complications include incisional bowel herniation as well as bowel obstruction.^{3,4} Many techniques and devices have been introduced into practice to minimize risk of port-site complications which occur in 1 to 6% of cases.^{5,6} It is recommended that all 10 and 12 mm trocar sites in adults and all 5 mm port sites in children be closed, incorporating peritoneum into fascial closure.⁷⁻¹⁰ A number of techniques have been developed in an attempt to prevent trocar-site hernia, but there is still no gold standard. Traditional suturing techniques have been used, but proven to be blind closure of fascial defect.¹¹ Therefore, many modified techniques using various devices and needles have been developed to facilitate the aim of prevention of trocar-site hernia.

MATERIALS AND METHODS

A literature search was performed for the articles related with techniques of closure of trocar sites. For this purpose, the search engines used were Google, HighWire Press, and SpringerLink. The term used for search was port-site closure techniques. All the articles dealing with port-site closure methods were reviewed along with their references.

RESULTS

Port closure techniques can be classified from technical point of view into two groups:

First group: Needle must be seen through telescope (laparoscopic visualization).

Second group: Needle must be seen by surgeon and no telescope required for it (no laparoscopic visualization).

First Group

In this group, port closure is performed from inside the abdomen under direct visualization of telescope, so as to avoid visceral injuries. They include maciol needles, grice needle, catheter or spinal needles, modified veress needle with a slit made in retractable blunt tip, prolene 2/0 on straight needle aided by a veress needle, straight needle armed with suture, modified veress needle bearing a crochet hook at tip, and Veress needle loop technique.¹²

Grice Needle

It was used by Stringer et al¹³ It was inserted into the abdomen at an angle by the side of trocar site to close. Then under direct telescopic vision the needle was placed through both peritoneum and fascia. Within abdomen, the suture was grasped and removed from Grice needle with a grasper inserted from opposite trocar. The Grice needle was then removed and reinserted at opposite site of previous puncture at an angle to trocar site. The suture was again grasped with Grice needle and pulled out of the abdomen. After complete removal of trocar, the suture was tied under direct laparoscopic visualization.

Maciol Needles

Contarini¹⁴ used these needles. They are a set of three needles which include two black handled introducers, one straight and one curved, and a golden-handle retriever. The introducer needle is used to pass suture through abdominal wall into peritoneal cavity from subcutaneous tissue. The retriever needle (needle with a barb) is then passed into abdomen on opposite side of the defect to retrieve suture, and then pulled back through tissue. The procedure is performed under direct telescopic visualization before trocar withdrawal and does not require skin incision enlargement.

Vein Catheter, Spinal Needle, and Angiocath

Vein catheter, spinal needle, and angiocath were used by Nadler et al¹⁵ under direct laparoscopic visualization. No.0 polypropylene suture is threaded through a 15 gauze needle and inserted along the umbilicus at an angle of 45° from the distance of 0 to 5 to 1 cm. After piercing an endograsp, forceps is used to pull the free edge of suture edge into abdomen. It goes all around umbilicus, penetrated all layers of subcutaneous tissue including fascia, and create a purse-string suture by continuously running stitches. The whole procedure is repeated three times until the purse-string stitch is made. For use of angiocath, a 14 gauze angiocath is used with a 50 cm no.0 braided polyglactin suture. Angiocath and

suture are inserted through all the layers of fascia one on side of port-wound under laparoscopic visualization. The needle and suture are placed exactly in the middle of one side of port-wound. The assistance grasps the suture from another 5 mm port and needle is removed; then suture feeded into abdominal cavity of about 10 to 15 cm length. Then a 5 mm grasping forceps is inserted through subxiphoid or other port and suture removed from abdominal cavity. These four steps are repeated by passing another preloaded angiocath needle and suture through midpoint of other side of trocar-wound. Ends of the suture are tied together with square knots. Knot is then reduced into peritoneal cavity by pulling on one or both ends of tied suture. The fascia is then closed and suture tied under direct vision through laparoscope.

Veress Needle Loop Technique

Hamood and Mishra¹⁶ used it making a loop by passing nylon suture to Veress needle and tied it. Then load the Vicryl suture to Veress needle tip and push the Veress needle with loop through abdominal wall without piercing the skin, 3 mm away from the trocar site. Then remove the Veress needle, leaving the Vicryl inside only by putting a finger on Vicryl, grasped Vicryl by grasper and pass it to other side of trocar to push it inside the Veress loop. Then after piercing the abdominal wall, leave the skin and then remove the trocar close to the wall by knotting.

The 5 mm Trocar Technique

Chapman¹⁷ developed a simple technique using curved needle and sutures for closure of rectus sheath defects at trocar-wounds. First, with 5 mm telescope the defect is inspected from inside of abdomen and then pass a hemostat through the incision. Then under direct laparoscopic vision the peritoneum and rectus sheath are grasped and pulled through incision, thus by facilitating the passage of needle. Chatzipapas et al¹⁸ developed a similar closure technique using standard suture with straight needles, a 5 mm laparoscopic grasper, and a 4 mm hysteroscope.

Second Group

The port to be closed is under direct vision of the surgeon in this group and for this purpose good insufflation of abdomen is a prerequisite. But if desufflation is performed, then a tactile feedback should be used to close the port-wound. These techniques are applicable during insufflation and desufflation. They include suture carrier, the dual hemostat technique, the Lowsley retractor, and application of bioabsorbable hernia plug in trocar sites.¹⁹ It included preliminary fascial stay-suture placement above and below trocar-wound, Foley's catheter threaded

through the port-hole for elevation of fascial edge for traction, fish-hook needle improvised out of a hypodermic needle by bending it to 180°, and a U-shaped purse-string suture placed in the fascia around port-hole.

Suture Carrier

Jorge et al²⁰ and Li and Chung developed this carrier making use of vertical rather than horizontal space. It is a hook suture carrier modified from a simple hook retractor with an eye drilled into the tip through which suture can be threaded. Its handle is 24 cm long and size approximated to the size of general closure needle (CT needle, Ethicon, etc.). To start closure, the edge of fascia is lifted vertically with a hook retractor and the suture carrier is partially inserted into the wound to catch peritoneum and fascia under direct vision, piercing it from the undersurface. Then 0-polypropylene suture is threaded into the exposed eye of carrier and brought beneath the fascia. Then the suture is passed from the edge of opposite wound with carrier and taking a single stitch from in to out. Then a simple stitch is taken with knot on the surface of port-wound.

Dual-Hemostat Technique

Spalding et al²¹ used this technique using two hemostats and a needle holder with suture and needle. First hemostat is placed into the wound. Then the tops are spread open and the fascia is lifted away from underlying viscera. Then second hemostat is used to retract overlying subcutaneous tissue. Then the suture needle is passed through the fascia to exit between the splayed tips. This procedure is repeated at the opposite side of wound also.

Port Plug Technique

In this method the bioabsorbable hernia plug is used in the trocar site with the help of bioabsorbable hernia plug device.²²

DISCUSSION

Incidence of port-site hernia is about 0.23% at the 10 mm port-site and 1.9% at the 12 mm port-site. This incidence drastically gets increased to 6.3% when patients are obese with body mass index greater than 30 kg/m². This complication arises after laparoscopy when there is failure to reapproximate fascial wound edges of the big trocar wounds, infection, and premature suture disruption. A bulge either on coughing or even without it at a previous trocar-site should immediately raise suspicion of a trocar-site hernia.²³

Hernia at trocar-sites is classified into three types:

1. The early-onset type, which occurs immediately after laparoscopic surgery and with a small bowel obstruction.
2. The late-onset type, which occurs after few months of laparoscopic surgery, mostly with local abdominal bulge and no small bowel obstruction.
3. The special type, which indicates protrusion of intestine and/or omentum.¹⁰

The Richter hernia usually presents few days later and patient experiences delay in realizing its occurrence due to normal bowel function, which causes significant morbidity. It is a rare complication but a dangerous one. The usual symptoms include crampy abdominal pain with nausea and/or vomiting. Treatment is reduction of the bowel which is incarcerated followed by repair of the fascial defect. Some authors advocate open repair of hernia or local exploration combined with laparoscopy, but the minimally invasive approach is an acceptable treatment at the time of diagnosis but only as long as the incarcerated bowel is not ischemic.²⁴ Risk factors for the development of trocar-site hernia are diameter of the trocar-site, trocar design, preexisting fascial defects, some surgeries, and patient-related factors.⁵ Many authors believe that inserting a 10 mm trocar in an oblique fashion or Z-tract will reduce hernia formation by putting the external and internal defects at different levels. So it is recommended that all 10 and 12 mm size trocar wounds must be closed. At the end, the perfection of all closure techniques has proliferated and improvements are continuously being made. But the surgeon must be familiarized with the useful port-closure techniques which he/she feels comfortable with, easy to perform, simple, safe, and effective.²⁵

The comparisons among all these techniques are beyond the aim of this literature review. It is suggested that tighter closure of the skin incision may control the leak of ascitic fluid in patients with ascites, but only for a short time. The tight closure of fascia may prevent the ascitic fluid leak.¹⁴ For the closure of skin, the transcutaneous closure with absorbable suture material seems to be the most suitable technique.²⁶

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