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Laparoscopic Versus Open-Component Separation Technique with Mesh Reinforcement for Closure of Large Anterior Abdominal Wall Defect

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Abstract: ***Background: A growing number of cases have a huge or complicated abdominal wall defect. Such defects might be a consequence of incisional hernia associated with several abdominal surgeries, surgical operations resection of the abdomen wall, necrotizing abdomen wall infections, or open abdominal therapy. Aim and objectives: The goal of the current work is the comparison among the laparoscopic and open anterior component separation with mesh reinforcement for the closure of large anterior abdominal wall defect with study further improvement in the surgical outcome of these complex cases using laparoscopy to decrease the morbidity associated with the open procedures. Patients and methods: A prospective study had been conducted from Jan. 2016 to Jan. 2020 at Al -Azhar University Hospital, New Damietta. Thirty hemodynamically stable cases with large ventral abdominal wall defects were fully assessed clinically with complete previous medical and surgical history and requesting the related investigations, underwent an anterior component separation technique with a record of the surgery, intra-operative, 30 days postoperative complications rates and 1 year follow up for recurrence. Results: Operational Period for group-I was (mean ±S.D.) 202.93±39.978 minute and in group-II was 217.4±44.368 min, with no remarkable difference statistically among the studied groups was detected. The hospitalization time in group-I ranging from 4 to 7 days and in group-II ranging from 7 to 10 days, with remarkable difference statistically was existing among the studied groups. Conclusion: The CST is a very useful technique, safe and successful for the treatment of huge and complex ventral hernias as it can cause the closure of the defect without tension.***

Keywords: Component Separation Technique, Incisional hernia, Laparoscopic, Skin-Flap Necrosis, Abdominal Wall Defects

1. Introduction

Large ventral defect occurs when one or several components of the abdominal wall are missed, the principal components of it including the fascia and muscles giving support & the skin which cover and protects the interior layers **(Breuing et al., 2010).**

In the hernia surgery field, there have been many advances in the techniques that have provided the surgeon with multiple choices to repair the complicated abdominal wall hernia. Nevertheless of the method, the eventual aim was to deliver a tension-free repair, that aim to reestablish the mid-line while restoring abdominal wall muscular structure to its standard anatomic location, that provides the patient with both a cosmetic and sturdy outcome with or without the application of a prosthetic reinforcement **(Albright et al., 2011).**

A huge incisional hernia with a horizontal defecting of >10 cm is challenging in surgery of the abdomen wall hernia. In a lot of these huge incisional hernias, the slandered repair either open methods or laparoscopic intraperitoneal onlay mesh (IPOM) are insufficient. Closure of the defect with a reforming of the linea alba can often only be reached with open component separation (OCS) **(Giurgius et al., 2012)**.

Ramirez et al. in 1990 is the first one to explain the Component Separation Technique (CST). It is very successful for managing wide or complicated midline abdominal wall defect and it has the benefit of reestablishing the innervated dynamic abdominal wall integrity with tension free repair based on the conception of reconstructing a functional abdominal wall with autologous tissue reconstruction. **(De Silva et al., 2014).**

CST types may be categorized based on the following principles: anterior versus posterior CST and open versus minimally invasive methods. Ramirez et al. explained in anatomic bases "that the external oblique muscle may be separated from the internal oblique in a relatively avascular plane". The rectus muscle with its covering rectus fascia may be raised from the posterior rectus sheath. The rectus flap with its attached muscles, maybe advance 10 cm at the plane of the umbilicus **(Kumar et al., 2018).**

Endoscopic-assisted CST (also called laparoscopic CST) was created to protect the periumbilical perforators and the outcomes were matched to the open method. In spite of the adaptability of the CST & its very low recurrent-rate in comparison with the recurrent-rate in the traditional management of the same complex abdomen wall defect, the method is not widely used in the surgical practices **(Daes, 2019).**

Patients and Methods

The study was prospective (case-control), had been carried out at Al -Azhar University Hospital, New Damietta, from January 2016 to January 2020. 30 hemodynamically stable patients with big ventral abdominal wall defect had been completely evaluated with a full history taking, clinical assessment and requesting the relevant investigations,

underwent an anterior component separation technique with a recording of operation, intra-operative and post-operative complications then postoperative follow up for 1 year.

The 30 patients were randomized subdivided into 2 groups: **Group-I:** 15 cases for Laparoscopic CST, and **Group-II:** 15 cases for open CST.

Inclusion criteria: This study had been included 30 patients with large midline anterior abdominal wall defect, age from 18 to 50 years old.

Exclusion criteria: This study had been excluded: Patients below 18 years old and above 50, Lateral abdominal wall hernia, Patients with recognized or clearly indication for interventional treatment, such as perforation of peritonitis, known intra-abdomen injury, complications of previous surgical operation, shocks, Patients with acute intestinal obstruction, Patients with uncorrected coagulopathy, Pregnancy and lactation, Severe cardiopulmonary disease, Uncontrolled hypertension and Decompensated liver cirrhosis.

Data Collection: The surgical department in Al-Azhar university hospital, New Damietta utilizes an established prospective data-base. The data-base is handled on the current base to collect: case demographics, diagnosis consequences, and intervention, result, and case satisfying variables.

The ethical commission approval was obtained from Institution Research Board (IRB) of Al Azhar faculty of medicine, (New Damietta).

Written medical informed consent had been secured from all of the participating cases submitted in the study.

Individual confidentiality was respected in all stages of our study.

The following data was obtained from all patients:

Clinical assessment:

a) History: complete history taking in details: Personal data, medical and surgical history and complaint
b) **Clinical examinations:** complete general & local examinations.
c) **Pre-operative investigations:** Routine laboratory investigations and specific testis as indicated from history
   1) Complete blood picture.
   2) Liver functions: SGPT & SGOT, Serum bilirubin and PT & INR.
   3) Renal functions test: Serum creatinine and BUN.
   4) Random Blood sugar.
   5) Imaging study: abdominal CT scan to evaluate the hernia defects extent and also abdomen wall musculature pre operatively.

Surgical technique

Open anterior component separation

The old scar will be excised followed by dissection of the hernia sac followed by adhesiolysis**.** Identification of the lateral border of the rectus muscle, the external oblique aponeurosis is divided 1 -2 cm lateral to it, vertically from the costal margin till the inguinal region. Lateral blunt dissection in an avascular plane between both oblique muscles allows the formation of a "sliding myofascial flap" made up of the transversus & internal oblique muscles**.**

Midline closure was done without tension with one layer of continuous or interrupted non-absorbable no 1 sutures.

A large piece of polypropylene mesh (30*15cm) is placed over the repair (onlay) to have an adequate cover and overlap all around the defect and fixed to parities with sutures**.** Drainage tubes are inserted in the abdominal flanks

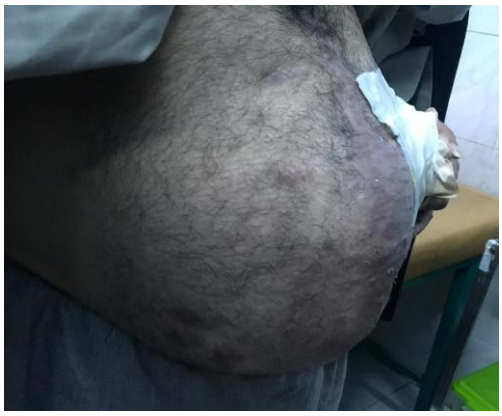

Figure 1: Figure shows case with big incisional hernia & para-stomal hernia pre-operatively

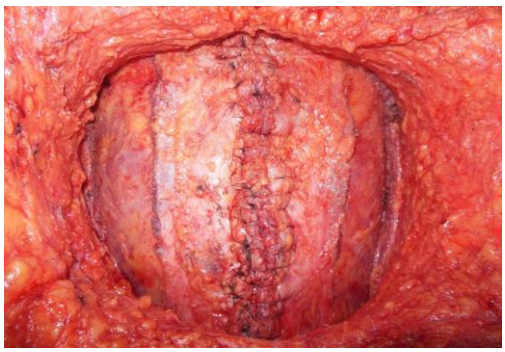

Figure 2: Closure of the midline after anterior CST

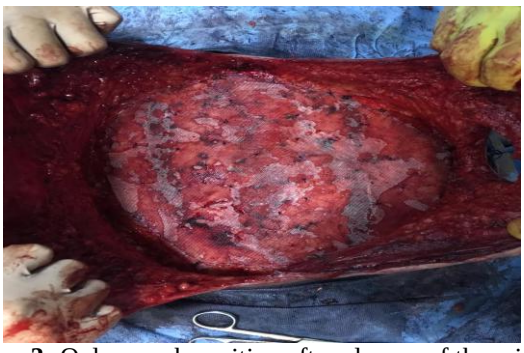

Figure 3: Onlay mesh position after closure of the midline post anterior CST

CST Laparoscopically

Started by 1 cm an incision just below the costal margin & lateral to the rectus muscle at mid-calvicular line (which was marked pre-operatively by ultrasound). Blunt dissection of the subcutaneous tissues, identifying the aponeurosis of the external oblique, and its fibers are divided in their normal direction exposing the internal oblique muscle.

The potential space between both oblique muscles is formed using a 10 mm circular dissecting balloon. The balloon was then replaced by a 10- to 12-mm trocar with maintaining the insufflation pressures of 10- 12 mmHg.

Another two ports are then placed. One 5-mm port is inserted just cephalad to the inguinal ligament and another 5 mm port approximately at the level of the umbilicus at the mid-to the post-axillary line.

The external oblique aponeurosis is vertically incised from the inguinal area to the costal margin and lateral of the rectus compartment by at least 2cm and beyond the inferior and superior edge of the hernia defect by at least 4cm. After the splitting of the aponeurosis of the external oblique. This process is performed on the contralateral side.

Then laparoscopically we enter the abdominal cavity and perform adhesiolysis, identification of hernia defects, primary closure of the midline defects using proline 1# or V-Loc continuous sutures with some of the stitches incorporating the protruding hernia sac, and placement of a composite mesh underlay. The mesh edge extended 3-4 cm beyond the original fascial defect site.

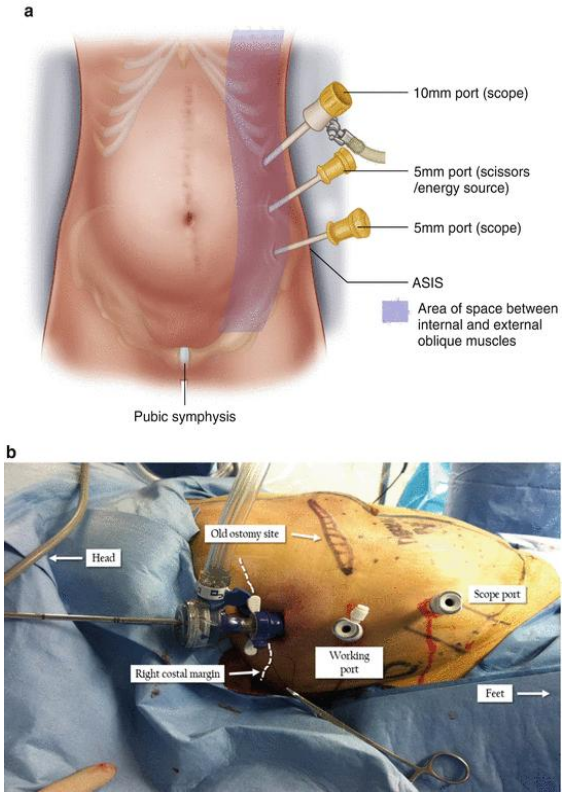

Figure 4: Demonstrating the patient position and site of ports

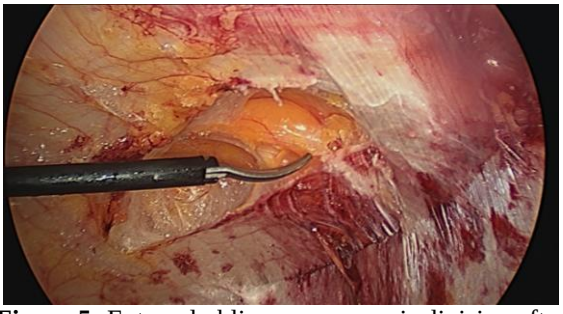

Figure 5: External oblique aponeurosis division after creation of space between both oblique muscles

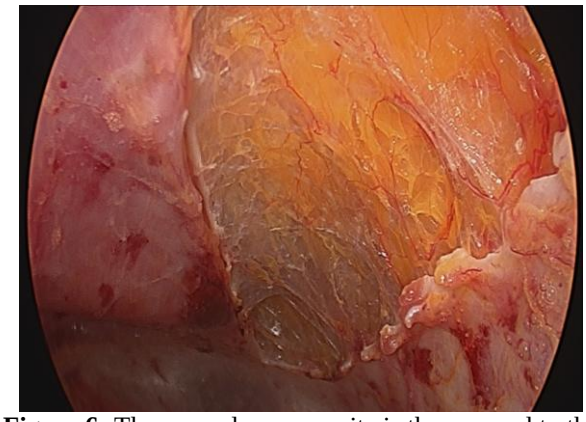

Figure 6: The muscular composite is then moved to the mid-line

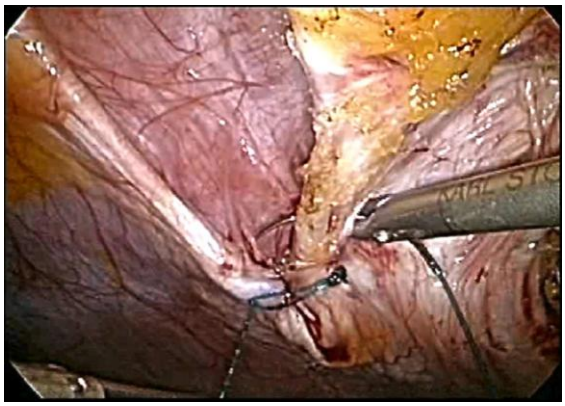

Figure 6: Laparoscopic midline closure after adhesolysis

Statistical analysis

Analyzing of the data was performed via the IBM Statistical Program for Social Science version 20 (SPSS-20). P value < 0.05 is accounted significant, coefficients were used to evaluate the correlation among two variables which are not normally distributed.

2. Results

Age in group-I was ranged from 23 to 46 yrs. with mean±S.D. 33.60±7.679 yrs. whereas in group-II ranged from 21-46 yrs. with mean±S.D. 35.60±7.908 years. There was no statistically remarkable difference was existing among the studied groups where P=0.488. **Table (1)**

Table 1: A Comparison among the studied groups regarding case's age (yrs.)

Age	Group-I (n=15)	Group-II (n=15)	P Value
Min.-Max.	23-46	21-46	0.488
Mean±S.D	33.60±7.679	35.60±7.908	

Hernia characteristics in group-I shows that 9 (60.0%) had incision hernia (IH), 3 (20%) had Recurrent incision hernia and 3 (20%) had huge paraumbilical hernia (PUH) but in group-II, 7 (46.7%) had Incision hernia, 4 (26.7%) had Incision and parastomal hernia (PSH), 2 (13.3%) have Recurrent incisional hernia and 2 (13.3%) had huge paraumbilic hernia. There were no noticeable differences statistically were existing among the studied groups where P=0.199. **(Table (2)**

Table 2: Comparison among the two groups regarding case's hernia characteristics

Hernia Characteristics	Group-I (n=15)		Group-II (n=15)		P Value
	No.	%	No.	%	
Incisional hernia	9	60.0	7	46.7	0.199
Incisional and parastomal hernia	0	0	4	26.7	
Recurrent incisional hernia	3	20.0	2	13.3	
Huge para-umbilical hernia	3	20.0	2	13.3	
Total	15	100	15	100	

The defect size in the group-I ranged between 8-12 with mean±S.D. 10.47±1.506 while in the group-II ranged between 8-12 with mean±S.D. 10.2±1.265. There were no considerable differences statistically comparing both groups where P=0.604. **Table (3)**

Table 3: Comparison between two groups as regards the defect size

Size of Defect	Group-I (n=15)	Group-II (n=15)	P Value
Min.-Max.	8-12	8-12	0.604
Mean± S.D	10.47±1.506	10.2±1.265	

Operation Time in the group-I was ranged between 139 to 268 min with median of 202.93±39.978 min but in the group-II ranged from 150 to 277 min with median of 217.4±44.368 min. There were no remarkable differences statistically existing among the studied groups where P=0.356. Blood loss in the group-I ranged between 203-300ml with mean±S.D.254.53±32.002 whereas in the group-II ranged from 206 to 293 with mean±S.D. 250.53±30.507. There were no remarkable differences statistically comparing both groups where P=0.729. The hospitalization period in the group-I was ranged from 4 to 7 days with median 5.33±1.234 days whereas in group-II ranged from 7-10 days with median 8.80±1.082 days. There were remarkable differences statistically among the studied groups where P<0.001. **(Table (4)**

Table 4: Comparison among two groups regarding case's operation Time, blood loss and hospitalization period

	Group-I (N=15)	Group-II (N=15)	P Value
Operation Time(min)			
Min.-Max.	139-268	150-277	0.356
Mean± S.D	202.93±39.978	217.4±44.368	
Blood Loss			
Min.-Max.	203-300	206-293	0.729
Mean± S.D	254.53±32.002	250.53±30.507	
Hospitalization Period			
Min.-Max.	4-7	7-10	<0.001*
Mean± S.D	5.33±1.234	8.80±1.082	

30 days Surgical-site complications and one-year hernia recurrence rate in group-I showed that 2 (13.3%) had Hematoma, 1 (6.7%) had Seroma, 2 (13.3%) had wound infecting, 1 (6.7%) had development of a novel hernia (lateral) which appeared 6-months postoperative and appointed for laparoscopic repair later on. while in group-II, 1 (6.7%) had Hematoma, 2 (13.3%) had Seroma, 1 (6.7%) had dehiscence, 4 (26.7%) had wound infecting, 1 (6.7%) had Skin necrosis, There were no marked differences statistically among the studied groups with P=0.552. **Table (5)**

Table 5: Comparison among two groups regarding case's surgical site complications and hernia recurrence

30 days surgical site complications and 1 years hernia recurrence	Group-I (n=15)		Group-II (n=15)		P Value
	No.	%	No.	%	
No	9	60	6	40	0.552
Hematoma	2	13.3	1	6.7	
Seroma	1	6.7	2	13.3	
Dehiscence	0	0	1	6.7	
Wound infection	2	13.3	4	26.7	
Skin necrosis	0	0	1	6.7	
Recurrence (midline)	0	0	0	0	
Development of new hernia (lateral)	1	6.7	0	0	
Total	15	100	15	100	

Morbidity in the group-I shows that 1(6.7%) had to re-admission, 1(6.7%) had to re-operation for operative intervention of relatively big abscess surrounded by cellulitis, while in the group-II 2(13.3%) had to re-admission (the first patient admitted by chest infection while the second patient admitted for operative intervention) 1(6.7%) had to Re-operation for wound dehiscence. There were no remarkable differences statistically between groups where P=0.194. **Table (6)**

Table 6: Comparison among two studied groups regarding case's Morbidity

Morbidity	Group-I (n=15)		Group-II (n=15)		P Value
	No.	%	No.	%	
No	13	86.6	12	80	0.194
Re-admission	1	6.7	2	13.3	
Re-operation for complication	1	6.7	1	6.7	
Total	15	100	15	100	

3. Discussion

As regards to age distribution in the current work, there were no remarkable differences statistically among both of the studied groups where P=0.488. Ages in group-I ranged from 23 to 46 years with a mean (33.60±7.679) year whereas in group-II ranged between 21 to 46 years with a mean of (35.60±7.908) years.

In the **(Peker et al., 2019)** study, the average age of the cases was (43.57 ± 19.99 yrs.), and the median age was 50 years ranged from (20 to 82). The average age of the cases who experienced endoscopic CST was 32.75 ± 17.14 yrs., and the median age was 22.5 years (20–61). The average age of the cases who experienced traditional CST was 50.23 ± 19.21 yrs., and the median age was 56 yrs. (21–82). There were no noticeable differences statistically regarding the average age amongst the two groups (P = 0.037), which is not consistent with our study.

In the **(Albalkiny and Helmy., 2018)** study, The average age for conventional group was 44 years, with a range of 28–65 years, whereas that for the laparoscopic group was 46 years, with a range of 33–63 years, with no remarkable differences statistically (P=0.48), which is consistent with our study.

As regards to the hernia characteristics in our study, in group-I there were 60% IH, 20% recurrent IH and 20% huge PUH. While in group-II 46.7% was IH, 26.7% IH with PSH, 13.3% recurrent IH and 13.3 huge PUH. (P = 0.199), so there were no noticeable differences statistically among the studied groups.

Regarding the **(Azoury et al., 2014)** study, in group-I 98% had previous abdominal surgery & 24% had a previous ventral hernia repair, but in the group-II all patients had previous abdomen surgical operation and 32% have a previous ventral hernia repair.

Also the **(Appleby et al., 2020)** study showed hernia characteristics for patient undergoing endoscopic release were 97% had IH and 3% had IH with PSH, of them there was 59% had recurrent IH. While in open group, 96% had IH and 4% had IH with PSH, of them there were 47% had recurrent IH, (P = 0.910). There were no considerable differences statistically among both groups, which agreeing our study.

As regards the assessment of the defect size in the studied group of patients, size of defect in group-I ranging from 8 to 12 of a mean (10.47±1.506) whereas in group-II ranging from 8 to 12 of a mean 10.2±1.265. There were no considerable differences statistically among both groups where P=0.604.

In the **(Peker et al., 2019)** study, cases were assessed for the extent of the defect of GVIH (in cm). In 21-cases, hernias with a mean extreme extent of 12.10 ± 3.95 cm and a median of 12 cm in the range (5–21) were closed. Hernia defect closed with endoscopic CST with a mean of (10.63 ± 2.76 cm) and median of 10.25 cm of a range (6–15), with an average one-sided rectus reduction of 5.57 cm and median of 5.13 cm with (3–7.5). The average size of the closed defect in linea alba with traditional CST was recorded to be 13.00 ± 4.38 cm with a median of 13 cm (5–21); the average one-sided rectus reduction was 6.5 cm with a median of 6 cm and range (2.5–10.5). There were no considerable differences statistically among the procedures regarding the capability to close hernia defect with (P = 0.185), which is consistent with our study.

In the **(Albalkiny and Helmy, 2018)** study, the assessment of defect width was as follow: Defect width [mean±SD (range)] (cm) 10.6±3.33 (6–17) in group-I, and 11.1±3.385 (6–17) in group-II (P 0.640). There was no notable difference statistically among both the studied groups, which comes into agreement with our study.

As regards operation time in the studied group of patients, operation time in group-I was ranged from 139 to 268 min with a mean of (202.93±39.978) min while in group-II ranged from 150 to 277 min with a mean of (217.4±44.368) min. There were no considerable differences statistically among both groups with P=0.356.

In the **(Albalkiny and Helmy., 2018)** study, operative time [mean±SD (range)] (min) in group-I 215.45±42.8 (122–280), and in group-II 217.1±41.04 (170–290). P 0.902, with no notable differences statistically was found among the studied groups, which come in agreement to our results.

In the **(Azoury et al., 2014)** study, the procedure period for the endoscopic group was longer significantly in comparison to the open group (334 vs 249 min; P <0.001) which is non-concordant with our study.

As regards blood loss during the operation in our work, Blood loss in group-I ranging from 203 to 300 with a mean of (254.53±32.002) while in group-II ranging from 206 to 293 with a mean of (250.53±30.507), There were no remarkable differences statistically among both groups with P=0.729

In the **(Albalkiny and Helmy, 2018)** study, the blood loss assessment was as follows: Blood loss [mean±SD (range)] (ml) in group-I 510±164.3 (300–750), and in group-II 545±184.88 (200–800). P0=531. There was no important disproportion statistically amongst both groups, which is agreeing with our results. In the **(Azoury et al., 2014)** study, the blood loss during surgery was as follows: Blood loss [mean±SD (range)] (ml) in group-I 97±74 (50–100) ml, and in group-II 93±84 (20–100). P = 0.847. There were no considerable differences statistically among both groups, which is consistent with our results.

Regarding the hospital stays in the studied group of patients, hospitalization period in group-I was ranged from 4 to 7 days with a mean of (5.33±1.234) days while in group-II ranged from 7 to 10 days with a mean of (8.80±1.082) days. There were a marked differences statistically were found among the studied groups with P<0.001.

In the **(Peker et al., 2019)** study, the involved cases were assessed for hospital-stay period. The mean hospital-stay period was calculated. Cases have mean hospital-stay period

of (8.30 ± 2.87 days) with a median of 7 days with a range (5–13). The mean hospital-stay for the cases submitted to laparoscopic CST was (8.25 ± 3.06 days) with a median of 7 days and range from (5–13); mean period of hospital-stay for the cases submitted to conventional CST was (8.33 ± 2.87 days) with a median of 7.5 days and ranging from (5–13). There were no remarkable differences statistically among both groups with (P = 0.910), which is non-concordant with our work.

In the **(Azoury et al., 2014)** study, hospitalization period in group-I ranged from three to five days with a mean of (4 ± 1.6) days whereas in group-II ranged from 3 to 5 days with a mean of (4 ±1.1) days, with (p=0.64), There was no considerable difference statistically among both groups was found among groups, which comes in disagreement with our study.

As regard surgical site complications in our study, group-I shows that 2(13.3%) had hematoma, 1(6.7%) had seroma, 2(13.3%) have wound infection, whereas in group-II 1(6.7%) had hematoma, 2(13.3%) had seroma, 1(6.7%) had dehiscence, 4(26.7%) had wound infection, 1(6.7%) had skin necrosis, There were no important differences statistically among the studied groups where P=0.552

In the **(Azoury et al., 2014)** study**,** post-operative wound complications in group-I were 7% of patients had seroma, 5% had hematoma, 2% had dehiscence, 7% had an abscess and 2% has cellulitis, while in group-II 9% had seroma, 3% hematoma, 3% dehiscence, 12% abscess, 3% fat necrosis and 3% skin necrosis. With totally lower complications in the endoscopic group, 24%, in comparison to the open group, 32%, however, it was not significant statistically (p = 0.42) which is consistent with our study.

In the **(Switzer et al., 2015)** study, the overall wound complications-rate was lesser for endoscopic group (20.6%) in comparison with the open group (34.6%). When comparing the endoscopic CST to the open CST, it was found to have lesser superficial infection rates (3.5 vs 8.9%, p = 0.26), skin dehiscence (5.3 vs 8.2%, p = 0.02), necrosis (2.1 vs 6.8%, p = 0.26), hematoma/ seroma construction (4.6 vs 7.4%, p = 0.74). The results were not statistically significant to come in agreement with our study.

As regards hernia recurrent in our study, there was no midline hernia recurrence in both groups, but there was one patient developed a new lateral hernia in the endoscopic group which developed 6 months post-operatively.

In the **(Azoury et al., 2014)** study, there was a single mid-line hernia recurrence recognized primary in the ECS group and no hernia recurrent was found in the OCS group. 3 cases in the ECS group had gained a novel lateral abdomen wall hernia with the interval ranging between 24 days and 3 months postoperative.

In the **(Switzer et al., 2015)** study, the recurrence rates in both groups were (10.9% vs 14.1%, P = 0.44) which is statistically insignificant.

As regard re-operation in our study, there was no important difference statistically between both group where the p = 0.194 which is not significant statistically.

In the **(Switzer et al., 2015)** study**,** the reoperation-rates in both groups was (5.2% vs 3.9%, P = 0.52) which is not significant statistically and matching our study result.

In the **(Muse et al., 2018)** study, no significant changes was found among the studied groups for SSOs (P = 0.305) or re-admission (P = 0.288) which is consistent with our study.

4. Conclusion

The CST is a very useful, effective, and successful technique for treating huge and complicated ventral hernias as it results in closure of the defect without tension. The laparoscopic method doesn't require generous subcutaneous dissection and may lead to a reduced incidence or reduced complication of post-operative wound infections and skin-flap necrosis. Laparoscopic CST is a feasible method and can be employed instead of traditional CST with lesser blood loss, hospital-stay and overall postoperative complications.

References

[1] **Albalkiny, Sherif, and Medhat Helmy. (2018):** "ACS versus PCS technique with transversus abdominus release in abdominal wall reconstruction for incisional hernia ".The Egyptian Journal of Surgery ,vol. 37, no. 3, 2018, p. 335 .Gale Academic OneFile ,Accessed 21 Apr. 2020.

[2] **Albright E, Diaz D, Davenport D & Roth JS (2011):** CST for hernia repair: a comparison of open and endoscopic techniques. Am Surg 77(7):839-43**.**

[3] **Appleby PW, Bilezikian JA, Faulkner JD, Fox SS & Hope WW (2020):** comparing outcomes of the endoscopic and open external oblique myofascial relaease. Int J Abdom Wall Herniia Surg 2020; 3:63-6.

[4] **Azoury S. C., Dhanasopon A. P., Hui X., De La Cruz C., Tuffaha S. H., Sacks J. M., et al. (2014):** A single institutional comparison of endoscopic and open CST. Surgical endoscopy, 28(12), 3349-3358.

[5] **Breuing K, Butler CE, Ferzoco S, Franz M, Hultman CS, Kilbridge JF, et al. (2010):** Ventral Hernia Working Group, incisional ventral hernias: review of the literature and recommendations regarding the grading and technique of repair. Surgery, 148:544–558.

[6] **Daes J. (2019):** Endoscopic subcutaneous approach to CST. Journal of American College of Surgeons; 218 (1): E1-E4.

[7] **De Silva GS, Krpata DM, Hicks CW & Criss CN, (2014):** Comparative radiographic analysis of changes in the abdominal wall musculature morphology after open PCS or bridging laparoscopic ventral hernia repair. J Am Coll Surg; 218(3):353-7.

[8] **Giurgius M, Bendure L, Davenport DL & Roth JS. (2012):** The endoscopic CST for hernia repair results in reduced morbidity compared to the open CST. Hernia 16(1):47-51.

[9] **Kumar S., Edmunds R. W., Dowdy C., Chang Y. W. W., King R., & Roth J. S. (2018):** Anterior versus

posterior component separation: which is better?. Plastic and reconstructive surgery, 142(3S), 47S-53S.

[10] **Muse TO, Zwischenberger BA & Miller MT (2018):** outcomes after venteral hernia repair using the Rives-Stoppa, Endoscopic and open CST. The American Surgeon. 2018 Mar; 84(3):433-437.

[11] **Peker YS, Hancerliogullari O, Can MF and Demirbas (2019):** Conventional versus endoscopic CST: New anthropometric calculation for selection of surgical approach .Turk J Med Sci 49(4): 1109-1116.

[12] **Switzer Nj, Dykstra MA & GILL RS. (2015):** endoscopic versus open CST: systemic review and meta-analysis. Surg Endosc. 2015; 29(4): 787-795.