Subcutaneous onlay laparoscopic approach versus laparoscopic intraperitoneal onlay mesh repair of ventral hernia and correction of rectus diastasis: randomized controlled study

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Background
The association between ventral hernia and rectus abdominis diastasis is a common condition especially in multiparous women. Hernia correction alone without midline reinforcement increases the risk of hernia recurrence. Subcutaneous onlay laparoscopic approach (SCOLA) is a new minimally invasive procedure that allows the surgeons to do simultaneous correction of rectus diastasis and hernia mesh repair with low cost without the need for large transverse abdominal incision.

Patients and methods
50 patients with non-complicated ventral hernia associated with rectus diastasis without significant redundancy in the skin of the abdominal wall were allocated randomly in 2 groups. 25 patients underwent SCOLA, and 25 patients underwent intraperitoneal on-lay mesh (IPOM) repair. Both techniques were compared as regard operative time, hospital stay, intra and postoperative complications, and recurrence rate.

Results
IPOM group experienced shorter operative time than SCOLA (115.27±10.54 vs 77.48±12.72) with no significant difference as regard intraoperative complications between both techniques. Although early postoperative pain was significantly less in SCOLA patients (P=0.021), IPOM group had earlier restoration of normal daily activities ($P< 0.001$). No significant recurrence rate was considered in both groups apart from one case (4%) after IPOM repair.

Conclusion
SCOLA could be a good choice in the concurrent repair of ventral hernia and rectus diastasis without significant postoperative complications. In addition, the use of regular proline mesh instead of composite mesh significantly decreases the economic burden.

Keywords:
hernia, onlay mesh, rectus diastasis

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Introduction

A ventral abdominal wall hernia is defined as an abnormal passage of abdominal viscera through a hole in the anterior abdominal wall. It may be primary or may be developed over the site of the scar of previous abdominal surgery hence named incisional hernia [1,2].

However ventral hernia repair is considered as one of the commonest surgical procedures done in the daily surgical practice, still it continues to be a surgical challenge due to the considerable high recurrence rate that ranges from 50% after only primary repair to 10–23% following the use of prosthetic mesh in repair [3].

Going with the vast advent of minimally invasive surgery in every surgical intervention, laparoscopic repair of ventral hernia is steadily increasing. However, only 25% of the ventral hernia in the United States are done via laparoscopy because of the severity of the complications that may follow laparoscopic repair when compared to traditional open repair in addition the learning curve for mastering the technique is difficult and challenging. LeBlanc, who started the first laparoscopic ventral hernia repair in 1991 documented incidence of intestinal injury and hence conversion to laparotomy in 1.8% of the cases [4,5].

Laparoscopic ventral hernia repair includes many methods as intra peritoneal on lay mesh placement

(IPOM), which is the most adopted technique. It has excellent outcomes however, it has some complications as adhesive intestinal obstruction, development of enterocutaneous fistula upon using regular proline mesh in direct contact with the bowel [6].

Other techniques for laparoscopic ventral hernia repair had evolved to avoid direct contact of the bowel to the mesh by placing the mesh outside the peritoneal cavity and hence evading the complications of IPOM. These techniques include trans abdominal preperitoneal (TAPP), transabdominal retro muscular (TARM), enhanced view totally extraperitoneal (e TEP) and subcutaneous on lay laparoscopic approach (SCOLA) [7,8].

Diastasis of rectus abdominis muscle is a very common association with ventral hernia especially in females due to weakness of abdominal muscles because of repeated pregnancies. In the scenario of simultaneous presence of hernia and rectus diastasis most of the surgeons consider only the hernia repair and not taking in consideration the correction of weakened abdominal muscles that makes the outcomes of hernia repair not optimum because of the reported high incidence of hernia recurrence [9,10].

The conventional technique of intraperitoneal mesh placement does not seem to correct the rectus diastasis unless intra or extra corporeal stitches in the linea alba was applied which is extremely difficult to do, hence other extraperitoneal techniques like (SCOLA) has evolved that makes simultaneous hernia repair and rectus diastasis correction is feasible [11,12].

So the aim of our prospective study is to evaluate the outcomes of SCOLA technique for simultaneous ventral hernia repair and correction of rectus diastasis compared with the conventional laparoscopic IPOM technique.

Patients and methods

Our prospective study was carried out in the period between April 2022 and October 2022 in Mansoura university hospitals.

Through the surgical outpatient clinic, out of 78 patients with ventral hernia admitted to the surgical ward, 50 patients who met the inclusion criteria were enrolled in our study.

Inclusion criteria were patients with noncomplicated primary ventral hernia aged above 18 years with hernia defect <5 cm and associated with diastasis of rectus abdominis muscles without significant redundancy of the skin of lower abdominal wall that necessitates abdominoplasty.

Exclusion criteria were: patients with complicated (obstructed or strangulated) or huge ventral hernia, large hernia defect >5 cm, incisional hernia, presence of excess skin in the lower abdominal wall requiring dermo-lipectomy or abdominoplasty and patients unfit for general anesthesia.

The current study was approved by the institutional review board (IRB) of our medical school. A written informed consent for contribution in the study was obtained from all the patients.

The included patients were randomly allocated in two groups

Group (1): 25 patients underwent the SCOLA technique.

Group (2): 25 Patients underwent the IPOM technique.

All included patients were clinically examined and assessed, routine preoperative abdominal ultrasound was performed to assess the size of the hernia defect and routine preoperative laboratory investigations and blood works were done.

All patients received a single perioperative dose of antibiotic (second-generation cephalosporins)

Operative technique

SCOLA technique

Under general anesthesia, patients in Trendelenburg's position with table break at the knee and hip.

Ports placement: A midline suprapubic skin incision about 1.5 cm was done, the subcutaneous tissue was sharply dissected using electrocautery all around until reaching the underlying sheath.

Purse string proline suture was applied to prevent gas leakage, then 12 mm camera port was inserted in the subcutaneous plane, and the purse string suture was tightened. Another two 5 mm ports were inserted in the same subcutaneous plane about 5-7 cm distant from the camera port at the same level medial to Linea semilunaris (Fig. 1).

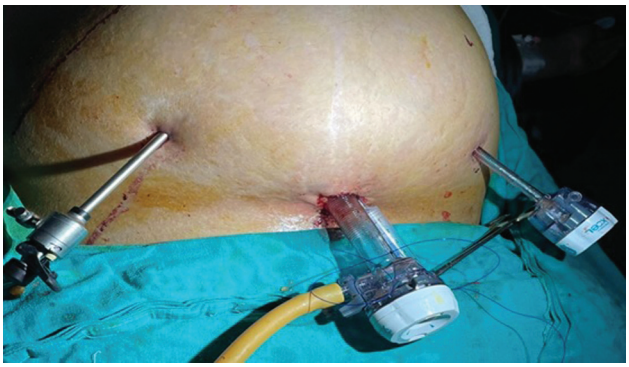
Dissection was started in the pre fascial subcutaneous plane using energy devise (harmonic scalpel or diathermy on hook) and going in a cranial direction till reaching the umbilicus.

The lateral borders for dissection were determined using syringe needles inserted through the skin at Linea semilunaris level to preserve good blood supply for the skin and subcutaneous flap.

Then, separation of the umbilical stack from the sheath, taking care not to penetrate the skin and dissection of the hernial sac from the skin and subcutaneous tissues were performed then complete reduction of hernia content to the peritoneal cavity (Fig. 2).

Continuing dissection was carried out in a cranial direction until reaching the substernal xyphoid process and laterally not extended beyond the linea semilunaris. (Fig. 3).

Figure 1



Ports placement.

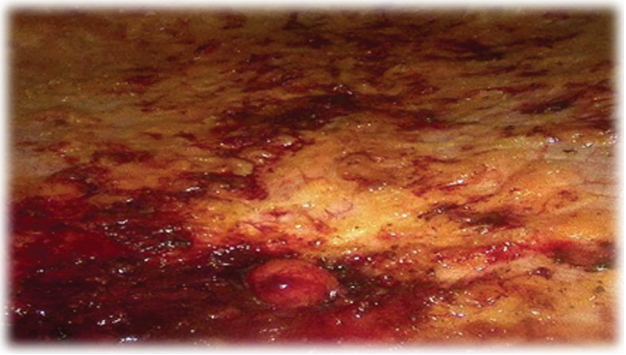
Figure 2

Dissection of umbilical stack.

The hernia defect was closed using proline 0 suture in an interrupted manner. (Fig. 4).

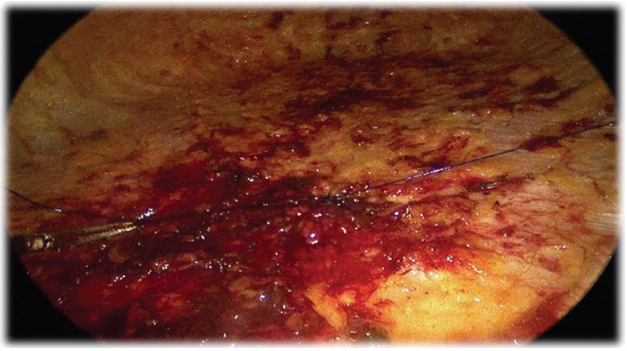
Marking the borders rectus diastasis was performed by using small peanut gauze stained with methylene blue dye then correction of rectus diastasis was done via plication of the midline using V – loc suture in a continuous manner or interrupted PDS loop 0 suture (Fig. 5).

Figure 3



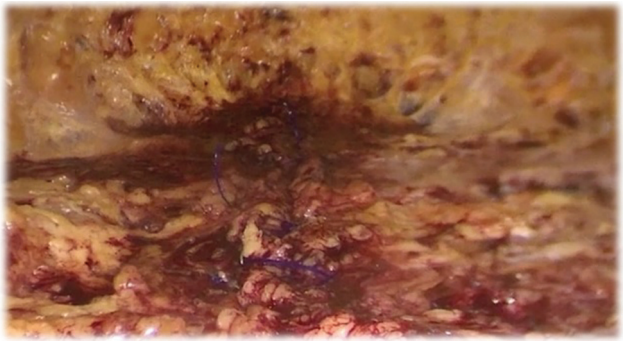
Extension of dissection till xyphoid process.

Figure 4



Defect closure

Figure 5



Midline plication.

The whole dissected subcutaneous plane in two dimensions was measured, and regular polypropylene mesh with the same size was refashioned and inserted (Fig. 6). Mesh fixation was done by stitches in the four corners and in the center. Umbilical stack was reattached to the sheath by vicyl 2–0. Routine wide pore suction drain was inserted over the mesh through the 5 mm port then closure of the ports was done by proline 2-0 (Fig. 7).

IPOM technique

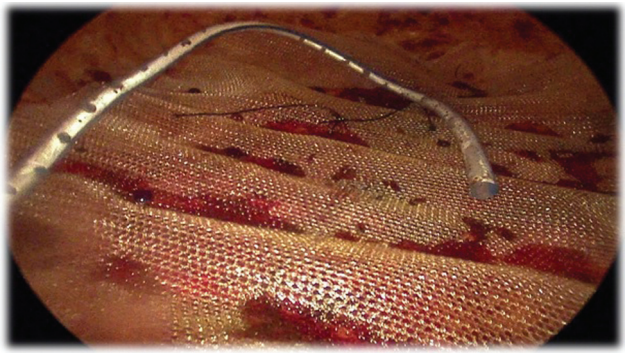
After induction of pneumoperitoneum, routine three ports were placed in the anterior axillary line (one 12 mm and two 5 mm), stating by reduction of hernia content back to the peritoneal cavity, then closure of the hernia defect via extracorporeal proline stitch and double face composite mesh of suitable size was applied. Mesh was fixed in place by tacking device in a double crowning manner and finally ports closure.

Postoperative plan

All the patients received IV crystalloid fluids and due medications (Intramuscular sodium diclofenac 75 mg, 1 gm paracetamol, proton pump inhibitors, and IM alpha chemo trypsin injection) were given.

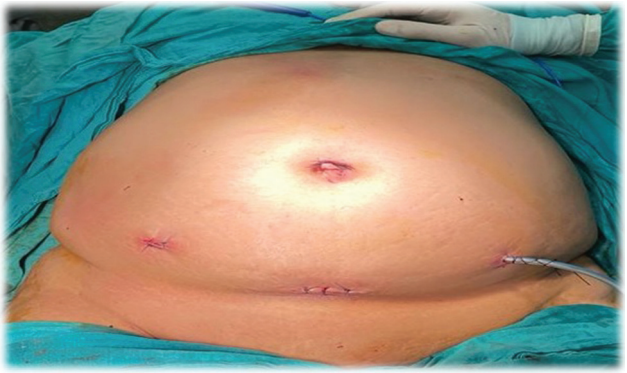
A fit size abdominal binder was applied to all patients for one month postoperatively.

Figure 6



Mesh insertion.

Figure 7



Drain insertion and port closure.

Data collection: Any intra operative complications like bleeding, injury to the bowel if contained in the hernial sac or umbilical skin penetration by the energy device were reported.

The operative time was estimated as the time from the first skin incision until skin closure, and any conversions to open repair was reported with the specifying the cause for conversion.

Postoperative data

Postoperative pain was assessed in the 1st 24 h postoperative using visual analogue score. Any extra analgesia required was reported.

Postoperative complications during the hospital admission, hospital stay and time of patient's discharge were reported

In the surgical outpatient clinic Patients were followed after the 1st, 4th week and after 6 months to pick up any postoperative complications as wound infection, seroma collection abdominal wall hematoma or edema.

In SCOLA patients, almost all the drains were removed after one week unless infected and high output was evident.

Time for restoration of patient's normal daily activities like return to work, sexual practice and regular daily exercise was reported. Recurrence rate was assessed after the first 8 months.

Statistical analysis

Demographic data (age, gender and hernia type) of all patients, intra and postoperative complications and recurrence rates were collected and analyzed using SPSS 24 for Windows software (SPSS Inc, Chicago, IL) . Qualitative data were represented as frequencies and relative percentages. Quantitative data were expressed as mean±SD (Standard deviation). Significance of the obtained results was estimated at (<0.05) level.

Results

Concerning patient's demographics, a total 50 patients, 39(78%) of them were female, and 11(22%) were

males. The mean age of the patients in the SCOLA group was 48.40±9.45 and in IPOM group was 44.96 ±7.27 with non-significant difference between both groups.

Paraumbilical hernia represented the majority of the performed cases in both groups (72%), while only (28%) of cases were epigastric with no significant difference.

As regards intraoperative parameters as shown in Table 1, the mean operative time in SCOLA technique was found significantly longer than in IPOM procedure (115.27±10.54 vs 77.48±12.72).

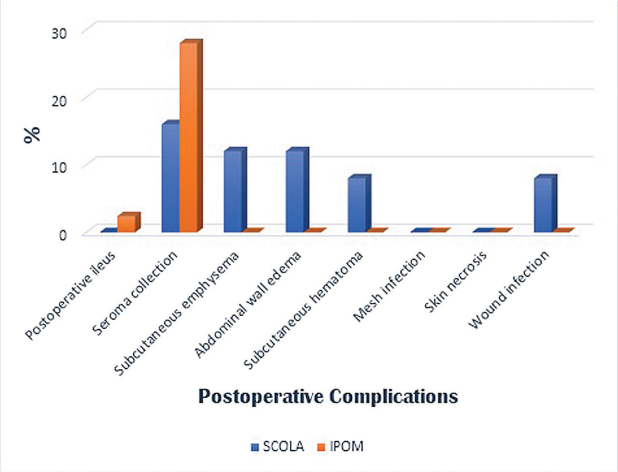
Whereas assessment of intraoperative complications or undesirable events like minor controlled bleeding, umbilical skin penetration or intraperitoneal visceral injury did not show any significant difference between both techniques. None of the cases in both groups were converted to open repair.

Upon evaluation of the early postoperative course of patients in both groups the following data were retrieved (Table 2), Patients underwent IPOM technique had experience more postoperative pain than those in SCOLA group that was illustrated by the increased demand of extra analgesic doses (P=0.009) and more pain score in VAS (P=0.021) and this was statistically significant.

During early postoperative follow up in the outpatient clinic, nonsignificant difference in the incidence of postoperative complications (Fig. 8) between both techniques was detected. However postoperative ileus and seroma collection were the main complications in IPOM while subcutaneous emphysema, abdominal wall edema, wound infection and subcutaneous hematoma were detected in small percentage in SCOLA group.

None of the patients in both groups developed any dangerous or severe postoperative complication like mesh infection or skin necrosis.

Figure 8



Postoperative complications.

Table 1 Intraoperative parameters

Operative variables	SCOLA Number (%)	IPOM Number (%)	*P* value
Operative time /mins	115.27±10.54	77.48±12.72	$P<0.001$*
Intraop complications			
Umbilical skin injury	0 (0.0%)	0 (0.0%)	$P=1.0$
Intraoperative bleeding	4 (16.0%)	2 (8.0%)	$P=0.543$
Visceral or bowel injury	0 (0.0%)	0 (0.0%)	
Conversion to open	0 (0.0%)	0 (0.0%)	

Table 2 Postoperative complications

	SCOLA Number (%)	IPOM Number (%)	*P* value
VAS Pain	5.21±0.94	5.92±0.86	$P=0.021$*
Extra analgesics need	11 (44.0%)	14 (56.0%)	$P= 0.009$*
Post-operative ileus	0 (0.0%)	2 (8.0%)	$P=0.490$
Subcutaneous emphysema	3 (12.0%)	0 (0.0%)	$P=0.143$
Subcutaneous hematoma	2 (8.0%)	0 (0.0%)	$P=0.490$
Mesh infection	0 (0.0%)	0 (0.0%)	
Seroma collection	4 (16.0%)	7 (28.0%)	$P=0.11$
Wound infection	2 (8.0%)	0 (0.0%)	$P=0.490$
Skin flap necrosis	0 (0.0%)	0 (0.0%)	
Abdominal wall edema	3 (12.0%)	0 (0.0%)	$P= 0.143$

Table 3 Postoperative variables

Variables	SCOLA Number (%)	IPOM Number (%)	*P* value
Hospital stays (hours)	32.40±9.24	34.56±15.6	*P*= 0.52
Return to work (days)	14.21±2.13	6.88±1.39	*P*<0.001*
Recurrence rate	0(0.0%)	1(4.0)	*P*=1.0
Mesh Cost (EGP)	400	9500	*P*<0.001*

As shown in Table 3, although the difference in mean length of hospital stay in both groups was not statistically significant (*P*=0.52), patients who underwent IPOM technique had an earlier recovery and restoration of regular daily activities than those in SCOLA group with significant *P* value (*P*<0.001).

Also because of the necessity of using double face composite mesh in IPOM technique, the total economic cost was significantly higher in IPOM than SCOLA procedure (*P*<0.001).

Upon long term follow up of the patients only 1(4%) case underwent IPOM developed hernia recurrence after 6months, while none in SCOLA group had hernia recurrence.

Discussion

Because of the acknowledged advantages of minimally invasive approaches for ventral hernia repair in the form less wound and mesh infection and shorter hospital stay, different laparo-endoscopic techniques are steadily evolving with trend to place the mesh outside the peritoneal cavity to avoid dangerous complications or use of expensive composite mesh [13,14].

Patients with rectus abdominis diastasis are usually having mainly aesthetic complaint because of bulging of abdominal wall that making it a plastic surgery interest, however in simultaneous presence of ventral hernia with rectus abdominis diastasis which is common particularly in multiparous women, general surgeons are usually incorporated to correct the hernia in the same setting but mesh is not routinely used [15,16].

Concurrent presence of hernia and rectus diastasis puts the general surgeons in a big dilemma because plication of the midline linea alba for correction of diastasis requires large transverse abdominal incision and mesh application is questionable which makes the recurrence risk of hernia is high especially if the defect is large (>2 cm) [17].

At the same time only hernia correction with mesh without midline plications for correction of rectus diastasis carries also a considerable risk of recurrence [9].

Almost all studies discussed SCOLA alone as a novel technique for rectus diastasis correction with or without hernia, no studies comparing it with another laparoscopic hernia repair technique.

So our current study aimed to evaluate this new technique (SCOLA) for simultaneous hernia repair and correction of rectus diastasis via minimal invasive manner in comparison with classic laparoscopic IPOM repair.

The mean operative time in SCOLA group was (115.27±10.54 min) which was significantly longer than in IPOM group (77.48±12.72 min) that was definitely expected because of spending more time in creation of prefascial subcutaneous space along the whole linea alba also time consumed for plication of midline.

Varying operative time for SCOLA was reported in different studies Dong *et al*. [18] and Naidu *et al*. [19] reported mean operative time (146±46.3 min) and (150 min) respectively. Shorter mean operative time (93.5 min) was reported by Claus *et al*. [20] that may be explained by nonuse of mesh in some cases with small hernia defect (6.25%).

Concerning intraoperative complications, no operative complications was reported in IPOM or SCOLA group going with results of other studies [18–20]. Minor controlled bleeding represented the main intraoperative undesirable events with nonsignificant difference between both techniques.

Postoperative pain evaluation revealed significant difference in the side of SCOLA over IPOM technique (*P*= 0.009) that can be attributed to the extensive use of tacking devices in double crowning manner or trans fascial sutures for mesh fixation in the parietal peritoneum in IPOM which has high sensitivity.

The pain intensity after IPOM repair especially in the first 2 postoperative days is usually very high even when compared with the open surgery as reported by Kadri *et al*. [21] On the other hand most of the patients after

SCOLA have early hypo anesthesia because of the cut peripheral nerves in preaponeurotic dissection but total recovery of sensitivity almost occurred within 2–6 months after surgery [20].

It is very clear now that the penetration of tackers to the abdominal wall musculature induces nerves and vessels trapping leading to ischemic muscle pain [22,23].

Overall assessment of postoperative complications, no significant difference between both groups. Seroma collection represented the commonest incidence. Although in SCOLA technique greater dissection and subcutaneous flapping than IPOM, incidence of seroma was higher in IPOM (28% vs 16%) this can be explained by the routine application of subcutaneous suction drain for 1 week at least while in IPOM seroma was collected at dead space left after hernia reduction.

After SCOLA technique Naidu *et al.* [19] reported seroma collection in (20%) of patients, Claus *et al.* [20] reported (13.27%) but spontaneously absorbed and did not require intervention and Dong *et al.* [18], found it in (18.8%).

Among other complications, abdominal wall edema (12%), wound infection(4%), and abdominal wall hematoma(4%) were reported after SCOLA similarly going with other studies [20,24].

None of our cases had recurrence, Dong *et al.* [18] had 8 months follow up and two recurrences were reported (12.5%) but in both cases mesh was self-fixing without additional fixation apart from fibrin sealant. Claus *et al.* [20] reported only one case of recurrence (2%)

Ghandi *et al.* [25] had the longest follow up period (24 months) and did not report any recurrence.

Although we did not find statistically significant difference between both groups in terms of length of hospital stay (P=0.52), Patients underwent IPOM had earlier recovery and restored their normal regular daily activities before those in SCOLA group (P <0.001), however early postoperative pain intensity was higher in IPOM group and this may be due to the routine use of suction drains for a minimum one week postoperative after SCOLA that restricts the patients movement and activities.

Similarly Muas D [26] had reported 1-2 days (median 1.3 days) length of hospital stay after SCOLA and the mean duration consumed by the patients to restore their normal daily activities was 16.4±5.1 days.

Always the economic cost in laparoscopic ventral hernia repair in favor of extraperitoneal mesh placement (on lay, retro-muscular or preperitoneal) because this does not require special double face composite mesh as IPOM demands, also the need of tacking devices for mesh fixation can be replaced by suturing [27,28]. Therefore the total cost was less in SCOLA group when compared with IPOM group (P<0.001).

Conclusion

SCOLA technique is an excellent alternative to IPOM especially in patients with ventral hernia associated with rectus diastasis in terms of better ergonomics for midline plication, less postoperative pain and total economic cost.

Limitations of the study

Paucity of the studies comparing both techniques and small sample size to assess early results.

Long term out comes needs to be evaluated.

Recommendations

Wider scale randomized controlled trials should be considered to evaluate early and long term results of SCOLA.

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Ethical Consideration: This study was evaluated and approved by the institute research board (IRB Code number: R.22.08.1777) belonging to our medical school.

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Nil.

Conflicts of interest

All the above-mentioned authors had declared no conflicts of interest.

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