Transversus Abdominis Muscle Release (TAR) for Large Incisional Hernia Repair

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Rezumat

Separarea mușchiului transvers abdominal (TAR) pentru tratamentul herniilor incizionale voluminoase

Introducere: cura herniilor incizionale complexe reprezintă un topic provocator și de mare actualitate. Tehnicile, numeroase sunt în majoritatea lor incapabile să atingă obiectivele chirurgiei moderne a peretelui abdominal. Separarea posterioară a componentelor cu eliberarea mușchiului transvers abdominal (TAR) reprezintă un abord nou și inovator care oferă soluția pentru tratamentul herniilor dificile.

Metoda: teaca posterioară a dreptului abdominal este deschisă pentru disecția planului retromuscular. Modificând tehnica Rives-Stoppa se creează un spațiu preperitoneal de mari dimensiuni prin secționarea mușchiului transvers abdominal medial de linia semilunară. Acest spațiu se extinde cranial până la tendonul central al diafragmului, inferior în spațiul Retzius și lateral până la psoas. Meșa este plasată în acest spațiu (sublay). În majoritatea covârșitoare a pacienților linia albă este reconstruită permițând recrearea unui perete abdominal funcțional întărit de proteză.

Rezultate: În intervalul noiembrie 2014 – iulie 2016 am aplicat procedeul la 24 de pacienți (14 de sex masculin) cu hernii

ventrale incizionale de mari dimensiuni. 18 (75%) prezentau defecte recidivate cu grade variabile de recidivă. Dimensiunea medie a lățimii defectului a fost de 18,3 cm (între 12 și 28 cm). La 5 dintre ei s-au instalat complicații ale plăgii care au necesitat reintervenție. Timpul mediu de urmărire a fost de 11,8 luni (2 – 18 luni) fără recidivă.

Concluzii: TAR pare să fie tehnica "ideală" pentru abordarea cu rezultate bune imediate a herniilor complexe.

Cuvinte cheie: hernie incizională gigantă, separarea posterioară a componentelor, eliberarea transversului abdominal (TAR)

Abstract

Background: complex ventral hernia repair is a frequent and challenging topic. Reconstructive techniques are numerous but most of them are unable to achieve the goals of hernioplasty. Posterior component separation with transverses abdominis muscle release (TAR) is a novel approach that offers a solution for complex ventral hernias.

Method: The posterior rectus sheath is incised and the retro-rectus plane is developed. In a modification of the Rives-Stoppa technique, the transversus abdominis is released medial to the linea semilunaris to expose a broad plane that extends from the central tendon of the diaphragm superiorly, to the space of Retzius inferiorly, and laterally to the retro-peritoneum. This preserves the neurovascular bundles innervating the medial abdominal wall. Mesh is placed in a sublay fashion above the posterior layer. In an overwhelming majority of patients, the

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linea alba is reconstructed, creating a functional abdominal wall with wide mesh reinforcement.

Results: Between November 2014 and July 2016 we used this procedure in 24 patients (14 males) with large median ventral incisional hernias. The recurrence in various degrees was present in 18 patients (75%). The average size of the defect was 18,3 cm. in width (12 to 28 cm.). Five patients (21%) developed various wound complications requiring reoperation. Follow-up between 2 and 18 months (11,8 months) without recurrence.

Conclusion: TAR seems to be the “ideal” approach for complex hernias with good immediate outcomes.

Key words: large incisional hernia, posterior component separation, transversus abdominis release (TAR)

Introduction

The ideal surgical approach to the difficult ventral hernia repair is still a matter of debate because of the high peri-operative morbidity (abdominal compartment syndrome, respiratory failure), frequent recurrences and poor quality of life. Recently described by European Hernia Association as a clear entity, difficult complex abdominal wall is a large challenge for both surgeon and patient (1, 2). Closing such defects is a significant problem in obtaining a reliable, durable repair with low morbidity and recurrence rate.

Rives – Stoppa repair evolved as an effective repair with favorable outcomes and low morbidity. The posterior rectus sheath dissection provides release of the rectus muscle and a well vascularised “box” for mesh placement. But the procedure is not appropriate for large defects due to its frequent inability of anterior fascial closure which leads to large surfaces of mesh under the skin (Fig. 1). The immediate result is an increased rate of surgical site events (SSE) and surgical site infections (SSI) as reported recently (3)

The approach of anterior component separation (ACS) as described by Ramirez, despite its wide fascial advancement and improved functional outcomes is encumbered by a significant wound morbidity at rates as high as 50% even in the presence of peri-umbilical perforators sparing (4,5). Minimally invasive surgery modifications reduced SSE but could not improve the recurrence rate which is still up to 30% (6).

As the number of large and complex abdominal wall defects is increasing it is obvious that the procedure is not adequate for such pathology. Some modifications of the technique were reported but the limited advancement of the rectus abdominis muscle (RA) make them inappropriate (7, 8).

In 2012 Novitsky et al reported a novel approach to posterior component separation by transversus abdominis muscle release (TAR) (9). This is a lateral extension of Rives – Stoppa repair with the creation of a wide space between the transversus abdominis muscle (TA) and fascia transversalis-peritoneum complex. The promising results of this initial

Figure 1. Inability to close the anterior rectus fascia expose to an increased number of SSE with mesh involvement

report determined us to implement the procedure as a daily practice.

The goal of the paper is to present operative technical details of the procedure and our short-term results.

Step by step procedure for a midline incisional hernia (8 - 15)

1. mid-line large laparotomy with complete excision of the scar if the skin is thin and poorly vascularized only by the contact with the peritoneal sac. The umbilicus is usually excised. Dissection of the sac in the classic fashion.
2. adhesiolysis: completely free all the bowel/omentum adhesions from the undersurface of the abdominal wall (AW) to allow medialization of this layer and to prevent bowel injuries at the reconstruction time. Minimize interloop dissection only to grossly adhesions in order to

Figure 2. Incision of the rectus sheath with opening and creation of the retromuscular space. The milestone of the procedure is identification of the rectus abdominis muscle (Yellow arrow). The dotted line is the line of incision of the entire rectus sheath

prevent postoperative obstruction. Protect the viscera with a wide wet soft towel.

3. creation of the retrorectus space is initiated at the level of the umbilicus. An incision is made on the posterior rectus sheath 0,5 – 1 cm. apart of its medial edge (Fig. 2).

Identify the RA not to enter pre-peritoneal plane !! If the plane is correctly approached the incision is extended cranially and caudally on the entire length of the RA sheath and the retro-rectus space is developed by blunt or sharp dissection. Laterally the dissection is extended to the semilunar line. Care must be taken to prevent damages of the epigastric vessels and of the neurovascular branches of the RA which perforate the posterior sheath just medial to Spiegel line (Fig. 3).

The retro-rectus plane is continued by cranial dissection to the retro-xiphoid plane and caudal in the pre-peritoneal space of Retzius with identification of both Cooper's ligaments and pubic symphysis.

4. incision of the posterior rectus sheath in the upper third of the abdomen, 0,5 cm medial to the perforating neurovascular bundles of the thoraco – abdominal nerves the posterior rectus fascia is sharply incised to expose the underlying TA muscle (Fig. 4).

Once the muscle is exposed the fibers are then divided along its entire medial edge. The separation from the pre-peritoneal plane is easily with an "L" curved dissector (Fig. 5).

In the upper third the muscle is well developed and easy to identify; its volume regress in the distal 2 thirds where there is no muscle but only tendinous component.

5. creation of the pre-peritoneal plane between the edges of the transected TA a new pre-peritoneal plane is created. Two Allis clamps on the lateral edge of the TA are elevated together with the muscle by the assistant surgeon. Left hand of the surgeon pushes inferiorly the medial edge of the TA so a dihedral angle is created between the muscle and the peritoneum. With a mounted swab the undersurface of the lateral border of the TA is freed from the peritoneum. In 20% or more frequent at the first procedures peritoneal tears are encountered (10). All of them must be carefully closed with an absorbable suture (3-0 Vicryl usually) to avoid protrusions of the small bowel under the mesh. In rare instances (2%) large peritoneal tears cannot be closed and must be buttressed with omentum, local fat or even an absorbable mesh. Laterally the dissection is extended as far as the psoas muscle; it's lateral border can be used as a landmark but usually the posterior axillary line is the main anatomic landmark for the lateral dissection (Fig. 6).

The cranial extend of the dissection depends on the extend of the defect; in upper hernias the space is advanced cranially through the costal margins to view the diaphragm. Inferior the pre-peritoneal plane is contiguous with the space of Retzius in the median line and with the space of Bogros on its lateral part. Trans-section of the medial attachments of the arcuate line of Douglas to the linea alba allow the access to the pre-peritoneal plane. Parietalization of the cord or resection of the round ligament extend the dissection in the space of Bogros and both miopectineal triangles.

Figure 3. The retrorectus space is created. The dissection is extended lateral as far as linea semilunaris (Spiegel) (yellow arrow) where can be easily identified the neurovascular bundles for the rectus abdominis muscle

Figure 4. After dissection of the retrorectus space the transversus abdominis muscle is incised at 0,5 cm medial from the semilunar line (dotted arrow). The incision is carried along its entire length (dotted line) medial to the neurovascular bundles (yellow arrow)

Figure 5. Incision of the transversus abdominis muscle. Arrow-transversus abdominis fibers

6. closing of the posterior rectus sheath with a 2-0 slowly absorbable suture (Polydioxanone) recreates the visceral

Figure 6. The newly preperitoneal plane is created separating the undersurface of the lateral transected transversus abdominis (arrow) from the peritoneum and fascia transversalis. Dotted arrow- the medial component of the transected transversus abdominis

sac excluding the bowel from the large retro-muscular space (Fig. 7).

7. placing the mesh this wide pre-peritoneal space is measured in length and width for an appropriate mesh adjustment. Usually a mesh larger than 30/30 cm is necessary. A low or mid weight large pores monofilament polypropylene mesh is used (40 to 60 g/m²). For lateral defects or very large defects a heavyweight mesh could be necessary. The mesh must overlap the defect minimally to the anterior axillary line, subxiphoid space and 2-4 cm. below the simphisis.
8. anchoring the mesh first step is to suture the mesh to both Cooper's ligaments and to simphisis with nr 1 slowly absorbable suture. Inferior fixation is essential for the protection of the supra-pubic area because the vectors of the intra-abdominal pressure are directed inferiorly. Cranially 2 stiches fixe the mesh around the xiphoid covering the epigastric area and retrosternal space. Three bilateral stiches below the costal margin, medial to the anterior superior iliac spine and medial to the psoas muscle are passed through the entire abdominal wall with a Reverdin needle and complete mesh fixation. Lateral wide overlap and intra-abdominal pressure maintain the mesh in position without the fear of lateral recurrence. The mesh could be fixed in the retromuscular space by the aid of biologic glue with better outcomes in terms of postoperative pain and recovery. There are no published data yet (Igor Beliansky – personal communication). The space and mesh are irrigated with a saline solution containing 80 mg of Gentamicyne in 250ml. Mechanical and chemical action reduce the risk of mesh infection. Two closed suction drains are placed on the ventral face of the mesh.
9. anterior fascial closure with a running slowly absorbable nr 1 suture recreates the linea alba. A subcutaneous

Figure 7. The posterior fascia closed with a running suture. Note the wide preperitoneal space which will be the "ideal" place for the mesh

drain is optional only if there are pockets which cannot be closed. Otherwise the subcutaneous tissue is closed with interrupted absorbable sutures. Skin closure. An abdominal binder is recommended in the first post-operative days in order to reduce seroma formation. After that is patient's choice.

Results

Between November 2014 and July 2016 we used this procedure in 24 patients (14 males) with large median ventral incisional hernias. The recurrence in various degrees was present in 18 patients (75%). One patient was with a large median and parastomal left hernia. The average size of the defect was 18,3 cm. in width (12 to 28 cm). The anterior rectus sheath was closed in all patients without one. Five patients (21%) developed various wound complications requiring reoperation (hematoma 3 patients and superficial wound infection without mesh involvement in 2 patients). Follow-up between 2 and 18 months (11,8 months) without recurrence.

Discussions

The benefit of the retro-rectus repair of abdominal wall defects has been well documented over the years by many authors after Rives and Stoppa published their researches. This technique provides many advantages in the reconstruction of complex defects (8-15):

1. the retro-rectus space is an easily dissected potential space;
2. it is a well vascularized compartment with a more efficient collagen deposition and mesh integration;
3. in a recent systematic review and network meta-analysis

sublay was associated with lower risk of recurrences and SSI compared to on-lay, inlay and underlay. Sub-lay was ranked the best mesh placement option with a high probability of being the best treatment (94.2% probability of having the lowest odds of recurrence and 77.3% probability of having the lowest odds for SSI) (16).

All this advantages are limited by the frequent impossibility of closing the anterior fascia in large defects with increasing SSE, recurrence and inability to properly heal.

The goal of any herniorraphy is first of all the restoration of a functional abdominal wall by recreating the linea alba reinforced with a large prosthetic mesh overlap and with minimal early and late wound morbidity.

The posterior component separation by transversus abdominis muscle release (simply TAR) is a modification of the Rives-Stoppa procedure which combines it with developing of a large retro-muscular/pre-peritoneal plane and a consistent medial advancement of the abdominal wall musculature and accompanying fascia. Dividing the TA fibers the hoop tension around the abdomen is released and the abdominal cavity is increased. The intra-abdominal pressure (IAP) is also lowered by drawing the abdominal wall upward (11). Also the force vector of the TA directly opposing the medialisation of the fascia is abolished. The result is a fascial advancement of 8 to 12 cm on each side which allows restoration without tension of the linea alba with improved abdominal core muscle function. Fascial closure rates of 91% for defects of 472 cm² with 50% reduction in wound morbidity were obtained in a recent study (17).

Closure of the posterior rectus fascia and the large pre-peritoneal compartment avoids the use of expensive meshes and minimizes mesh-bowel interaction. Bi-laminar closure of the abdominal wall prevents mesh migration and protection against the infection. Working outside the rectus sheath the procedure avoids disruption of the neurovascular bundles that supply the antero-medial abdominal wall.

Unnecessary extensive skin flaps and preservation of a significant portion of the abdominal wall blood supply improves healing and decrease wound morbidity (10).

A wide range of patients benefits from the advantage of the procedure (8-15):

1. any patient with large abdominal wall incisional or ventral hernia (defects larger than 10 cm in width, loss of domain);
2. large subxiphoid, parailiac, and suprapubic hernias, subcostal/bisubcostal hernias;
3. recurrent incisional hernias after intra-abdominal mesh plasty;
4. recurrences after anterior component separation;
5. parastomal hernias with or without medial incisional hernias;
6. incisional hernias after open abdomen with or without planned ventral hernia.

Difficulties could be encountered for recurrent hernia after Rives-Stoppa repair or after primary or secondary pre-peritoneal fibrosis due to extensive necrotising pancreatitis.

Conclusions

TAR is superior to Rives-Stoppa repair and seems to be the best option for a wide spectrum of complex primary and incisional hernias with low morbidity and good long-term results. Good anatomy knowledge and surgical skills are necessary for valid outcomes.

Disclosures

OV – no conflict of interest to declare; RGhV – no conflict of interest to declare; MD – no conflict of interest to declare. No outside financial contribution to declare.

Authors contribution

All the authors equally contributed in preparing this manuscript.

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