Laparoscopic purse-string suture sac closure is appropriate procedure for children with unilateral indirect inguinal hernia: comparative study versus laparoscopic sac excision and closure procedure

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Objective
Evaluation of immediate and 6-month postoperative (PO) outcomes of laparoscopic repair of unilateral indirect inguinal hernia (IIH) and comparison of outcomes of purse-string versus stitch closure of the deep inguinal ring (DIR).
Patients and methods
The study included 84 children who had unilateral IIH, and they were randomly divided into two groups: group I included patients who underwent sac disconnection and stitch closure, and group II included patients who underwent purse-string suture closure of DIR without manipulation or sac dissection. PO pain sensation was evaluated using the observational pain-discomfort scale. Time till first oral intake, length of PO hospital stay, and immediate and 6-month PO outcomes were determined.
Results
One patient in group I was converted to open procedure and another patient in group II required sac disconnection. Patients of group II had significantly shorter operative time, lower collective observational pain-discomfort scale pain score, and shorter time till first oral intake and duration of PO hospital stay compared with patients of group I. A total of three (3.6%) patients developed port site wound infection. At the end of follow-up, in group I, one patient developed hydrocele and three patients developed recurrent hernia, for a 6-month PO complication rate of 9.8%. In group II, one (2.4%) patient developed recurrent hernia.
Conclusion
Application of laparoscopic purse-string suture closure of the DIR shortens operative time, time till first oral intake, and home return of children with unilateral IIH with low 6-month recurrence rate than disconnection and stitch closure of the DIR (2.4 vs. 7.3%).

Keywords:
children, laparoscopic purse-string suture deep ring closure, recurrence rate, unilateral indirect inguinal hernia

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Introduction

Repair of an indirect inguinal hernia (IIH) is one of the most common operations performed around the world by pediatric surgeons [1]. Inguinal hernia in children is traditionally repaired through a groin incision by dissecting the hernia sac from the spermatic cord and suture ligating its base [2]. However, inguinal hernia repair (IHR) with opening of the external ring, hernia sac twisting, and double ligation of the processus vaginalis confers no advantage for repair [3].

The application of laparoscopic surgery to the treatment of inguinal hernia is a revolution in IHR surgery [4]. Laparoscopic hernia repair has emerged as an alternative technique for traditional open hernia repair in children [5].

Many techniques have been developed for a simplified and safe procedure with a low recurrence rate, and good cosmetic result is the main concern [6], and various methods of repair have been described especially concerning suture ligation of the neck of the hernia sac at the deep ring with or without its transection[7], use of periperitoneal stitching or purse-string suture [8], and whether to apply intracorporeal or extracorporeal suturing [1].

Hypothesis

Purse-string suture deep inguinal ring (DIR) closure without any further manipulation will improve immediate postoperative (PO) outcome without

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compromising 6-month PO outcome of laparoscopic repair of unilateral IIH in children.

Objective

The objective is to evaluate the immediate and 6-month PO outcomes of laparoscopic repair of unilateral IIH and to compare outcomes of purse-string versus stitch closure of the DIR.

Design

This was a prospective single-blinded two-armed comparative study.

Setting

The study was conducted in El-Minia University Hospital, Egypt.

Patients and methods

The current study was conducted at Department of General Surgery, Faculty of Medicine, El-Minia University, from March 2015 until October 2016, to allow a minimum follow-up period of 6 months for the last case operated up on. The study protocol was approved by the local ethical committee. Parents of enrolled patients had to sign a written fully informed consent concerning the study plan and the laparoscopic approach. The study was conducted on 84 cases – 69 males and 15 females – with mean age range of 1–3 years.

Patients requiring additional surgical procedures at the same setting, had complicated IIH, recurrent inguinal hernia, umbilical hernia, other indications for open laparotomy, contraindication for pneumoperitoneum, or bleeding diathesis were excluded from the study. Moreover, patients whose parents refused to sign the consent form or could not attend the follow-up visits were excluded from the study. All patients underwent full clinical examination for assurance of inclusion and exclusion criteria and were evaluated on the night of surgery by anesthetist in charge.

Operative procedure

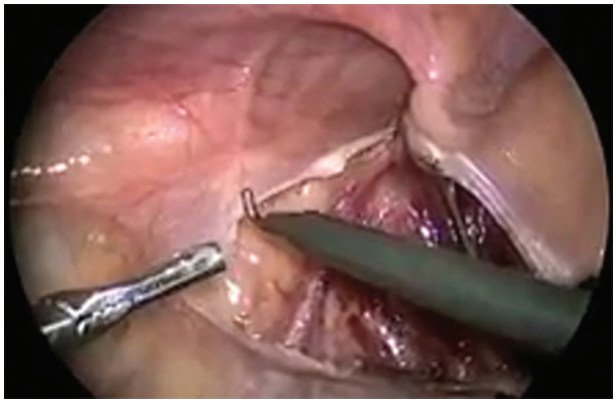
Patients were randomly, using sealed envelopes prepared by blinded assistant and chosen by parents of enrolled children, divided into two groups according to mode of the DIR closure. All patients received general anesthesia with nasal tracheal intubation and received one intravenous injection of third generation cephalosporin at dose of 50 mg/kg body weight.

Primary umbilical port (5 or 10 mm) was inserted by open cannulation, and pneumoperitoneum was created at a pressure of 10 mmHg. Inguinal anatomy was assessed with a straight telescope for assurance of indication and exploring the competence of the other inguinal ring. Two 5-mm working ports were inserted one on each side of the umbilicus. A hernia was defined as an open DIR of any size. The peritoneum was incised, both testicular vessels and vas deference were identified, and then the peritoneal incision was completed circumferentially to excise the sac tissue. The resultant peritoneal defect was closed by a stitch of 4/0 vicryl using intracorporeal knotting in patients of group I (Fig. 1). In patients of group II, no manipulation or dissection of vas deferens, testicular vessels, or sac was performed; a purse-string suture including 5–6 bites using 4/0 vicryl was inserted in the periorifical peritoneum (Fig. 2a) and tightened with intracorporeal knotting (Fig. 2b).

Postoperative care

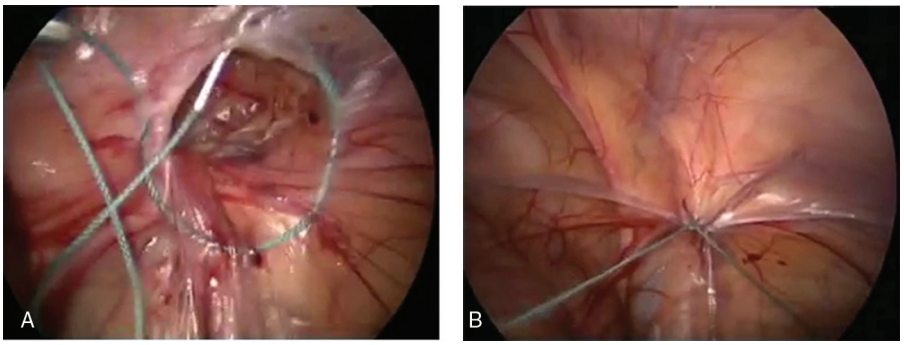
All patients received their immediate PO care at pediatric postanesthetic care unit. Pain sensation was evaluated using the observational pain-discomfort scale (OPS) [9] which assesses behavioral objective parameters, namely crying, facial expression, position of torso, position of the legs, and motor restlessness using a three-point scale, with 1=none, 2=moderate, and 3=severe to give a cumulative score of 5–15, and analgesia was provided in the form of paracetamol suppository (30 mg/kg) at OPS was more than 11 on two subsequent observations 10 min apart. Mean OPS score was recorded at 30, 60, and 90 min PO, and frequency of rescue analgesia administrations was also recorded. Time till first oral intake and duration of PO length of hospital stay were determined. Parents were asked to attend the outpatient clinic for follow-up at twice a weekly for 1 month and at 3 and 6 months PO. Follow-up examination included determination of the frequency of wound infection, development of

Figure 1



Laparoscopic sac dissection in cases of the first group

Figure 2



a: Insertion of a purse string suture in the periorificial peritoneum. b: Tightening of purse string suture and intracorporeal knotting.

secondary hydrocele, testicular atrophy, or hernia recurrence.

Statistical analysis

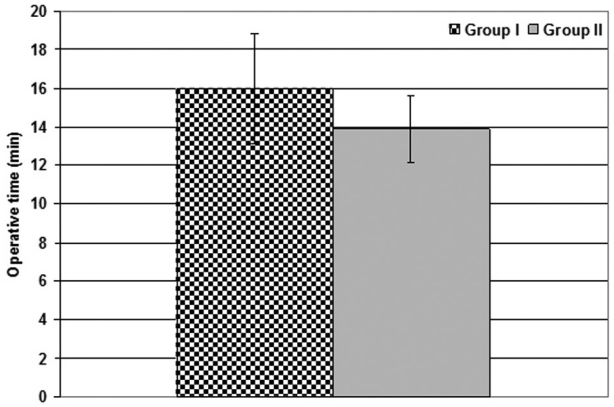
Obtained data were presented as mean±SD, ranges, numbers, and ratios. Results were analyzed using one-way analysis of variance with post-hoc Tukey HSD test and χ^2-test. Statistical analysis was conducted using the SPSS (version 15, 2006; SPSS Inc., Chicago, Illinois, USA) for Windows statistical package. *P* value less than 0.05 was considered statistically significant.

Results

The study included 84 patients who had unilateral IIH; 69 were males and 15 females, with mean age of 2.1± 0.8 years and range of 1–3 years, with nonsignificant difference ($P>0.05$) between both groups. One patient in group I showed adhesions between sac wall and vas deferens that was difficult to be dissected laparoscopically for fear of vas injury, so this patient was converted to open procedure and vas was completely dissected, and surgery was completed uneventfully for an open conversion rate of 2.4% in group I; no patient in group II required open conversion, so the open conversion rate for total study population was 1.2%. Another patient in group II required sac disconnection because of sac tearing during dissection, and surgery was completed uneventfully for a decision–conversion rate of 2.4%. Mean operative time for cases that underwent complete laparoscopic repair was significantly ($P=0.001$) shorter in patients of group II compared with patients of group I (Fig. 3). Intraoperative blood loss was minimal in both groups with nonsignificant difference ($P>0.05$) (Table 1).

The OPS scores determined at 30-min PO were significantly ($P=0.001$) lower in patients of group II compared with patients of group I. Mean OPS determined at 60 and 90-min PO were nonsignificantly lower in patients of group II compared with those of group I, but collective OPS pain score was significantly ($P=0.001$) lower in patients

Figure 3



Operative time (mean±SD) for laparoscopic repair of unilateral indirect inguinal hernia in both groups

Table 1 Preoperative and operative data of patients of studied groups

Data	Group I [*n* (%)]	Group II [*n* (%)]	*P* value
Preoperative			
Age (years)			
1	14 (33.3)	8 (19)	NS
2	13 (31)	22 (52.4)	
3	15 (35.7)	12 (28.6)	
Mean±SD	2±0.8	2.1±0.7	NS
Sex			
Male	34 (81)	35 (83.3)	NS
Female	8 (19)	7 (16.7)	
Operative			
Operative time (min)	16±2.8	13.9±1.7	0.001
Open conversion	1 (2.4)	0	NS
Decision–conversion	0	1 (2.4)	NS

Data are presented as numbers and mean±SD. Percentages are in parenthesis. NS, nonsignificant difference between both groups. $P<0.05$, significant difference between both groups.

of group II compared with group I. A total of 49 patients required rescue analgesia once, whereas 35 patients required it for two times, with significantly (P=0.046) lower frequency of patients who received rescue analgesia once in group II compared with group I (Fig. 4).

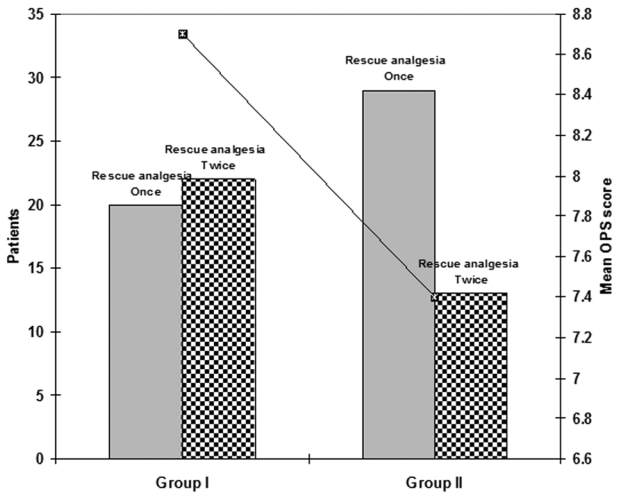
Patients of group I received their first oral intake significantly (P=0.005) earlier, with significantly higher frequency of patients who received their first oral intake within 60 min in group II than patients of group I. Mean PO hospital stay was significantly shorter, with significantly (P=0.033) higher frequency of patients discharged within 3 h PO in group II compared with patients of group I (Fig. 5). A total of three (3.6%) patients developed port wound infection – two in group I and one in group II – with nonsignificant (P>0.05) difference between both groups despite being in favor of group II. At the end of follow-up, in group I, one patient developed hydrocele and three patients developed recurrent hernia for a long-term complication rate of 9.5%. On the contrary, in group II, only one patient developed recurrent hernia, for a 6-month PO complication rate of 2.4%, with nonsignificantly (P>0.05) higher frequency of 6-month PO complication among patients of group I (Fig. 6 and Table 2).

Discussion

The study included 84 children with unilateral IIH, and diagnosis was ensured during laparoscopic examination to assure competent contralateral inguinal orifice. In line with laparoscopic diagnosis conformation of hernia laterality, Mortellaro *et al.* [10] reported minimal risk of infection or recurrence following unilateral IIH repair, and this risk is not increased with the use of contralateral exploration using laparoscopy.

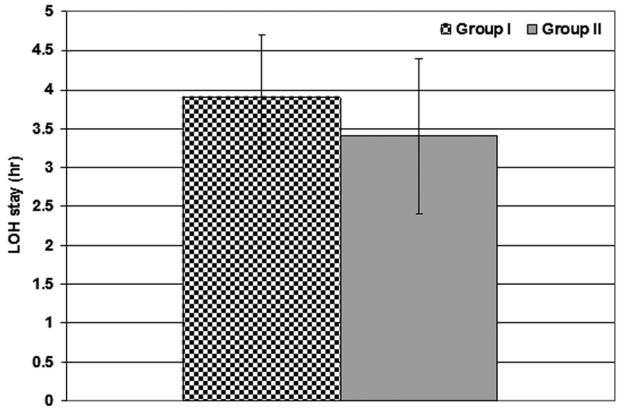
The current study was biarmed: the first for evaluation of outcome of laparoscopic indirect inguinal hernia repair (IIHR) and the second for evaluation of outcome purse-string suture closure versus stitch closure of DIR. Regarding the first arm outcome, only one patient of the total study population required open conversion for dissection of dense adhesions between vas and sac for an open conversion rate of 1.2%. A total of three patients developed port site wound infection for a rate of 3.6%. Concerning long-term complications, five patients developed PO complications for a rate of 6%; one developed hydrocele and four developed recurrent hernia.

Figure 4



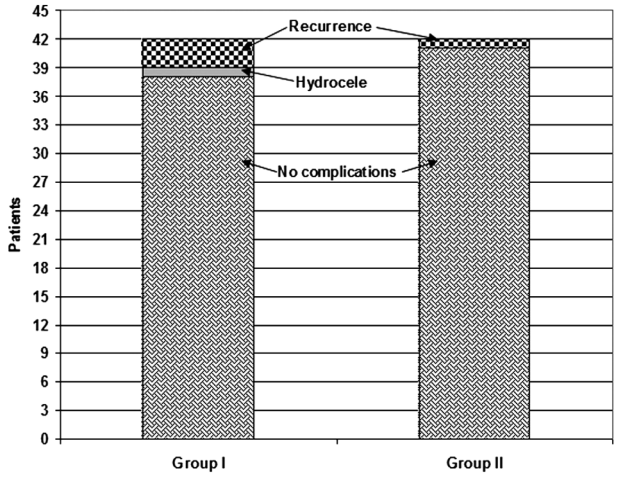
Mean observational pain-discomfort scale (OPS) pain score and frequency of requests of rescue analgesia by patients of both groups

Figure 5



Length of hospital stay (LOH) (mean±SD) of patients of both groups

Figure 6



Long-term outcomes of patients of both groups

Table 2 Postoperative immediate and 6-month postoperative outcomes of patients of studied groups

Data	Group I [*n* (%)]	Group II [*n* (%)]	*P* value
Immediate outcome			
Pain score			
30 min	10.3±2.7	7.6±4.1	0.001
60 min	8.1±3.5	7.6±3.7	0.542
90 min	7.8±3.8	6.8±4.1	0.263
Mean score	8.7±1.6	7.4±1.5	0.001
Frequency of rescue analgesia administration			
Once	20 (47.6)	29 (69)	0.046
Two times	22 (52.4)	13 (31)	
Time till first oral intake			
≤60	2 (4.8)	8 (19)	0.043
>60	40 (95.2)	34 (81)	
Mean	85.4±12.1	77.8±13.4	0.008
LOH stay			
2 h	0	7 (16.7)	0.033
3 h	15 (35.7)	20 (47.6)	
4 h	16 (38.1)	8 (19)	
5 h	11 (26.2)	7 (16.7)	
Mean	3.9±0.8	3.4±1	0.005
Port site wound infection	2 (4.8)	1 (2.4)	0.556
6-month PO outcome			
Hydrocele	1 (2.4)	0	0.456
Port site hernia	0	0	0
Hernia recurrence	3 (7.1)	1 (2.4)	0.306

Data are presented as numbers and mean±SD. Percentages are in parenthesis. LOH, length of hospital stay; NS, nonsignificant difference between both groups; PO, postoperative. $P<0.05$, significant difference between both groups.

The reported collective outcome of laparoscopic IIHR goes in hand with literature [2,11–16] which previously reported varied figures for open conversion, regarding short-term and long-term complications. Moreover, the reported figures coincided with that recently reported, in 2017, by Gause *et al.* [17], Zhao *et al.* [18], and Davies *et al.* [19] who found laparoscopic unilateral IIHR demonstrated shorter operative time [17,19] and was associate with a lower recurrence rate and lower PO complications [18] and concluded that minimally invasive IIHR is safe and effective [19].

In support of the efficacy of laparoscopic IIHR, multiple previous trials concluded that laparoscopic herniorrhaphy is a good alternative option in recurrent childhood hernia [20], to avoid the difficulties of redo surgery in scarred operative field with delicate structures liable [21], in bilateral hernias [22,23].

Intracorporeal knotting was used for tightening of the stitch applied after sac disconnection in group I or the purse-string suture in group II. In support of the use of intracorporeal knotting, Shalaby *et al.* [24] compared intracorporeal versus extracorporeal knotting of purse-string suture around the internal inguinal ring and reported significant differences in the operative time, recurrence rate, and cosmetic results between the studied groups.

Patients of group II who had DIR closure using purse-string periorificial peritoneum stitching did favorably better than patients who had sac disconnection and stitch closure of DIR in terms of significantly shorter operative time, lower PO pain scores, earlier resumption of oral intake, and shorter PO hospital stay. Moreover, only one patient developed PO port site wound infection and another developed recurrent hernia for PO complications rate of 2.4%. In line with these findings, Montupet [25] using a purse-string suture around the periorificial peritoneum after sac sectioning reported a recurrence rate of 1.5%. Moreover, Wheeler *et al.* [26] documented that laparoscopic pediatric IIHR with transperitoneal division of the hernia sac and purse-string closure of the proximal peritoneum allows for a minimally invasive option for pediatric IIHR with high parent satisfaction, minimal scarring, and good cosmetic results. Thereafter, Cho *et al.* [27] in a series of laparoscopic pediatric IHR using intracorporeal knotting of purse-string suture at sac neck reported a recurrence rate of 1.8% and PO groin swelling that resolved spontaneously in 1.8%, but iatrogenic PO cryptorchidism requiring subsequent orchidopexy was reported in 2.7% of patients. Moreover, Shalaby *et al.* [28] found that during follow-up period of 10–140 months, the recurrence

rate ranged between 0 and 1.13%, hydroceles occurred in 0.58%, and no occurrence of testicular atrophy or iatrogenic ascent of the testis after laparoscopic IIHR using transperitoneal purse-string suture technique. Moreover, Lee *et al.* [29] suggested that the laparoscopic purse-string suture of internal inguinal opening of hernia sac could be a safe, effective, and reliable alternative for management of pediatric inguinal hernia, and McClain *et al.* [30] using extra corporally tied purse-string suture reported that during laparoscopic unilateral IIHR, mean operating time was 20.5 min with PO minor complication rate of 4% and recurrence rate of 0.56%. Thereafter, Steven *et al.* [16] compared surgical outcomes for a simple purse-string method of laparoscopic IIHR with traditional open IIHR in children and found recurrence and overall complication rates were 2.9 and 7.8%, respectively, with laparoscopic, but were 3.9 and 9.9%, respectively, with open. Recently, in 2017, Esposito *et al.*[31] performed purse-string suture on periorificial peritoneum in inguinal orifice diameter more than or equal to 10 mm and N-shaped suture in orifices less than or equal to 5 mm and reported a recurrence rate of 0.3% and complication rate of 1.5%.

Conclusion

Laparoscopic purse-string suture closure of the DIR shortens operative time, time till first oral intake, and home return of children with unilateral IIH with low 6-month recurrence rate than laparoscopic sac disconnection and DIR stitch closure (2.4 vs. 7.3%).

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Conflicts of interest

There are no conflicts of interest.

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