Laparoscopic Port Closure Technique

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INTRODUCTION

Minimal access surgery is a routine surgical practice due to its minimal invasive and associated advantages. It has a lot of advantages but not devoid of complication, one of the major concerned complication is the trocar site herniation (TSH). TSH is a serious complication often requiring emergency repair. If unattended, TSH can lead to small bowel strangulation and incarceration.

The literature says that preventative measures should be taken to avoid the occurrence of herniation at the portal site. Fascial closure has been recommended as a means of TSH prevention. One study reported a statistically higher frequency of hernia at 12 mm port site where the fascia was left open (8%) compared with those that were closed (0.22%) following laparoscopy. There is a consensus that all the port site ≥10 mm should be closed due to an increased risk of herniation. For smaller ports, fascial closure may not be necessary, except when manipulated extensively.

Trocar site herniation is also associated with other technical factors other than the port site. Port location is another factor. There are many reports suggesting that umbilical sites are at greater risk of herniation when compared to lateral port sites. This is due to weakness of the fascia and absence of supporting muscle in the area. Stretching or even extending the incision of a port site during specimen extraction has a great risk hernia development. Factors such as high body mass index (BMI) are patient-related risk factors that are associated with TSH. Here it is related to increase intra-abdominal pressure and increase abdominal wall thickness. Studies show that wound infection is a predisposing factor to hernia development. Therefore, closure of fascia is necessary for umbilical ports, ports sites that are stretched or enlarged for specimen retrieval, and trocar sites in obese patients.

Minimally invasive laparoscopic surgery has revolutionized the way surgery is performed for an increasing number of patients. Incisional hernia can occur after any abdominal surgery and laparoscopic surgery is not immune to this complication. The hernia that follows laparoscopy usually occurs through the larger ports (size >10 mm), especially the umbilicus.

Predisposing factors include:

- Previous laparoscopies
- Extensive manipulation during surgery
- Increased intra-abdominal pressure
- Obesity
- Use of sharp cutting-tip trocars
- Rapid abdominal deflation at the end of surgery
- Poor port removal techniques and defective closure of the abdominal fascia
- Wound extension
- Male sex
- Infection of the wound
- Pre-existing umbilical defects
- Postoperative chest infections
- Pre-existing diseases such as diabetes mellitus
- Connective tissue disorders
- Job profile of the patient (weight lifting).

Among all these factors, the single most important factor remains the improper closure of the fascial defects at the port sites and not using proper port closure instruments **(Figs. 1 to 3)**. The diagnosis is often delayed because most cases present late, and treatment might be instituted along other lines. Computed tomography scans are helpful in its diagnosis and will facilitate prompt treatment to avoid the grave consequence of bowel gangrene.

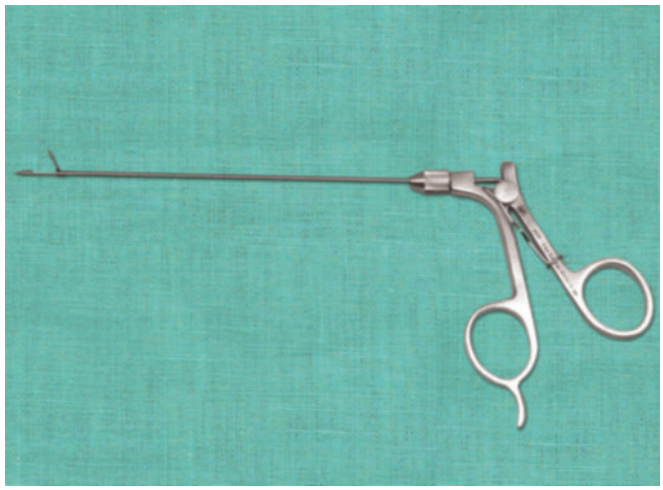


Fig. 1: Typical port closure needle.

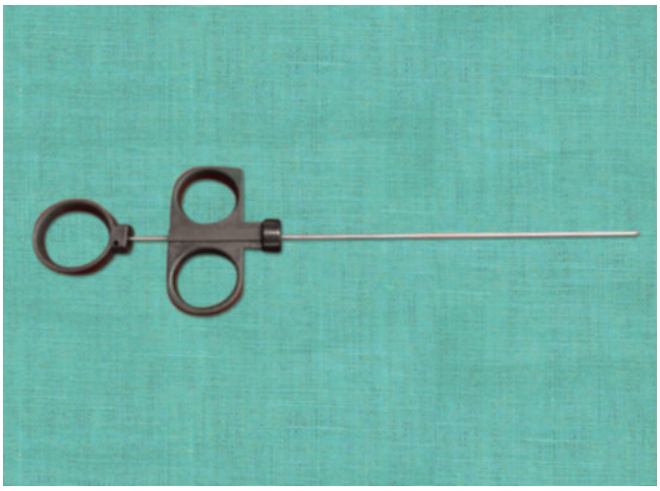


Fig. 2: Laparoscopic port closure Cobbler's needle.

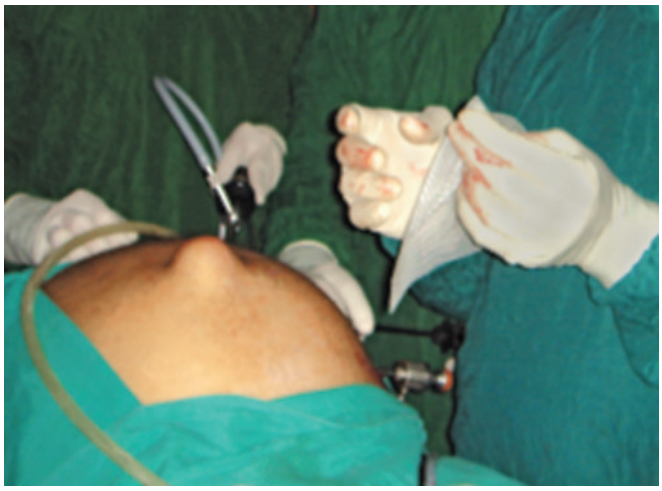


Fig. 3: Incisional hernia development due to improper closure of port should be repaired later by mesh.

While surgical techniques and instrumentation have made significant advances, it is usual that the surgical incision is closed using invasive suturing techniques or by the use of tapes or by the use of topical cyanoacrylate skin adhesives (TCAs) for closure of surgical wounds. The incidence of incisional hernia occurring at the port sites after laparoscopic surgery lies between 0.02 and 3.6% and usually remains unreported, until the development of complications.

Any port closure technique should have following characteristics:

- Effective (strong and secure) surgical wound closure
- Faster wound closure
- Better scar cosmesis
- Occlusive microbial wound dressing
- Less tissue trauma, reduced inflammatory reaction
- No requirement for suture/staple removal
- Easy to use/simple learning curve
- Reduced risk of needlestick injury—safety and costs
- Cost effective.

Fig. 4: The tip of telescope should be introduced in and cannula is pulled over telescope to prevent suction of omentum or bowel.

WITHDRAWAL OF INSTRUMENTS AND PORTS

Once the surgery is finished, all the instruments should be removed carefully under vision. All the accessory ports should be removed and the gas is removed by releasing the valve of 10 mm cannulas. The primary port should be taken out in the end **(Fig. 4)**.

If last port is suddenly withdrawn, sudden suction effect of cannula can pull the omentum or bowel inside the port wound, the chance of port-site hernia and adhesion is much higher in this case. It is a good practice to insert some blunt instrument or telescope inside the abdomen while removing the last cannula out over that instrument, to prevent inadvertent entrapment of omentum or bowel.

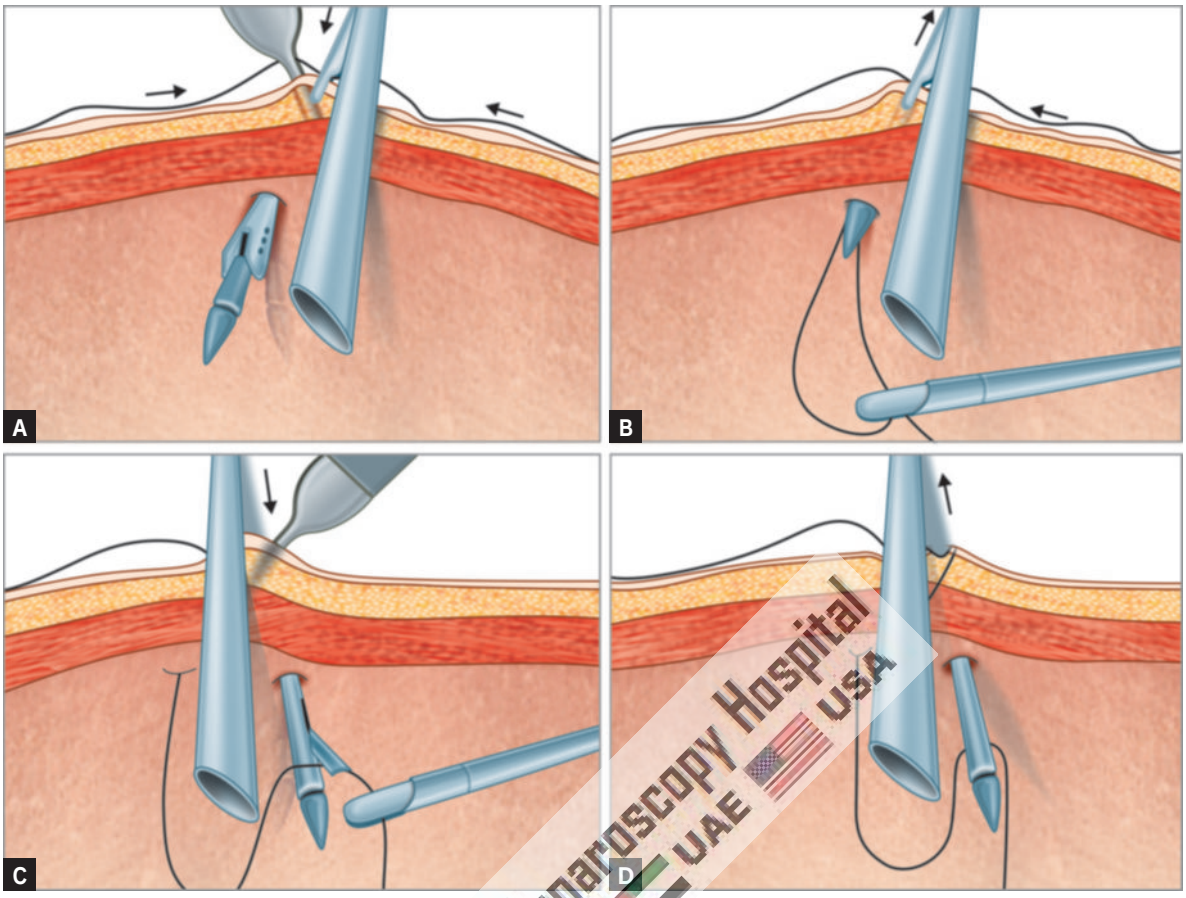
The access technique will result in breach in continuity of abdominal wall which need to be repaired at the end of surgery. All the 10 mm or >10 mm port should be repaired properly to prevent any future possibility of hernia. The rectus sheath should be sutured with Vicryl. Only one stitch is required in middle which will convert 10 mm wound into 5 mm. The 5 mm port wounds are not necessary to repair.

Laparoscopic Port Closure Instruments

Various types of port closure instruments are available. The suture passer is a convenient instrument for port closure. It is used to pass the thread on the side of cannula and then it is tied externally **(Figs. 5A to D)**.

Port Closure Needle

This is a simple instrument just like cobblers and it can be effectively used for closing the port. The tip of the instrument is blunt and the needle faces toward the fascia, so the chances of injury to the bowel are less with the use of this instrument **(Fig. 6)**.



Figs. 5A to D: Port closure with the help of suture passer.

Fig. 6: Port closure needle.

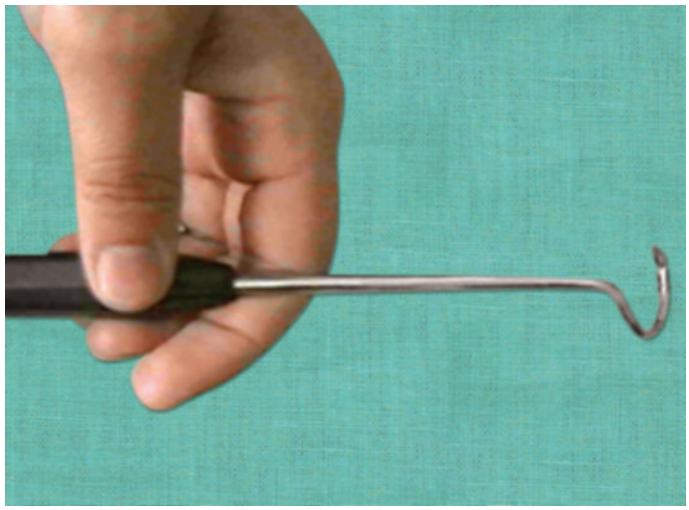


Fig. 7: Aneurysm needle.

Aneurysm needle can also be used for closing fascia. The advantage of this needle is that eye is at the tip and due to rigid structure there is no risk of bending or rotation of needle **(Fig. 7)**.

After closing the rectus sheath, the skin can be closed by intradermal, skin stapler or any of the surgical skin glues TCAs available **(Fig. 8)**.

New Laparoscopic Port Closure Instruments

Weck® EFx Shield Fascial Closure System (Figs. 9A and B)

The Weck® EFx Shield Fascial Closure System from Teleflex is the only shielded port closure device, providing enhanced sharps protection for uniform and consistent performance.

The EFx Shield® System is designed with speed and safety in mind. An array of enhanced features includes:

- Unique shielded wing design for enhanced sharps protection
- Intuitive wing deployment
- Innovative suture retrieval system for unassisted fascial closure.

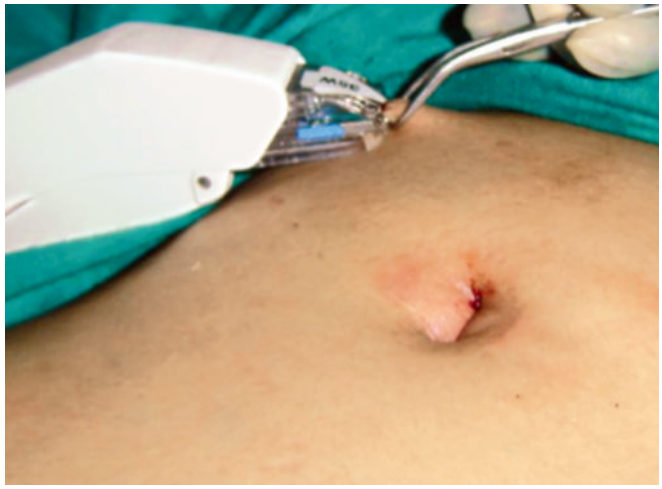
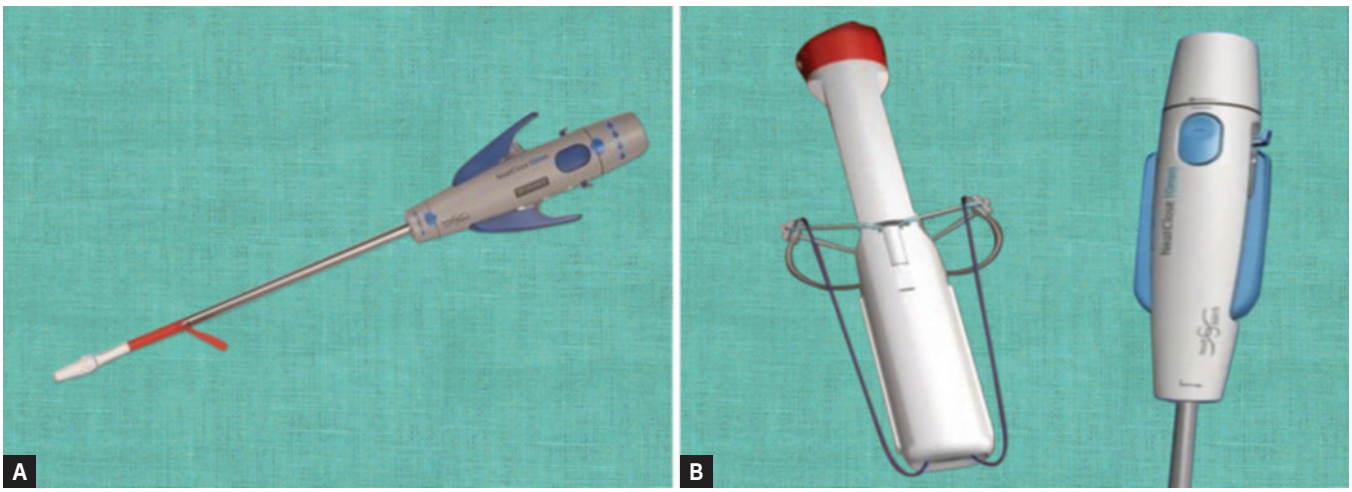


Fig. 8: Closure of skin wound by skin stapler.

NeatClose Automated Port Closure Device (Figs. 10A and B)

NeatStitch of Israel has come up with an automated port closure device known as NeatClose, where it also picked up both the Food and Drug Administration (FDA) and European approvals in the process. It is marketed to be an alternative to manual port closure, making it a speedy and efficient manner to help laparoscopic surgeon save time and money by lowering intraoperative costs. This system lets surgeons produce a watertight seal quickly, and it goes without saying that this would go a long way in aiding the recovery of a patient, never mind that one does not have Wolverine's healing factor. When inside the operating cavity, the surgeon can squeeze the handle leavers in order to release a couple of blunt needle guides, where said guides are specially positioned in a perpendicular manner to the

Figs. 9A and B: Weck® EFx Shield Fascial Closure System.



Figs. 10A and B: NeatClose automated port closure device.

port plane. With the activation button pressed, it will release the needles from the guide, via the tissue and back to the NeatClose cartridge. Once the system is pulled outside the port, you can be sure that a safe and efficient airtight seal is created, hence aiding the recovery of a patient for surgery quickly. Now we are still waiting for a painless method without the need for anesthesia.

Carter-Thomason CloseSure System—Port-site Closure (Figs. 11A and B)

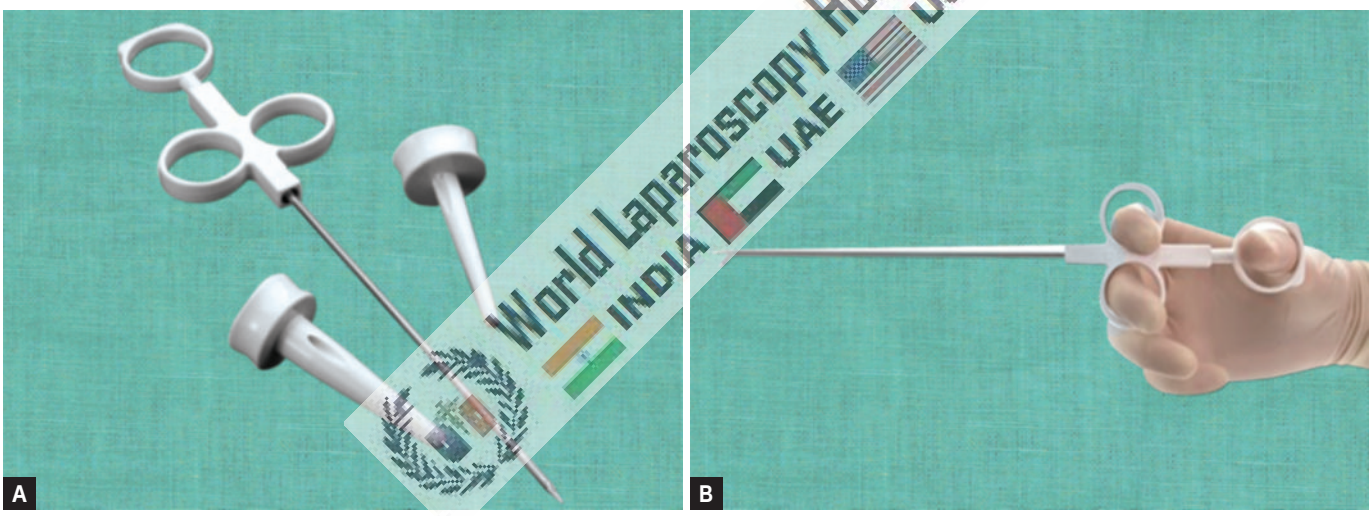
Closing any trocar site is a simple, fast and safe procedure with the Carter-Thomason CloseSure System. The cone-shaped Pilot Guide correctly angles the suture passer to achieve full-thickness closure. It closes the port including fascia and peritoneum (preventing Richter's hernias)—while maintaining pneumoperitoneum. The guide's unique design ensures precise placement of the suture passer for consistent, reproducible results on any body type.

VersaOne Fascial Closure System (Figs. 12 and 13)

Port-site hernias are serious complications across procedures and are a burden on patients, clinicians, and health systems. Appropriate port-site closure is considered to be one of the most critical factors for the prevention of port-site herniation. The VersaOne Fascial Closure System is a novel all-in-one device that serves as a trocar and fascial closure device to deliver consistent port-site closure and suture placement. The unique system features a special cannula that allows for defect closure without the need of additional devices.

As a result, the VersaOne Fascial Closure System:

- Provides procedure efficiency
- Eliminates the need to remove the trocar before closing
- Makes reinsufflation unnecessary—pneumoperitoneum can be maintained throughout the procedure
- Enables tissue layers to remain aligned.



Figs. 11A and B: Carter-Thomason CloseSure System—port-site closure.

Fig. 12: VersaOne Fascial Closure System with its trocar.

Fig. 13: VersaOne Fascial Closure System demonstrating insertion of suture.

There are a number of methods of post site closure but there is no gold standard. Use of traditional suturing techniques are difficult due to blind closure of the fascial defect. Varying degrees of success are achieved by modified hand suturing techniques. Finding the rectus sheath and suturing through the layers of a thicker abdominal wall through a relatively small hole is challenging particularly in the obese. In such cases, we need special instrument for efficient closure of the port site. Veress needle is an instrument that is commonly used for creating pneumoperitoneum but it has been used to close the port site efficiently under vision.

VERESS NEEDLE TECHNIQUE OF PORT CLOSURE

In 1983, Janos Veress of Hungary developed a specially designed spring-loaded needle. Interestingly, Veress did not promote the use of his needle for laparoscopy purposes. He used Veress needle for the induction of pneumothorax. But now Veress needle is the most important instrument today to create pneumoperitoneum. Veress needle consists of an outer cannula with a beveled needle point for cutting through tissues. Inside the cannula of Veress needle is an inner stylet, stylet is loaded with a spring forward in response to the sudden decrease in pressure encountered upon crossing the abdominal wall and entering the peritoneal cavity.

TECHNIQUE OF PORT CLOSURE BY VERESS NEEDLE (FIGS. 14 TO 25)

Occlude the port site with a finger so that the pneumoperitoneum is maintained and pass the Veress beside the finger through all the layers except the skin and subcutaneous tissue under vision. Maintenance of pneumoperitoneum is important as it is very difficult to close the port if vision is compromised.

Minimal access surgeries are the present and future of surgical procedures and no surgery is complete without port site closure. There are a lot of methods to close the port-site but no gold standard. This procedure with the Veress needle is safe, efficacious, and cost-effective.

One of the preventable complications is port-site incisional hernia (PIH), which could develop at any port site, most frequently at the midline, possibly because of the absence of supporting muscle. The incidence of PIH is variable from center to center, depending on several factors including surgical technique and of course surgical experience.

Fig. 14: Remove the stylet from the cannula.

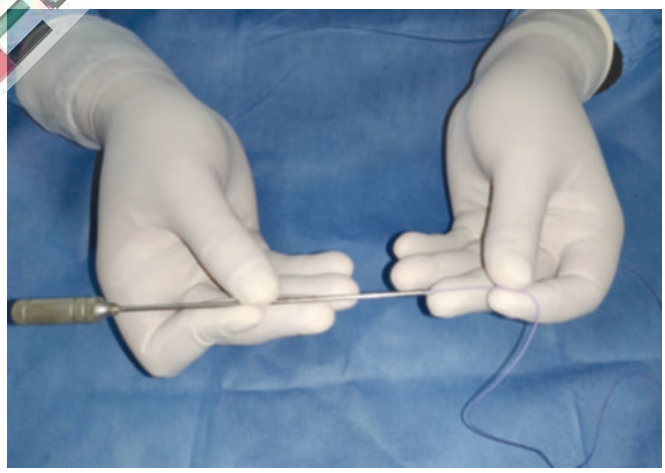


Fig. 15: Pass a suture material through the cannula from the tip.

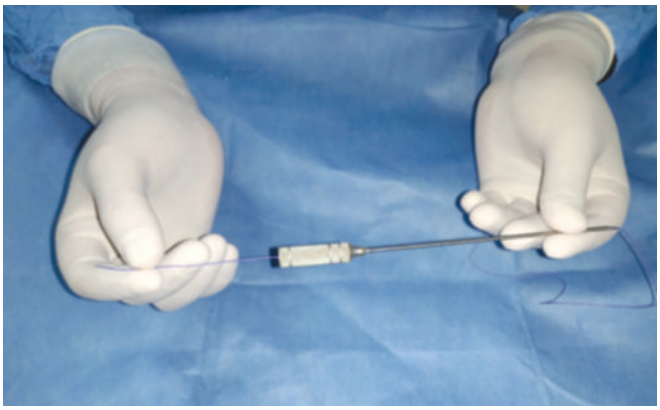


Fig. 16: Take suture out from the other end.

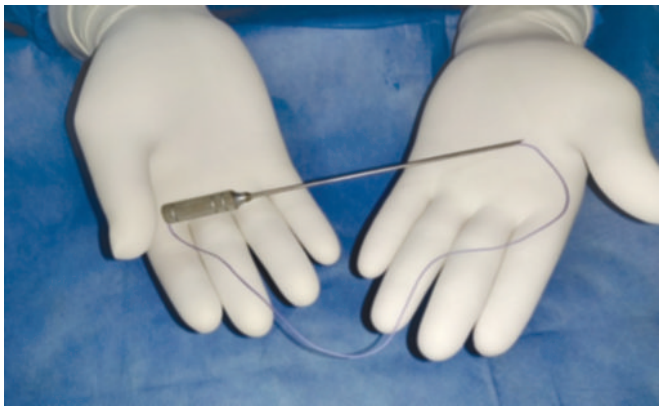


Fig. 17: Tie the loop and hide the knot in the cannula.

Fig. 18: Insert the suture material (that should close the port site) into the cannula tip about 2 cm deep and bend it so that it stays in place.

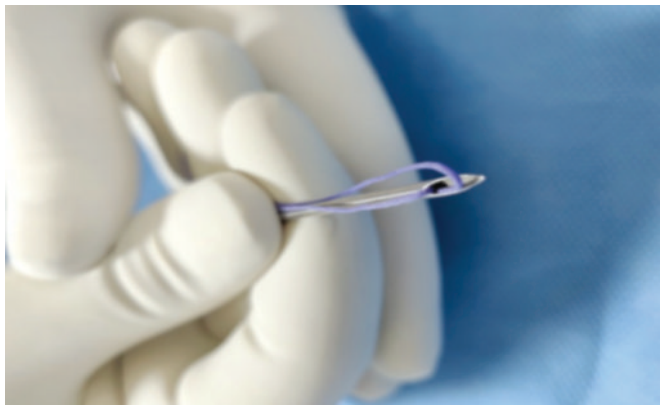


Fig. 19: Now Veress needle is ready for port closure.

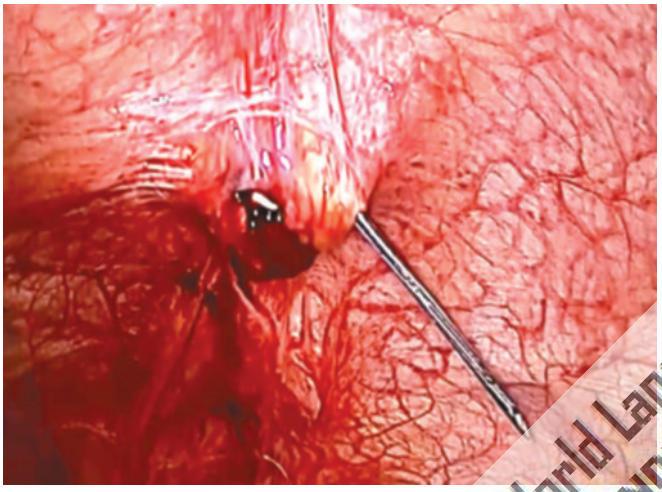


Fig. 20: Veress needle inserted with loop and tying suture on one side.

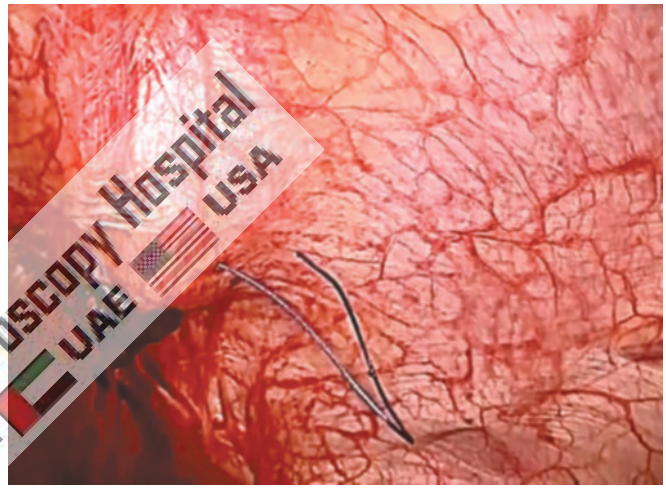


Fig. 21: Retract the Veress and the suture is automatically retained inside.

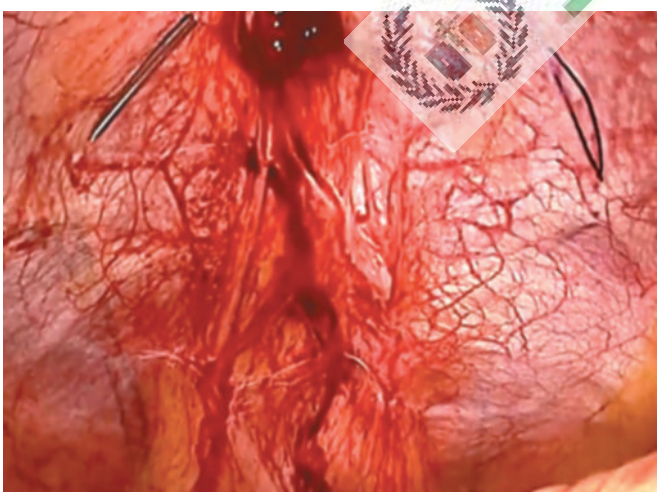


Fig. 22: Insert the Veress from the other side of the defect.

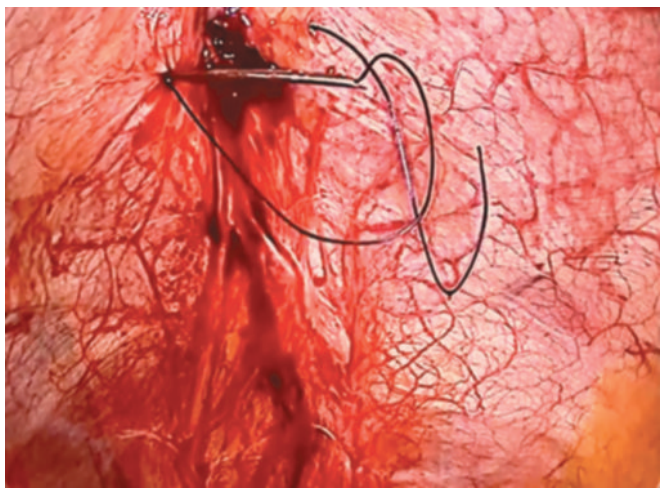


Fig. 23: Entangle the suture in the loop of the Veress.

The trocar diameter, trocar design, pre-existing fascial defects, tissue retrieval from the port site, and some operation and patient-related factors, direction of the port insertion, use of drain are the risk factors for development of PIH. In obese and bariatric patients because of larger preperitoneal space and elevated intra-abdominal pressure, the risk of formation of trocar site hernia is greater. Size of the port is another major risk factor and it is advisable to close the hole >5 mm at the fascia level.

The meticulous closure of the laparoscopic ports is important to prevent and reduce the chances of formation of PIH. Port-site closure by Veress needle is an efficient

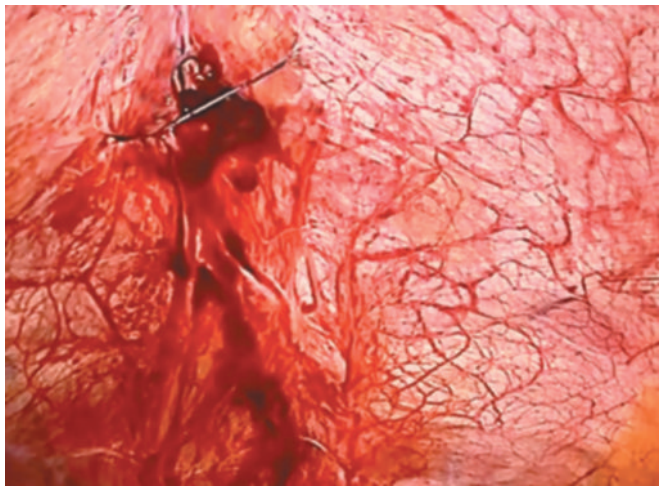


Fig. 24: Tighten the loop and retract the Veress along with the suture and tie the knot outside.

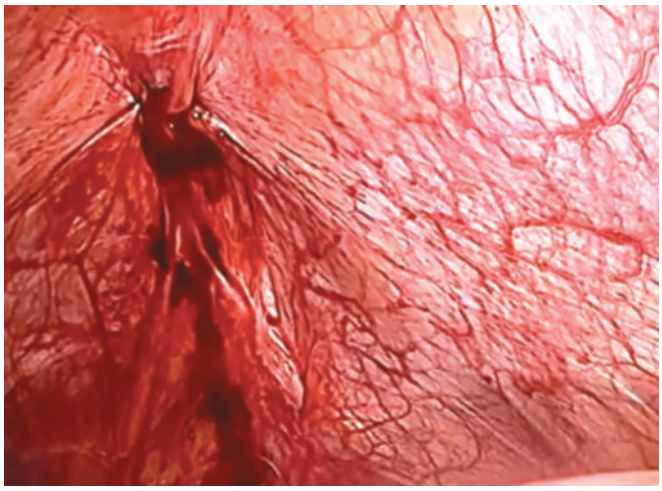


Fig. 25: Thus, the port site closed under vision and is safe procedure.

and safe technique done under vision and there is no need to buy additional equipment to close the port site thus cost effective.

The hernia may become evident at any time following laparoscopic surgery and the patient may either have an uncomplicated hernia, or may be afflicted with a variety of complications such as evisceration of the bowel or omentum and it may become a cause of significant morbidity. Meticulous closure of the fascia, avoidance of unnecessary wound extension, the use of nonabsorbable sutures when faced with defects >2 cm in size, completely defining the extent of any pre-existing hernia and repairing this at the time of port-site closure, are recommended to minimize the incidence of port-site hernia after laparoscopic surgery.

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