A case report of the trauma patient who has complex abdominal wall reconstruction by using the posterior component separation with transversus abdominis release technique

Lertpong Somcharit, M.D.[1]

ABSTRACT

Posterior component separation with transversus abdominis release is a technique that corrects complex abdominal wall defects. Many studies have proven that it has lower recurrence and surgical site infection rates. This technique has become popular in the large complex ventral hernia reconstruction. There is less data to use this technique in trauma patients who have complex abdominal wall defects. This is a report of the trauma case receiving posterior component separation with transversus abdominis release technique for chronic ventral hernia after blunt abdominal injury with multiple organ trauma. Techniques and procedures are explained, along with relevant literature.

บทคัดย่อ

รายงานเคสผู้ป่วยอุบัติเหตุที่ได้รับแก้ไขการบาดเจ็บผนังหน้าท้องที่ซับซ้อนโดยการแยกส่วนผนังหน้าท้องด้านหลังร่วมกับการปลดกล้ามเนื้อหน้าท้องส่วนขวาง

การผ่าตัดแยกส่วนผนังหน้าท้องส่วนหลังร่วมกับการปลดกล้ามเนื้อหน้าท้องส่วนขวาง เป็นอีกหนึ่งวิธีในการแก้ไขการบาดเจ็บผนังหน้าท้องที่ซับซ้อน มีหลายการศึกษาวิจัยที่พิสูจน์ว่าการรักษาโดยวิธีนี้มีอัตราการเกิดเป็นซ้ำ และการเกิดภาวะติดเชื้อที่ตำแหน่งผ่าตัดต่ำ วิธีการผ่าตัดนี้เริ่มได้รับความนิยมในการแก้ไขภาวะไส้เลื่อนหน้าท้องขนาดใหญ่และซับซ้อน

[1]Division of Trauma surgery, Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand.
*Correspondence to: Assoc. Prof. Lertpong Somcharit
Division of Trauma Surgery, 4th Floor Trauma Building, Siriraj Hospital, 2 Prannok Road, Bangkoknoi, Bangkok, Thailand, 10700
Tel. (662) 419 7727, lertjung@gmail.com

แต่วิธีนี้ยังถูกนำมาน้อยในผู้ป่วยอุบัติเหตุที่มีปัญหาการบาดเจ็บซับซ้อนที่ผนังหน้าท้อง นี่คือรายงานการรักษาในผู้ป่วยที่มีภาวะไส้เลื่อนผนังหน้าท้องขนาดใหญ่ชนิดซับซ้อนภายหลังเกิดอุบัติเหตุในช่องท้อง ที่ได้รับการแก้ไขโดยวิธีนี้ มีการอธิบายเทคนิคและขั้นตอนการผ่าตัด รวมทั้งทบทวนงานวิจัยที่เกี่ยวข้อง

KEYWORDS

PCS/TAR in trauma

CASE REPORT

A 32-year-old male singer had a blunt abdominal injury due to a high-speed car accident one year ago. He had undergone exploratory laparotomy at the first hospital. The findings were as follows: 80% circumferential jejunal tear at 8cm from the DJ junction, 90% circumferential tear at the 2nd and 3rd part of the duodenum, superior mesenteric vein injury, and superficial contusion at the uncinate process of the pancreas (pancreatic injury grade I). He underwent primary repair of the jejunum, duodenum, and the superior mesenteric vein, and a closed suction drain for the pancreatic injury. A few days later, the patient developed sepsis due to leakage of the duodenal anastomosis. He had a second operation by Roux-en-Y gastrojejunostomy with feeding jejunostomy, abdominal toilet, and temporary abdominal closure. After that, the patient was transferred to Siriraj Hospital for proper management.

At Siriraj Hospital, the patient presented with sepsis due to an intraabdominal collection, and his abdomen could not be closed due to a prolonged open abdomen and matted bowel. He had a split-thickness skin graft covering the matted bowel and was stabilized in the ICU for several days *(Figure 1A).* After he recovered from sepsis, the anastomotic leakage closed spontaneously, and he was discharged with a large complex ventral hernia.

After he was discharged, the patient returned to daily life. However, he complained that he had a large ventral hernia. It could disturb his appearance because he is a singer *(Figure 1B)*. The patient had to wait one year due to a lot of adhesions in his abdomen. Then he was scheduled for closure of the abdomen by posterior component separation with transversus abdominis release technique. The operation went smoothly, with no clinical signs of intra-abdominal hypertension (IAH) post-operation, and he was discharged 6 days after surgery without complications. The patient had follow-ups in the outpatient department at 1 month and 6 months post-operation. No complications were seen. His abdominal wall appeared normal in terms of shape and function. He felt happy because his abdominal wall looked normal, and he could sing confidently *(Figure 1C).*

Figure 1 A-B-C

1A- The patient had STSG for abdominal closure.

1B- Demonstrating a large ventral hernia 1 year after STSG.

1C- Appearance of the patient's abdomen 1 month after PCS/TAR.

BACKGROUND OF THE COMPONENT SEPARATION

Large complex ventral hernia is among the most challenging conditions, especially in patients who have complicated abdominal trauma. The common cause of complex ventral hernia is the result of temporary abdominal closure[1]. The criteria for diagnosis include: defect >100 mm, loss of domain >20%, hernia at bony prominence, abdominal wound dehiscence, or multiple hernial defects[2].

The technique for abdominal wall reconstruction was first described by Ramirez et al in 1990[3]. This technique is now called 'anterior component separation'. This technique requires extensive skin and subcutaneous tissue flaps, a lack of space for prosthetic reinforcement, and recurrent rates of up to 30%, with 26%-42% wound infection rates[4]. The posterior component separation is based on the technique of Rives-Stoppa-Wantz retro-rectus repair[5-7]. This technique is limited because it cannot dissect over the lateral border of the posterior rectus sheath (PRS). Therefore, it is difficult to perform tension-free repair of the large defects that allow mesh overlap. The posterior component separation with transversus abdominis release technique (PCS/TAR) is a modification of the Rives-Stoppa-Wantz repair. It makes a space between the PRS and the rectus abdominis muscle to place a mesh. Releasing the transversus abdominis muscle provides an increase in space while preserving the neuromuscular supply. Novitski et al. published this PCS/TAR technique in 2012, noting a low recurrent rate, decreased wound morbidity, and rare mesh-related complications[4,8].

This PCS/TAR technique has become popular in the large complex ventral hernia reconstruction. It requires abdominal wall anatomy knowledge, appropriate surgical training, and strict prehabilitation programs8.

INDICATIONS

The PCS/TAR is primarily indicated for treating large and/or complex ventral hernias. Large ventral hernia is defined as a fascial defect with a width > 100 mm, or involving an important part of the abdominal wall, mostly over 25%[9]. This technique is appropriate for placing a large prosthesis, facilitating midline reconstruction. It is also suitable for lateral hernias, for which traditional approaches cannot perform a durable repair[10]. This technique is effective in significant comorbidities, for example, diabetes and COPD patients[11].

PREOPERATIVE CARE

Preoperative assessment is recommended for complex abdominal wall reconstruction. Preoperative abdominal computed tomography provides insights into the hernia defect dimensions, content, hernia sac volume to the abdominal cavity volume ratio, muscle thickness, and retroperitoneal abnormalities. Measurement of the length and width of the fascial defect helps ensure complete coverage and adequate mesh overlap.

Pulmonary function tests should be performed in patients with a history of heavy smoking or pulmonary disease. These patients should be assessed for baseline lung function and optimized perioperative care[11].

Patients with colon content in the hernia should usually have mechanical bowel preparation before surgery. Polyethylene glycol or PEG reduces postoperative complications in patients with colon in the hernial sac, but it is not universally required[12].

This patient has good pulmonary function due to his occupation as a singer. He does not have malnutrition or obesity. His CT shows an abdominal wall defect measuring 129 x 196 mm, and small bowel content in the hernia, so in this case, it is not necessary to receive bowel preparation *(Figure 2)*.

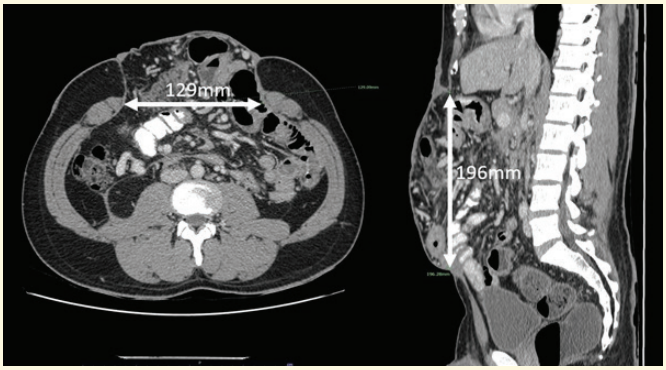

Figure 2
Axial and sagittal CT images demonstrate the large ventral hernia and its contents.

SURGICAL PROCEDURE

The patient is placed in a supine position after general anesthesia is performed. These are the steps of the procedure:

1. Skin graft removal and scar excision

This patient previously had a split-thickness skin graft (STSG) for abdominal closure. The removal of STSG and scar excision started the procedure. Small bowel injury should be avoided when the hernial sac is close to the STSG. Dissection was done with the use of sharp scissors and surgical peanut sponges to identify the rectus sheath *(Figure 3)*.

2. Rives-Stoppa plane creation

The posterior rectus sheath (PRS) was incised 5-7 mm from the midline to identify the Rives-Stoppa plane. The incision was extended along the entire length in cranial and caudal directions *(Figure 4)*. Blunt and sharp dissection was applied to create a plane to the linea semilunaris on the lateral side. Neurovascular bundles represent the mark of the lateral extent of the dissection. Continuing dissection below the arcuate line at the caudal side, preserving the deep inferior epigastric vessels, exposing the Cooper ligaments and pubic symphysis. The dissection was repeated cephalad and may extend to the subxiphoid and costal margin.

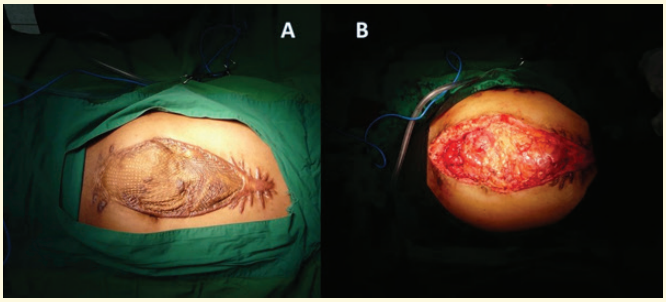

Figure 3 A-B
3A- Before STSG and scar removal.
3B- After STSG and scar were excised.

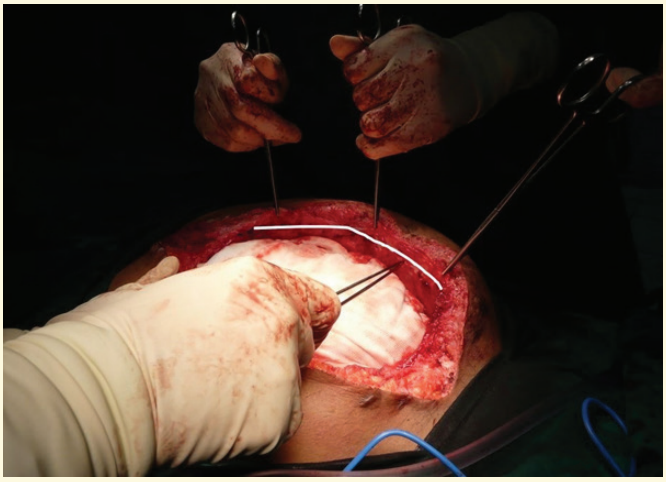

Figure 4
The white line demonstrates the incision for the Rives-Stoppa plane creation

3. Establishing the transversus abdominis (TA) release

The 5 mm incision was performed on the posterior lamella of the internal oblique aponeurosis, medial to the neurovascular bundles, to identify the TA muscle. The incision usually starts at the middle third, where the TA fibers are muscular, because the lower third is more aponeurotic. The TA fibers were divided by the 'bottom-up' approach with electric cautery to establish the plane *(Figure 5)*. This approach continues to the cranial as well as caudal aspects of the plane. The dissection was repeated on the opposite side.

4. The posterior rectus sheath (PRS) closure

The PRS was reapproximated in the midline with less than 10 mm suture bites using 1-0 Polyglactin suture *(Figure 6A)*. The peak/plateau respiratory pressure monitoring should be performed when the PRS is closed.

5. Mesh placement

A large polypropylene mesh was placed into the retro-rectus space between the rectus abdominis muscle and the reapproximated PRS. Trans-fascial fixation by 1-0 Polyglactin interrupted suture under physiological tension can help prevent mesh migration. The 10 Fr closed suction drain was placed to relieve seroma formation *(Figure 6B)*.

6. The anterior rectus sheath (ARS) closure

The ARS was reapproximated with 1-0 Polyglactin continuous sutures. Peak inspiratory pressure and urine output should be monitored during closure of the sheath to identify signs of compartment syndrome.

7. Subcutaneous tissue and skin closure

The subcutaneous tissue was stitched using 2-0 polyglactin interrupted sutures. Lastly, the skin was closed with skin staples *(Figure 7)*.

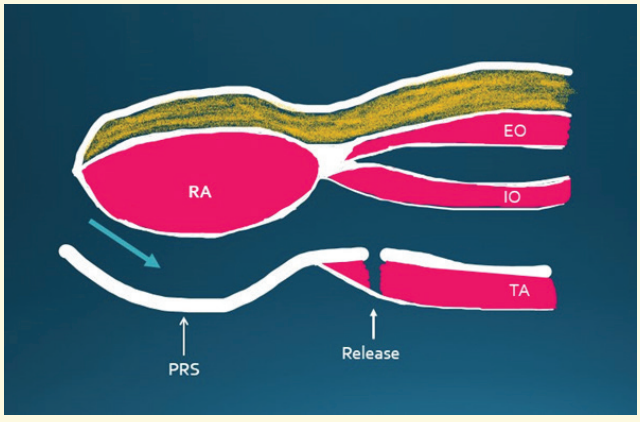

Figure5
Demonstrating the Rives-Stoppa plane and TA release.
***RA**: Rectus abdominis muscle, **EO**: External oblique muscle, **IO**: Internal oblique muscle, **TA**: Transversus abdominis muscle, **PRS**: Posterior rectus sheath.*

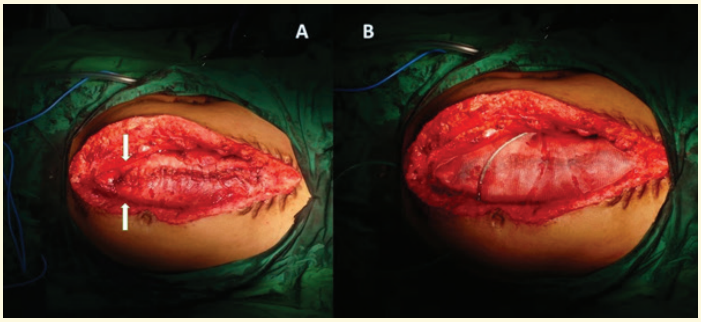

Figure 6 A-B
6A- The PRS was closed by a 1-0 Polyglactin continuous suture; the release TA fiber was seen at the border of the PRS (white arrow).
6B- A large polypropylene mesh was placed into the retro-rectus space, and a closed suction drain was placed to relieve seroma formation.

Figure 7- Skin was closed with skin staples.

POSTOPERATIVE CARE

This patient was encouraged to ambulate and feed when his intestinal motility recovered. Wounds were observed daily for the presence of hematoma, seroma, and infection. The color and volume of the drain were also monitored, and it can be removed when the daily output decreases to 50ml/day. The patient was discharged after tolerating an adequate oral diet, with no complications. He was advised to avoid heavy lifting for at least one month.

The patient had a follow-up in the outpatient department 2 weeks after surgery for staple removal, 1 month, and 6 months for clinical examination. No complications were seen. His abdominal wall appeared normal in terms of shape and function. Finally, he could perform his songs well.

DISCUSSION

The advantages of PRS/TAR include: first, it facilitates substantial medialization of the rectus abdominis muscle, achieving 80-120 mm on each side, in contrast to 50-70 mm with anterior component separation[13].

Second, large skin and subcutaneous tissue flaps are not required, which might result in wound complications. Third, the underlying viscera do not directly contact the mesh after closing the PRS. Last, this technique is particularly effective for patients who have morbidity, such as diabetes and obesity[11].

However, this technique requires understanding abdominal wall anatomy and appropriate training. Significant concerns are avoiding neurovascular bundle injuries when creating the TA plane, injury to the semilunar line, and accidentally making a hole in the posterior layer. These risks can be reduced by considering the surgical technique.

In 2014, Criss et al evaluated the abdominal wall function of 13 patients who underwent PCS/TAR and agreed to dynamometric analysis before and 6 months after operation[14]. The study showed that 'the PCS/TAR improved peak torque, power during isokinetic analysis, and quality of life'. The authors concluded that restoring the linea alba by returning the rectus muscle to midline improved abdominal wall function and quality of life.

Many studies showed good results of the PCS/TAR in the risk of recurrence and incidence of surgical site infection, but no studies included trauma patients. For example, Novitsky et al showed the result of 428 consecutive PCS/TAR procedures in 2016[15]. Only 39 patients (9.1%) developed surgical site infections. Moreover, the recurrence rate was only 3.7%.

Wegdam et al published a systematic review of 5 articles, including 646 PCS/TAR patients in 2019[16].

They focused on postoperative complications and recurrence rates. Pooled calculations demonstrated that the mean surgical site infection occurrence rate of PCS/TAR was 15%, while 20-35% by ACS. The mean 2-year recurrence rate was 4%, but 13% after ACS. The authors concluded that PCS/TAR is a good alternative regarding surgical site occurrence and recurrence, especially in large ventral hernia.

In 2019, Como et al reported a trauma case in which a patient received PCS/TAR[17]. A middle-aged man had a gunshot wound to the abdomen with multiple intraabdominal injuries. His abdomen was closed by STSG due to leakage of hollow viscus anastomoses and low-output enterocutaneous fistula. He had PCS/TAR at 9 months later. His abdominal wall defect was 120 mm in width. He did not have in-hospital complications, and he was discharged on postoperative day 8. Two months after the operation, he was feeling well, with no evidence of infection, and able to do sit-ups without evidence of recurrent hernia.

The PCS/TAR has been performed by open technique, but some studies reported using minimally invasive approaches with TAR[18-19]. The robotic TAR has been proven feasible and is a good option for correcting complex abdominal wall defects. Although it has a prolonged operative time, it reduces pain, facilitates recovery, and decreases the length of hospital stay. This robotic TAR might soon be an alternative surgical technique for complex abdominal wall defects.

LIMITATION

This case report needs a long-term follow-up on the risk of surgical site infection, recurrent hernia, and abdominal wall function.

CONCLUSION

The PCS/TAR is a technique for correcting complex abdominal wall defects that lowers recurrence and infection rates. Success demands understanding the anatomy of the abdominal wall, appropriate training, and adopting a prehabilitation program. The PCS/TAR continues developing, especially by adapting minimally invasive or robotic surgery. There is less data to use this technique in trauma patients. This case report is an example of using PCS/TAR in a trauma patient with no complications, short hospital stays, and a good functional outcome.

ACKNOWNLEDEMENT

The Faculty of Medicine at Siriraj Hospital, Mahidol University, supported this case report. The author would like to thank Ms.Susan Adler-Shaw for editing assistance.

REFERENCES

1. Leppäniemi A, Tukiainen E. Reconstruction of Complex Abdominal Wall Defects. Scandinavian Journal of Surgery. 2013 Mar;102(1):14–9.
2. Rabie M, Abdelnaby M, Morshed M, Shalaby M. Posterior component separation with transversus abdominis muscle release versus mesh-only repair in the treatment of complex ventral-wall hernia: a randomized controlled trial. BMC Surgery. 2022 Sep 20;22(1).
3. Ramirez OM, Ruas E, Dellon AL. "Components Separation" Method for Closure of Abdominal-Wall Defects. Plastic and Reconstructive Surgery. 1990 Sep;86(3):519–26.
4. Novitsky YW, Elliott HL, Orenstein SB, Rosen MJ. Transversus abdominis muscle release: a novel approach to posterior component separation during complex abdominal wall reconstruction. Am J Surg 2012;204:709–16.
5. Rives J, Pire JC, Flament JB, Convers G. [Treatment of large eventrations (apropos of 133 cases)]. Minerva Chir 1977;32:749–56.
6. Stoppa RE. The treatment of complicated groin and incisional hernias. World J Surg 1989;13:545–54.
7. Wantz GE. Giant prosthetic reinforcement of the visceral sac. Surg Gynecol Obstet 1989;169:408–17.
8. Chatzimavroudis G, Kotoreni G, Kostakis I, Voloudakis N, Christoforidis E, Papaziogas B. Outcomes of posterior component separation with transversus abdominis release (TAR) in large and other complex ventral hernias: a single-surgeon experience. Hernia. 2022 Oct;26(5):1275-1283.
9. Riediger H, Holzner P, Kundel L, Gröger C, Adam U, Adolf D, et al. Laparoscopic transversus abdominis release for complex ventral hernia repair: technique and initial findings. Hernia. 2023 Aug 28;28(3):761–7.
10. 10. Punjani R, Arora E, Mankeshwar R, Gala J. An early experience with transversus abdominis release for complex ventral hernias: a retrospective review of 100 cases. Hernia. 2021 Apr;25(2):353–64.
11. Oprea V, S. Mardale, F. Buia, D. Gheorghescu, R. Nica, S. Zdroba, et al. The influence of Transversus Abdominis Muscle Release (TAR) for complex incisional hernia repair on the intraabdominal pressure and pulmonary function. Hernia. 2021 Mar 22;25(6):1601–9.
12. Ramos M, Khalpey Z, Lipsitz S, Steinberg J, Panizales MT, Zinner M, et al. Relationship of perioperative hyperglycemia and postoperative infections in patients who undergo general and vascular surgery. Ann Surg. 2008;248(4):585–91.
13. Majumder A, Martin-Del-Campo LA, Miller HJ, Podolsky D, Soltanian H, Novitsky YW. Evaluation of anterior versus posterior component separation for hernia repair in a cadaveric model. Surg Endosc. 2020 Jun 1;34(6):2682–9.

REFERENCES

14. Lee L, Mata J, Landry T, Khwaja K, Vassiliou MC, Fried GM, et al. A systematic review of synthetic and biologic materials for abdominal wall reinforcement in contaminated fields. Surg Endosc. 2014 Mar 12;28(9):2531–46.
15. Novitsky YW, Fayezizadeh M, Majumder A, Neupane R, Elliott HL, Orenstein SB. Outcomes of Posterior Component Separation With Transversus Abdominis Muscle Release and Synthetic Mesh Sublay Reinforcement. Ann Surg. 2016 Aug;264(2):226-32.
16. Criss CN, Petro CC, Krpata DM, Seafler CM, Lai N, Fiutem J, et al. Functional abdominal wall reconstruction improves core physiology and quality-of-life. Surgery. 2014 Jul;156(1):176–82.
17. Como JJ, Gunter OL, Diaz JJ, Ho VP, Miller PR. Use of posterior component separation and transversus abdominis release in trauma and emergency general surgery patients: a case report and review of the literature. Trauma Surgery & Acute Care Open. 2019 Jan;4(1):e000268.
18. Belyansky I, Zahiri HR, Park A. Laparoscopic Transversus Abdominis Release, a Novel Minimally Invasive Approach to Complex Abdominal Wall Reconstruction. Surg Innov. 2016 Apr;23(2):134-41.
19. Vitória M, José Ricardo Guimarães, Volpe P, Martins M, Carlos Eduardo Domene, Roll S, et al. Robotic Transversus Abdominis Release (TAR): is it possible to offer minimally invasive surgery for abdominal wall complex defects? Rev Col Bras Cir. 2017 Mar-Apr;44(2):216-219.