

Preperitoneal space, is it an ideal layer for endoscopic sublay repair of ventral hernia?

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Earlier, the major surgical treatments for ventral hernia were open sublay repair and laparoscopic intraperitoneal onlay mesh (Lap-IPOM) repair. Sublay is an effective and safe plane.^[1] Recently, some surgeons successfully transferred open sublay repair to endoscopic sublay repair (ESR), which may avoid the wound events after open procedure and potential risks of intra-abdominal injury and mesh complications from Lap-IPOM repair.^[1-3]

In medial region, two layers can be separated for sublay mesh placement: retromuscular (also called retrorectus) and preperitoneal space [Figure 1A]. Conventionally, mesh is mainly placed at *retrorectus* space above Douglas line. However, the space separation requires the incision of natural musculoaponeurotic structures (rectus sheath and/or the transversus abdominis), breaking the integrity of rectus sheath, and bringing additional damage.

It is worthwhile for repairing medium-to-large incisional hernias, but excessive for defects, such as umbilical hernia, linea alba hernia, or small incisional hernia.

Instead, different regions of preperitoneal space are potentially connected. Therefore, if space separation and mesh repair is refined to preperitoneal layer, no musculoaponeurotic structure need be cut off, and consequently the damage will be extremely minor.

There are two approaches to realize ESR: Totally extraperitoneal sublay (TES) and transabdominal sublay (TAS).^[2-4] In literature, both retrorectus and preperitoneal space were employed in TAS. However, the *preperitoneal* space separation was realized mostly by Robotics.^[4] The major difficulty is to dissect the very thin peritoneum from

rectus sheath without damage. Robotics' flexibility alleviates the problem. We consider that it is also the major cause why no previous report of separating preperitoneal space in TES procedure is available. Jiang *et al*^[5] firstly conducted preperitoneal repair successfully in TES. This article presents the technical details and the preliminary results of endoscopic preperitoneal repair with TES procedure for small ventral hernias.

Sixty-two patients with small incisional or primary ventral hernia who were scheduled for preperitoneal repair with TES procedure at six hospitals in China between March 2016 to January 2020 were retrospectively reviewed. The study was approved by Institutional Ethical Board (2017–201) and all patients signed written informed consent preoperatively.

Surgical procedure and technical points. 1. Typical trocar arrangement [Figure 1B–F]. 2. Access and separation of preperitoneal space.

Defect of M1–M3. The preliminary working space was established in lower abdomen without posterior sheath, accessed by cutting linea alba above pubis, and expanded by blunt dissection with camera. Two 5-mm trocars are placed [Figure 1B]; the separation then continues towards cephalad side. Around Douglas line, the posterior sheath and the correct layer need to be identified carefully [Figure 1G]. Next, separation is conducted close to posterior sheath [Figure 1H]; peritoneum and extraperitoneal tissue are gradually detached from the sheath towards cephalad side [Figure 1I]. Hernia sac is reduced [Figure 1J] or transected [Figure 1K]; the open peritoneum

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Chinese Medical Journal 2022;135(15)

Received: 15-06-2021; **Online:** 28-12-2021 **Edited by:** Yanjie Yin and Xiuyuan Hao

Access this article online	
Quick Response Code:	Website: www.cmj.org
	DOI: 10.1097/CM9.0000000000001884

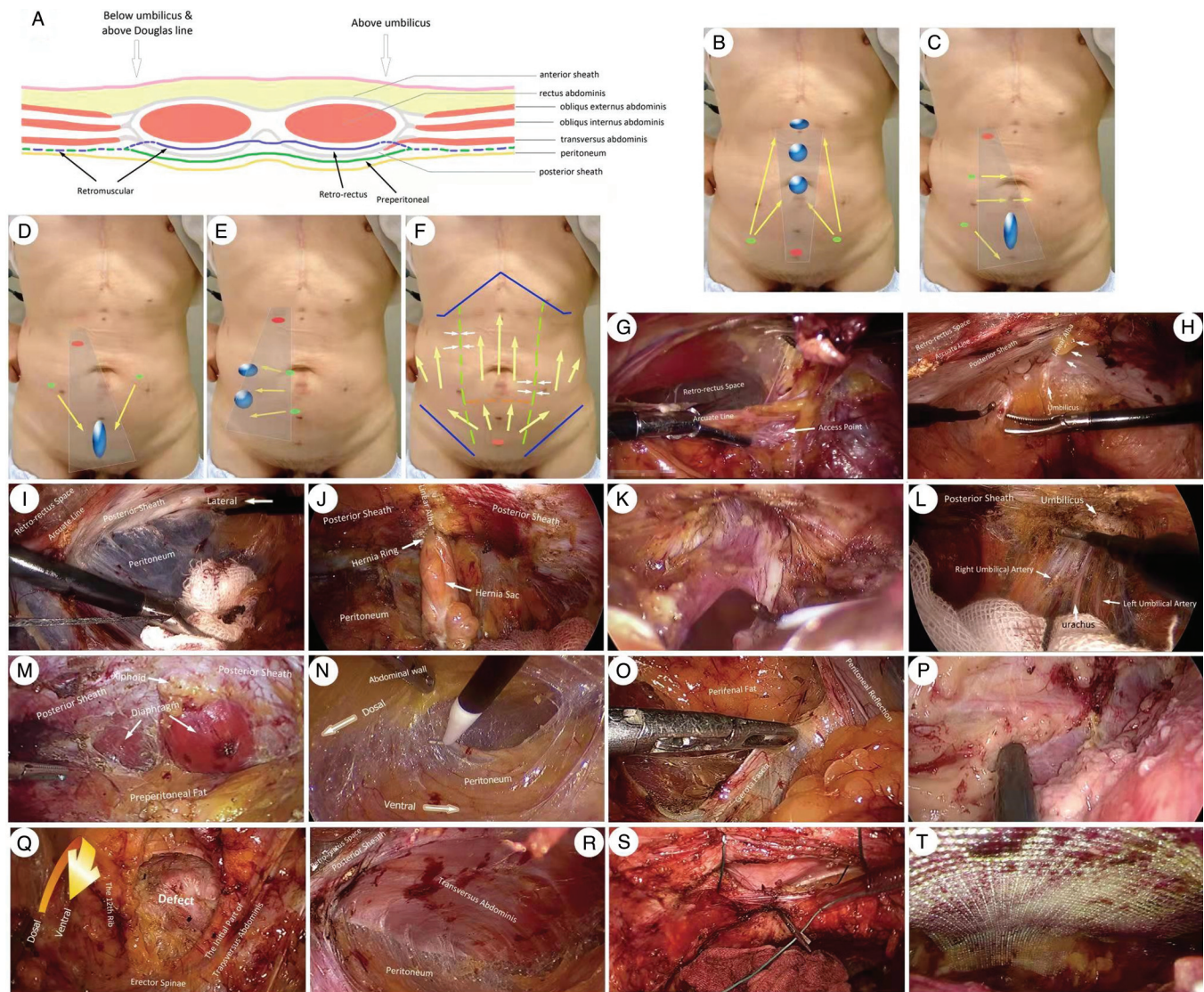


Figure 1: Two Sublay layers (A) and trocar arrangement (B–F). Gray shadow: Camera scope direction; Red dot: Camera trocar; Green dot: Surgeon trocars. Green Line: Margin of rectus sheath; Brown Line: Douglas line; Red dot: Access point and camera site; Yellow arrow: Direction of separation; White arrow: connection of preperitoneal space behind rectus sheath and transversus abdominis. Surgical procedure (G–T).

is sutured after separation. Frequently, sac reduction is easy for linea alba hernia [Figure 1J]. At umbilicus, skin damage should be avoided to prevent subsequent skin necrosis; ligamentum teres hepatic, atretic urachus, and umbilical arteries that assemble at the base of umbilicus are severed at the attachment point [Figure 1L]. If necessary, separation continues forward to the space behind xiphoid process [Figure 1M], and the diaphragmatic peritoneum should be separated from diaphragm carefully. The instruments are often interfered by the legs during separation. Placing patients in a jackknife position and lowering the abdominal wall by pushing from outside will alleviate this problem. The separation range is usually 5 cm from defect margin. For small defects, lateral separation ends at the outer margin of sheath.

Defect of M4–M5 and L3. The access and separation are similar as inguinal hernia totally extra-peritoneal. For M4–M5 defects, unilateral and bilateral trocar arrangement are both OK [Figure 1C–D]. For L3 defect, midline

trocar arrangement is recommended, and should be moved cephalad [Figure 1E].

Lateral defect of upper abdomen (L4). The patient is placed with lateral decubitus position. The camera is placed at 1-cm above iliac crest. After accessing the space, separation continues in cephalad and dorsal direction, the peritoneum and extraperitoneal fat are detached from the transversus abdominis [Figure 1N]. The dorsal separation will reach perinephric fat capsule, here the peritoneum reflection and Gerota fascia can be observed clearly [Figure 1O]. The retroperitoneum separation should be conducted between muscle fascia and extraperitoneal fat, avoiding injuries to diaphragm and iliohypogastric ilioinguinal nerve at the surface of muscle [Figure 1P]. Hernia sac is reduced or transected [Figure 1Q] during separation.

Crossing multiple regions. It should be required when separation is required if the defect is big or near the border of the regions [Figure 1R, across medial and

lateral regions]. The most used route is presented in Figure 1F.

3. Defect closure and mesh placement. Defect is closed with either continuous barbed suture or transfascial suture [Figure 1S]. An appropriate mesh is then placed. The mesh size is related to not only the size of the defect, but also the range of separation, covering as much separated space as possible [Figure 1T].

4. Drainage. A closed drainage is recommended to eliminate the preperitoneal space, which helps to position the mesh, avoid mesh displacement, facilitate mesh-tissue incorporation, and avoid seroma. If separated area is small and wound is clean, the drainage can be spared.

The follow-up points were 2 and 8 weeks, 6 months, and 1 year post-operatively. Then, telephone interviews were conducted every 6 months, and patients with concerns visited the clinic to check for possible complications. The follow-up was halted in April 2020 and ranged from 3 to 45 months, with a median of 8 (interquartile range [IQR] 5–21) months. One patient was lost to follow-up after 1 year.

All results are shown in the [Supplementary Materials, <http://links.lww.com/CM9/A842>]. Briefly, 56/62 cases scheduled to undergo preperitoneal repair with TES procedure completed repair. All failures occurred in patients with M1–M3 defect due to severe peritoneum damage during space separation. Two cases were converted to Lap-IPOM repair, and 4 to routine TES. Two wound events occurred and healed with debridement. All seroma was absorbed after 2 to 4 months. No patient required readmission. Short-term discomfort was observed in 11 patients in the first 3 months post-operatively and was relieved in the next 1 to 3 months.

As we described above, the space behind rectus sheath directly connects Retzuis space, same opposite space, and lateral retromuscular space, and further connects the retroperitoneum. Anatomically, the surface of whole peritoneum surrounded by the *preperitoneal* layer forms a whole visceral sac. Therefore, it is potential to separate the visceral sac as large as possible. We named this conception as “*total visceral sac separation (TVS)*”^[3,5,6] However, the implementation of TVS is difficult because the separation is like peeling an eggshell along its shell membrane. Certainly, no case needs a complete TVS, but the concept is important because it provides us a new perspective on ESR repair.

Peritoneum tears during separation is common, it shrink operating space and mak following steps difficult. Instead of closing the open peritoneum immediately, the strategy is first to enlarge the space by further separation of surrounding area. With space expansion, the peritoneum will drop down, the damaged peritoneum will be isolated, and then easy to close.

In this series, although the operative time is relatively long, successful *preperitoneal* space separation was achieved in most cases. No severe peri-operative and post-operative

complications occurred except seroma and delayed wound healing. No chronic pain or recurrence was observed. Given the above, for small incisional and primary ventral hernias, preperitoneal repair with TES procedure is safe, feasible, and effective.

This procedure also suits lumbar hernia. Currently, the major repairs include open sublay and laparoscopic transabdominal repair. The approach of open sublay repair is straightforward but brings the risk of wound occurrences. The laparoscopic transabdominal repair is not straightforward because the left/right colon needs to be dissected for exposing the defect behind.^[7] Instead, TES repair combines the advantage of direct approach and low wound occurrence. The surgery is performed without dissecting the colon and disturbing the abdominal cavity. Additionally, the peritoneum here is thick, making space separation and sac reduction relatively easy.

However, this technique is still challenging; so, currently, the indications should be limited to primary ventral hernias and small incisional hernias.

Acknowledgements

We thank Jiajie Liu and Jianfeng Shen (Shanghai East Hospital) for the collection and the pre-handling of the data.

Conflicts of interest

None.

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How to cite this article: Wu W, Jiang H, Tang R, Meng X, Liu G, Zhang Y, Liu N, Wei N. Preperitoneal space, is it an ideal layer for endoscopic sublay repair of ventral hernia?. *Chin Med J* 2022;135:1855–1857. doi: 10.1097/CM9.0000000000001884