
Technical Basics: Insufflation, Trocar Insertion, Instruments, Needle Insertion, Suturing, Ligating

2

The physical dimensions are smaller in children. The small spaces are quickly filled with gas. The space within the CO₂ tubing may suffice to fill the child's abdomen; it will be room air if the tubes are not flushed with CO₂ prior to starting the insufflation – with the incorrect assumption that CO₂ is insufflated.

The distance from skin to aorta is short. We never start insufflation without prior having checked with the laparoscope where the Veres needle tip is located.

Insufflation rates are smaller than in adult patients, although a number of pediatric laparoscopists insufflate at rates of 1 l/min. In animal experiments, however, such high insufflation rates have led to cardiovascular problems (and more so did rapid desufflation).

It is an incorrect prejudice that 2-mm instruments bend and break easily. They are sturdy enough, and 3-mm instruments are even sturdier. Two- and three-millimeter instruments come in all varieties, just like 5- or 10-mm instruments.

Needle insertion is in small children mostly directly through the abdominal wall. If a needle has to be removed at the end, it is removed together with the trocar – and the trocar reinserted if needed.

Suturing and ligating are just as in “instrument knotting” in “open” surgery.

2.1 Insufflation (1)

2.1.1 When Starting Insufflation with a 5-mm Trocar

A 4-mm transverse incision below the lower rim of the umbilicus is made so that the incision is later hidden inside the umbilicus. This also may save a skin suture later when withdrawing the trocar (Fig. 2.1).

The tissue is spread with small scissors down to the fascia (Fig. 2.2).

The Veres needle is inserted while lifting up the abdominal wall on both sides (Fig. 2.3). There are two distinct snaps – both of them visible, audible and palpable – when inserting the Veres needle. The second structure, the peritoneum, is the tougher one.

It is preferable to stay inside the umbilicus, because there are fewer structures to be crossed, and to go almost vertically down, not too obliquely because one may end still within the abdominal wall layers. Do not aim toward the bladder.

The penetration depth of the Veres needle may be estimated by tilting it and palpating for the tip (Fig. 2.4).

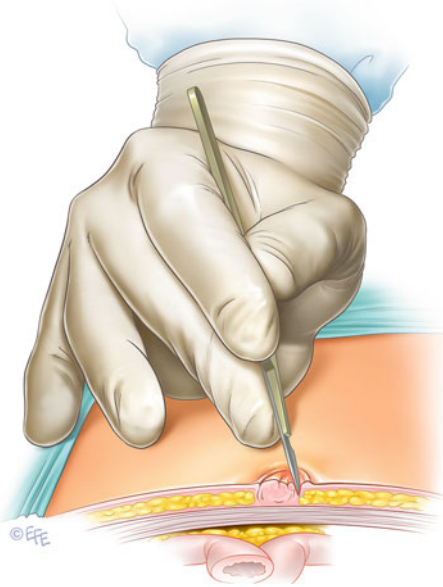


Fig. 2.1 Scalpel incision at the lower aspect of the umbilicus for insertion of a 5-mm trocar



Fig. 2.2 Spreading with scissors down to the fascia

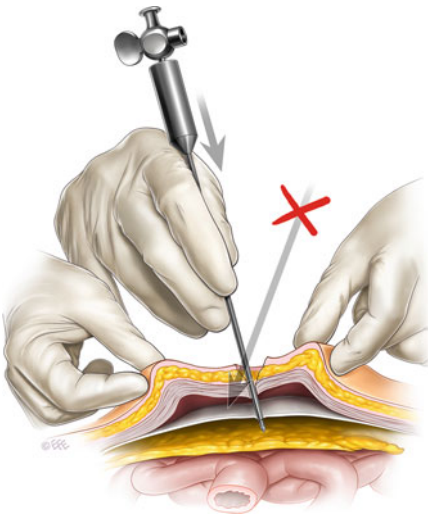


Fig. 2.3 Lifting the abdominal wall while inserting the Veres needle

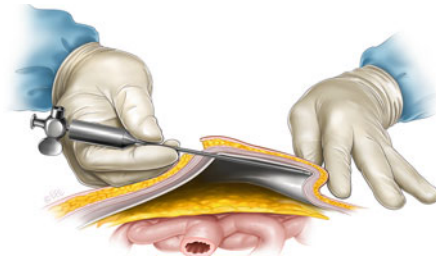


Fig. 2.4 Estimating the intraabdominal length of the Veres needle

2.2 Insufflation (2)

First, physiologic saline is injected in order to rule out high resistance as one would expect in intramuscular injection (Fig. 2.5). Intravascular placement is ruled out by aspiration. When using a 2-mm trocar and a 2-mm laparoscope for checking the correct placement, this maneuver is skipped.

The “hanging drop test” indicates correct needle placement: The Veres needle is completely filled with physiologic saline until a meniscus builds on top of the needle (Fig. 2.6). Then the abdominal wall is lifted up: The saline will be sucked into the abdomen (Fig. 2.7). This is considered proof that the needle tip is located intraperitoneally. Thereafter, insufflation is started (Fig. 2.8).

The following insufflating rates are used:

<1 year: 0.3 l/min, >1 year: 0.5 l/min, >5 years: 1 l/min.

We start with 0.5 l/min until we are sure that the needle tip is correctly located intraperitoneally.

2.2.1 When Starting Insufflation with a 2-mm Trocar

The trocar together with the Veres needle is inserted directly through the skin within the umbilicus, without a prior scalpel incision. The Veres needles are sharp enough. Next, a 2-mm laparoscope is passed in order to check for correct placement within the abdominal cavity. Lifting the abdominal wall enables visualization. Thereafter, insufflation is initiated (with the laparoscope removed from the trocar, because it will hamper insufflation due to its narrowing of the small trocar diameter).

Intraabdominal pressure will initially be -2 to $+2$ mmHg and will slowly increase. We pull up the abdominal wall during insufflation (this prevents the occlusion of the needle tip with the omentum). Initial pressures of 13–17 mmHg indicate that the needle is in a *wrong* position (most likely outside the peritoneum and not deep enough). In this case the Veres needle is withdrawn and reinserted.

The maximum pressure is 12 mmHg for all age groups. In children older than 10 years, 15 mmHg is acceptable, but this may result in postoperative shoulder pain. Visualization will not be reduced when the pressure is lowered to 8 mmHg.

In animal experiments, piglets were killed by extremely rapid desufflation at the end of the procedure.

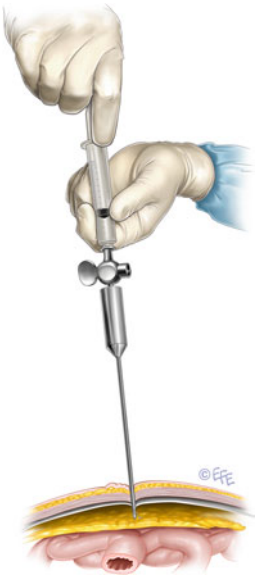


Fig. 2.5 Injecting to verify needle placement



Fig. 2.6 Hanging drop test (1). Veres needle is filled with saline

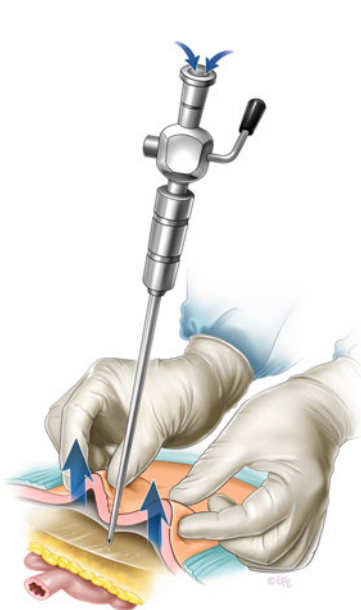


Fig. 2.7 Hanging drop test (2). Lifting the abdominal wall will suck the saline into the abdomen: correct needle placement

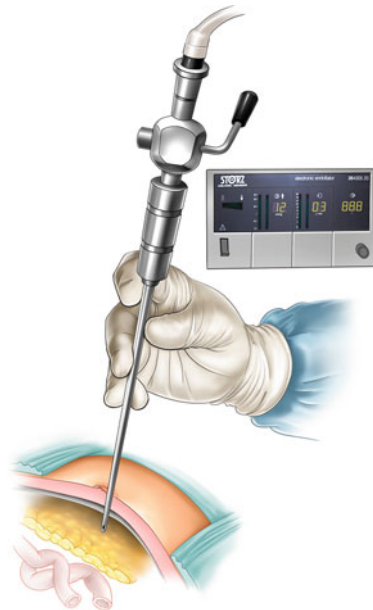


Fig. 2.8 Insufflation rate and pressure

2.3 Trocar Insertion

- Two-mm trocars are inserted directly through the abdominal wall, without prior skin incision. And the correct placement is checked with a 2-mm laparoscope.
- When a 5-mm trocar is inserted at the umbilicus, the valves should be closed and the safety mechanism should be activated (if the valves are left open, the CO₂ will escape immediately upon entering the abdominal cavity). The abdominal wall is lifted and the forearm is guarded in order to prevent rushing in too quickly and too deeply (Fig. 2.9).

The laparoscope is inserted and the correct trocar position is verified. If it is correct, insufflation is started.

The next trocars, the working trocars, are inserted at some distance from the target organ, not directly on top of it. The line between the target organ, the trocar, and the instrument should be considered as an extension of the surgeon's forearm, very much like eating with cutlery (Fig. 2.10).

Once the laparoscope has been inserted into the abdominal cavity, remember that the space is small, that the bowel is dilated (especially in small children) and that the view is close. All these factors may make the initial orientation difficult.

In most instances, the laparoscope is inserted through the umbilicus.

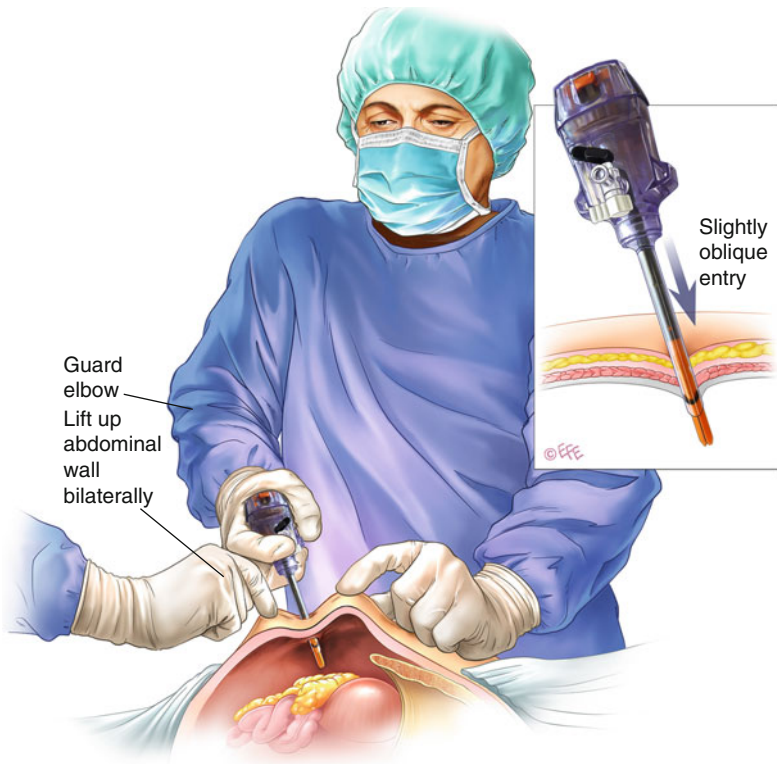


Fig. 2.9 Guarding of the elbow and lifting of the abdominal wall for 5-mm trocar insertion

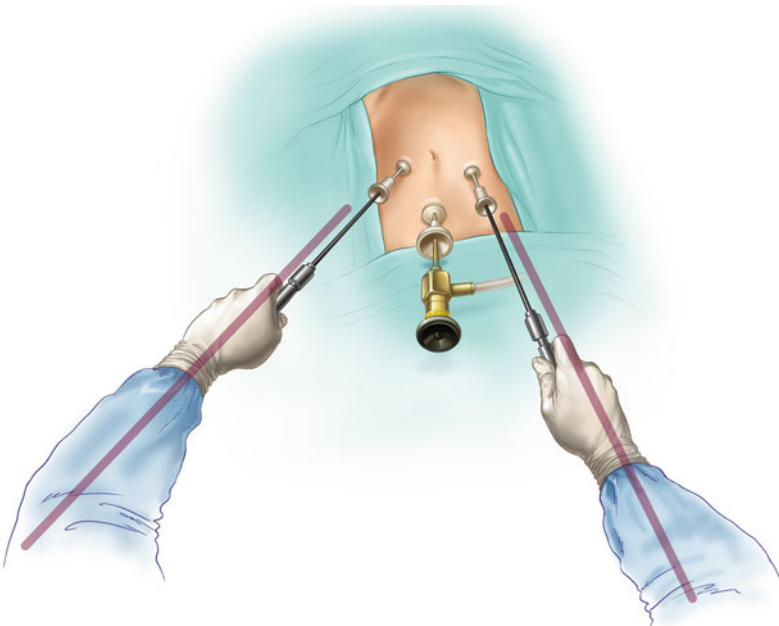


Fig. 2.10 Working trocars are placed in a configuration similar to using cutlery while eating

2.4 Instruments

Since the last edition of the book, we have adopted 2-mm instruments and 2-mm laparoscopes for most operations. They do not break and bend as easily as feared.

Previously we had used mostly 5-mm/0° laparoscopes. In the meantime the 2-mm laparoscopes have become much better. They also have the advantage that they are exchanged easily from one 2-mm trocar to another for better visualization. Unfortunately, the 2-mm laparoscopes pass less light. At the distance, the pictures thus are darker. Photographs for documentation are not as good as with 5-mm laparoscopes. And the 2-mm laparoscopes indeed do break more easily.

Thirty degree laparoscopes are more difficult to handle than 0°. But they have advantages, for example, in funduplications for the visualization of the esophagus' left side.

Five millimeter instruments and trocars are relatively large for small children (Figs. 2.11 and 2.12). Sets of 3-, 2- and even 1-mm instruments are available; 2-mm instruments are easily bent and even broken, but 3-mm instruments are sturdy.

Trocars for 3-mm instruments are still rather large. Trocars for 2-mm instruments are significantly smaller. Several types are commercially available (Fig. 2.13). They may be replaced without hesitation intraoperatively, should the initial placement prove inadequate since they leave virtually no scar. Also, they do not need any suturing upon withdrawal; a bandage suffices.

Suction and irrigation is useful with 5-mm instruments. Suction is difficult with 2-mm instruments, as the fluid will be expressed through the cannula due to the increased intraabdominal pressure.

The cosmetic results achieved with 2-mm instruments are superb, and there are virtually no scars. Two-mm clips are not available, and tied ligatures have to be used with 2-mm instruments.

Fogging can be reduced by increasing the light intensity to 100 % before inserting the laparoscope. This heats the tip of the laparoscope. Antifogging solution works well. Simply waiting until the laparoscope warms up works as well. Keeping the laparoscope at distance from the target organ facilitates orientation.

At the end of the procedure, the 5-mm entry site at the umbilicus is closed with an absorbable 4-0 fascia suture and skin sutures (Fig. 2.14). Two-mm entry sites are only closed with Steri-Strips (Fig. 2.15).



Fig. 2.11 Comparison of instrument sizes



Fig. 2.12 Trocars of 2-mm, 5- and 10-mm diameter



Fig. 2.13 Various 2-mm trocars



Fig. 2.14 Fascia suture and skin suture at 5-mm trocar sites

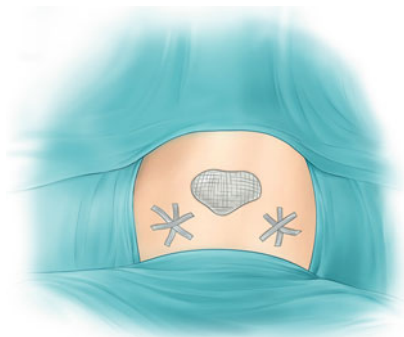


Fig. 2.15 Steri-Strips only at 2-mm trocar sites

2.5 Needle Insertion

- When *using 5-mm trocars*, the needle is inserted through the 5-mm trocar shaft, with the needle tip covered within the jaws of a needle holder (Fig. 2.16). In analogy, the needle is removed eventually via the 5-mm trocar.
- When *using 2-mm trocars*, the needle is inserted directly through the abdominal wall (Fig. 2.17). When the suturing is finished, the needle eventually is removed together and in combination with the trocar (Fig. 2.18).
- 5-0, 6-0 or 7-0 sutures may be inserted via 2-mm trocars. The needles will scratch along the inner trocar shaft, but they can be inserted and removed through the same trocar several times until valve leakage occurs.

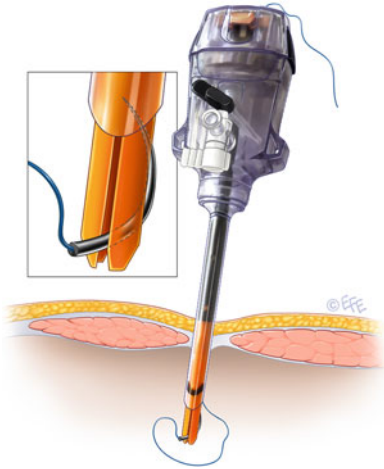


Fig. 2.16 Insertion of a needle within a 5-mm trocar shaft, shielding the needle tip within instrument jaws

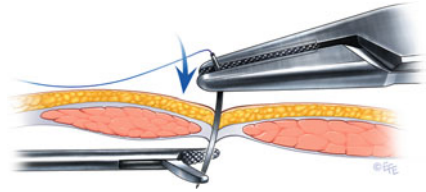


Fig. 2.17 Insertion of a 2-mm suture directly through the abdominal wall

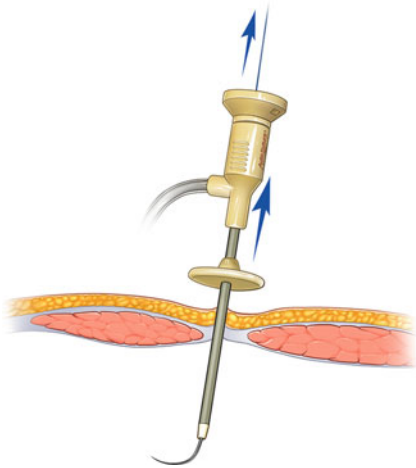


Fig. 2.18 Removal of the suture together with the trocar after completion of suture. The trocar is reinserted immediately afterwards

2.6 Suturing

Initially, suturing is tedious and frustrating; practice helps. (Inguinal hernia is a good practice procedure.) Intracorporeal knotting is familiar to most surgeons due to its similarity to “open” instrument knotting.

We use *two* 2-mm needle holders. The second hand has a firmer grip with a needle holder. We use a *ratched* needle holder for the right hand and a *non-ratched* needle holder for the left hand. Regular sutures for open surgery are used. 4-0 and needle sizes of 18–20 mm are adequate for small children. To make the suture pass through a 5-mm trocar more easily, the needle curve is bent open a bit. The total length of the suture is cut to approximately 7 cm – depending on the size of the abdominal cavity (the smaller the cavity, the shorter the suture). With the first stitch done (Fig. 2.19), the free end of the thread is kept under visual control (in order to keep it as short as possible, so short that it does not need to be cut later). The needle is held in the left instrument, with the thread looking toward the surgeon. The instrument in the right hand is rotated around the needle/thread connection of the left hand so that the thread builds a double sling around the jaws of the right instrument. Through the center of the slings, the jaws of the right instrument are advanced and opened. They grab the free thread end – and close the knot (as in open instrument knotting). The maneuver is repeated in the opposite direction (Fig. 2.20).

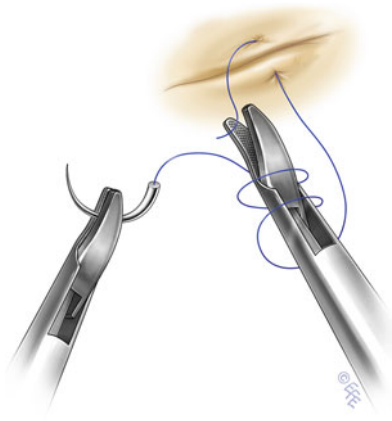


Fig. 2.19 First step of intraabdominal instrument knotting, as in “open” surgery

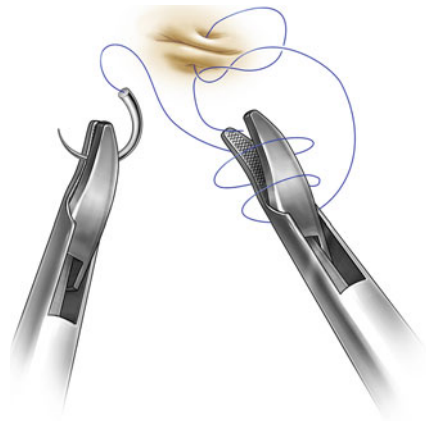


Fig. 2.20 Second step, opposite direction

2.7 Ligating

Pre-tied pretied knots are most convenient.

Pass the pretied knots using an “introducer” through the trocar (otherwise the loop bends and is difficult to maneuver inside).

Commercial pretied knots are available, but you can make your own by using the guider from commercially available pretied knots and making the knot yourself. The principle of the knot is easy to remember (Fig. 2.21).



Fig. 2.21 Principle of the pretied knots



<http://www.springer.com/978-3-642-37637-5>

Laparoscopy in Children

Schier, F.; Turiel, S.

2013, VIII, 148 p. 172 illus., 171 illus. in color.,

Hardcover

ISBN: 978-3-642-37637-5