Review Article

Robotic repair for ventral hernias

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Abstract: Anterior abdominal wall reconstruction is one of the most challenging tasks for the general surgeon and the variety of procedures are in practice to repair ventral hernia with minimal recurrence rate requires a deep knowledge of the physiopathology and of the technical aspects. Laparoscopic repair has gained popularity over open mesh placement because of certain benefits but at the same time some concerns regarding trans-fascial closure leading post op seroma formation and pain tried to look for other horizon. Minimally invasive surgery has introduced many techniques for ventral hernia repair. Robotic assistance ventral hernia repair has revolutionized this field and has introduced more techniques to overcome surgical difficulties. The number of robotic-asssisted cases is increasing but the potential benefits of robotic surgery in ventral hernia repair is yet to establish.

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Introduction

Ventral Hernias are always a big challenge for general surgeons and its incidence after laparotomy is reported as high as 32% (1). Among all mesh repair technique, the Rives Stoppa retromuscular repair has a recurrence rate less than 5% and it relies on the principle to restore linea alba and to place the mesh in a physiological posterior retromuscular position (2).

Among the so called minimally invasive approaches, the laparoscopic repair IntraPeritoneal Onlay Mesh (IPOM) technique with or without defect closure is the most common performed technique worldwide. In the latest year, several alternative to the IPOM have been reported from the laparoscopic trans-abdominal preperitoneal (TAPP), pre-peritoneal onlay mesh (PPOM), extended-view TEP (e-TEP), transabdominal partial extraperitoneal (TAPE), the MILOS (min or less open sublay operation), the endoscopic version e-MILOS and many more (3).

Laparoscopic TAPP is an alternative for large ventral defects; and robot assisted TAPP gives advantages of increased range of motion and flexibility of the instruments allowing for high-performance suturing of the abdominal wall making it possible to perform dissection in three-dimensional imaging systems and mesh placement in a minimal invasive manner (4,5). Conventionally, minimally invasive ventral hernia repairs have been performed without defect closure as the data supporting defect closure is reserved for open techniques mostly, But robotic surgery seems best for closure of the defect and for recreation of "new "abdominal wall due to its enhanced intracorporeal suturing technique. This intracorporeal suturing technique is not getting popularity because it does not only require advance laparoscopic skills but also considered as surgically complex (6,7). The robotic-assisted surgery has showed some advantages like increased range of motion, more ergonometry, better flexibility of the instruments allowing for high-performance suturing of the abdominal

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wall making it possible to perform dissection and mesh placement in a minimal invasive manner (8).

Robotic and laparoscopic hernia repairs are superior to open repair techniques but if we compare to both of minimally invasive techniques then robot is comparable not comparable to laparoscope in short terms effects, rather seems more expensive. Data presented in many studies shows better results with robotic surgery instead of laparoscopic approach when performing an IPOM or TAPP with defect closure (9). Conflicting data on the benefits of defect closure and outcome of robotic versus open and laparoscopic surgery in ventral hernia repair has yet to be established. Long term follow-up and surgical techniques comparing the defect closure, the differet type of fixation and mesh positioning are still needed (10,11).

Pre-operative consideration

Before considering patient for robot assisted ventral hernia repair it is important to select case properly. BMI, smoking history, prior repairs, and immune-compromised states should be considered. Contraindications are same as that of laparoscopic surgery and include; inability to have general anesthesia, hypercoagulable condition, active skin infection. Other limitations are the loss of muscle domain for defect closure, thin overlying skin due to any reason and sometime patient expectations in terms of cosmetic results.

Surgical team especially surgeon's comfort level and his competency should be kept in mind during consultation in parallel with patient expectation. Patient expectation in terms of cosmetic results might be higher and needs to address properly before considering for surgery in selected cases. Pre op consideration for likelihood of post-operative pain and seroma formations are also an important factor in patients with or without defect closure. Pre op defect orientation by clinical examination adjuncts with CT scan of abdomen and pelvis would be helpful to address these problems properly for recurrent, incisional or large ventral hernia. Patient should be properly counseled for need to conversion to open procedure due to adhesions or inadvertent visceral injury specially in those with previous failed hernia repair. Such patient may also need enterostomy depending on the level of contamination resulting in longer hospital stay and another surgery at later stage for reversal of enterostomy; post op use of antibiotics and later consideration for mesh placement as staged procedure. Despite the repair of the hernia defect and mesh placement, bulge at surgical site may be visible due to multiple reasons ranging from previous nerve injury in case of incisional hernia or current procedure, excessive skin or laxity.

Universal port placement

Ports placement in robotic hernia is a critical step and patient factors and anticipated docking should be kept in mind before this step. Patient BMI, body habitus, previous surgery, defect orientation and its size may affect port positioning and minor amendments can be done accordingly. Port should be placed as much laterally as possible and after insufflations up to 15 mmHg. Assess defect orientation and mark the site. Consider additional 3–5 cm for mesh placement around the defect. Mark the anticipated mesh perimeter at which fixation will be considered latterly. Draw a semicircular line around the mesh perimeter marking, 10–12 cm away from mesh perimeter. Camera port should be placed on this line exactly opposite to anticipated patient cart. Two working arms ports should be placed on each side of camera port almost 8 cm away and on semicircular line. It's better to place assistant port at this stage if needed. Later, once docking is done, can't move the patient or patient cart afterwards. Assistant port is placed almost 4 cm from camera port and at least 6 cm away from the semicircular line. These port placements are critical for surgery because this will ultimately bring optimal triangulation.

Patient positioning and preparation

Patient is placed in supine position with both arms tucks in by the side of body in a secure way to avoid any movement. Arms can be placed in a sling or arm boards to optimize access of da Vinci arms. All the bony prominences and pressure areas should be pad. Roll up the side of the patient where patient cart will approach. Whole of the abdomen should be exposed in a way that can be approached from any side if needed. Gas insufflation should be 15 mmHg.

Patient cart positioning and docking

Cart positioning docking acts as a rate limiting step because once patient cart is docked, operating table or even cart cannot be moved. First step is to align the camera port, camera arm, and patient cart in a straight line with hernia. Then, position the patient cart arms to clear the patient and move away all overhead lights and other equipments. Da Vinci stands opposite to the carts which come in contact

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with patient and table at 90 degree. Ports and arms clutches are used to adjust the lengths of carts and to give a better position to da Vinci and also to maximize the space between the working ports and camera.

Operative steps

Adhesiolysis and peritoneal dissection to create flap

Just like laparoscopic surgery, after a panoramic look on inside structures, adhesiolysis is done to bring down adhesions if adherent to the anterior abdominal wall. This step is more time consuming and is determined of the complexity of the surgery. For patients with history of no abdominal surgery, minor adhesiolysis is required. Short neck, incisional, recurrent and long standing hernial defects are more notorious to have such adhesions but can easily be manipulated to clear the defect. Intra-peritoneal structures including omentum or intestine are brought down back to abdomen.

Bringing down peritoneal flap is one of the most difficult steps in terms that even a small tiny hole in peritoneum can expose the mesh to the abdominal viscerae. Using a combination of blunt, sharp, and light diathermy dissection, the preperitoneal plane is dissected out until reaching the hernia defect. The plane is continued within the hernia defect, bringing the hernia sac down as part of the flap.

Defect closure

There are several techniques available for closure of the defect, but the mist common in practice is the transfascial closure or "shoelace technique". Before starting defect closure, bring down insufflations to 6–8 mmHg to reduce the tension on sutures. Transfascial closure or not is debatable and either can be used to close the defect or temporary to facilitate the intracorporeal suturing. It depends on patient's criteria and surgeons choice as well. Some favors transfascial closure even in robotic repair despite flexibility of instruments and argue that it is better to bring tension of abdominal wall back to equilibrium so mesh can be held at place in a nice way. Data suggest that defect closure is robotic hernia repair is far superior than its counterpart laparoscopic approach due to increased ergonomics and wrist flexibility. Defect closure is done with continuous non-absorbable monofilament suture in an interrupted way. Either way, it is necessary to bring down intra-abdominal pressure to around 6–8 mmHg to avoid tension on wall. Robot gives advantage of defect closure in a continuous fashion for small hernia using two sutures, starting from each end and meeting at centre point.

Mesh placement

Two tissue plane locations exist for mesh placement: pre-peritoneal (i.e., transabdominal pre-peritoneal, or TAPP, repair) or intraperitoneal underlay (i.e., intraperitoneal onlay mesh, or IPOM, repair). Mesh is introduced through assistant port and is deployed at the defect site. Mesh is oriented over the closed defect so it covers almost 5 cm on each side of the defect. This is because of fibrosis and later contraction of mesh and preventing it to expose hernia defect vulnerable for recurrence.

Mesh fixation

This can be achieved by different methods like transabdominal or intracorporeal suturing, tacking, glues or bone anchors as done is laparoscopic surgery. But, robotic surgery is superior to laparoscopic surgery when fixation of mesh because flexibility of instruments makes it possible to do intracorporeal suturing. After placement of mesh, peritoneal flap is bringing around to close the peritoneal defect as well. This can be achieved either using absorbable sutures in a continuous fashion or by using tacking technique if the mesh is positioned in the pre-peritoneal or retromuscular plane fixation may be avoided but we need long-term study to verify the efficacy of this approach. Care must be taken on lateral side when tacking because injury to nerves can cause devastating results. All port sites larger than 8 mm are closed with absorbable sutures for prevention of port site hernia.

Conclusions

Staying with the promise of minimally invasive surgery, Robot provides improved visualization, flexibility with proper ergonomics and excellent precision. Robot assisted ventral hernia repair is comparable with laparoscopic and open repairs because postoperative outcome as per patient expectations regarding post op pain and early recovery; and according to surgeons satisfaction regarding "cure" are excellent. Preperitoneal mesh placement pushes Robotic surgery towards summit of leading method because it does not only allow completing the task easily but also prevent the mesh to be in direct contact with abdominal viscera. In a

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nutshell, Robot assisted ventral repair should be considered in place of laparoscopic or open mesh repair.

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