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Primary abandon of hernia sac for inguinoscrotal hernias: a safe way to cut corners

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Abstract

Introduction Inguinoscrotal hernias (ISH) pose a challenge to surgeons with consistently higher rates of postoperative complications and recurrence rates. The aim of this study is to report our initial experience and early results with a new technique for inguinoscrotal hernia repair.

Methods A review of a prospectively maintained multi-center database was conducted in patients who underwent minimally invasive repair using the "primary abandon-of-the-sac" (PAS) technique for inguinoscrotal hernias from March 2021 to July 2022. Demographics and outcomes were analyzed. Univariate analysis and multivariate logistic regression were performed.

Results A total of 76 minimally invasive inguinal hernia repairs were performed. In 70 patients (92%) C-PAS was used as the technique to abandon the sac while in the remaining 6 patients, "pirate-eye-patch" technique was used. Median hernia ring was 3 (IQR 2.5–3.5) cm and median hernia sac was 9.5 (8–10.8) cm. Median operative time was 70 min (IQR 56–96). Seroma was present in 22 (28.9%) patients 7 days after surgery. Most had seroma only in the inguinal area ($n=19$; 25%). Thirty days after surgery, 12 (15.8%) patients still had seroma in the inguinal area and 6 (7.9%) in the inguinoscrotal area. Ninety days after surgery, four (5.3%) patients had inguinal seroma, 2 (2.6%) scrotal seromas and 3 (3.9%) inguinoscrotal seromas. The size of the hernia sac was not associated with seroma formation 7 days after surgery (OR 1.06; 95% CI 0.89–1.2; $P=0.461$) in the multivariate logistic regression. BMI was also not associated with seroma formation (OR 0.8; 95% CI 0.74–1.06; $P=0.2$).

Conclusions Planned abandon of the hernia sac is an interesting alternative and is associated with a low rate of complications and acceptable seroma formation rates.

Keywords Abandon the sac · Inguinal hernia · Minimally invasive surgery

Surgery for inguinal hernias is one of the most performed surgical procedures around the world [1, 2]. A special subgroup of patients are those who have large inguinal hernias or inguinoscrotal hernias (ISH). They pose a challenge to surgeons with consistently higher rates of postoperative complications and recurrence when compared to “normal” inguinal hernias [3, 4].

In the past, this discussion was almost exclusive to open or conventional techniques as minimally invasive surgery (MIS) was considered relative contraindications for ISH

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hernias [1, 4]. However with better understanding of the technique and the surgeon's skills, MIS—laparoscopic or robotic—has been used now for practically all cases of inguinal hernias, including the large ones.

Generally, recommendation for ISH hernias has been to attempt to completely reduce the hernia sac [2, 5]. The abandonment or transection of the hernia sac has been reserved only for cases in which the complete dissection is more difficult, takes a long time or some complication such as bleeding (non planned tactic) [5]. Recently, this approach has been questioned due to the risk of complications and the planned abandonment of the hernia sac has been recommended by some authors [6, 7].

Although seroma is a complication described as more frequent in cases where the hernia sac is abandoned, in cases of IHS with fibrotic hernia sacs, the presence of seroma can be considered a minor complication when compared to ischemic orchitis, hematoma or cord elements injury that can occur in cases of more extensive dissection [5]. However, studies published to date, in general, compare the complete dissection of the hernia sac versus the transection as an unplanned tactic, which means that some dissection with difficulty was performed. As well, few randomized trials published do not consider the size of the hernia itself [5]. The aim of this study is to report our initial experience and early results with a new technique for inguinoscrotal hernia repair.

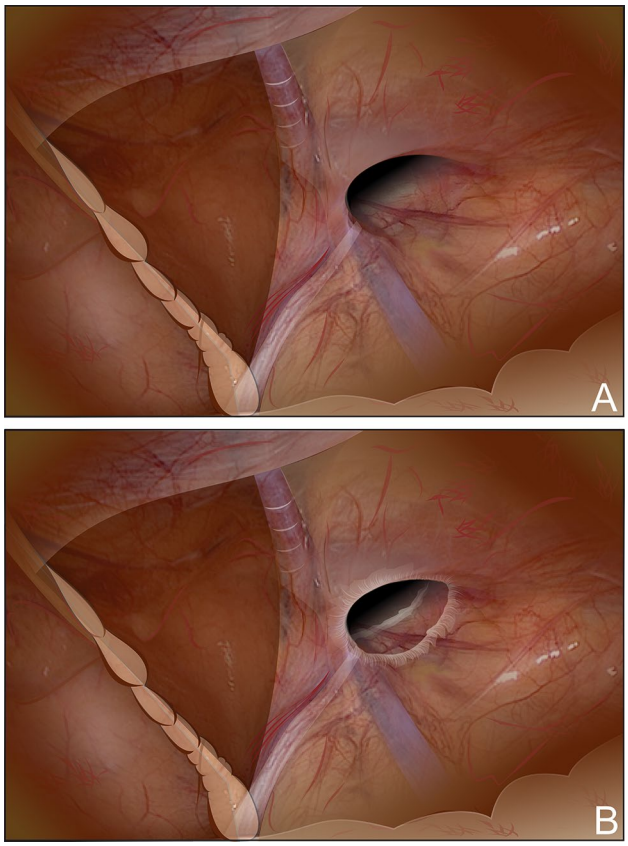

Fig. 1 **A** Inguinoscrotal hernia, **B** circular 360° incision of the peritoneum at the level of deep inguinal ring as first step of the procedure. Distal part of the sac hernia sac is abandoned

Methods

This is a retrospective chart review of prospective multicenter cohort study designed to evaluate the concept of primary abandon of the hernia sac technique in large inguinoscrotal hernias. A prospective database was created, and patients were enrolled from March 2021 to July 2022 in 6 centers in Brazil and the US. The surgeons were far beyond their learning curve (at least 250 previous minimally invasive inguinal repairs), and all those centers were considered as reference for management of complex abdominal wall hernia. ISH were defined as hernias in which the hernia sac extends to the scrotum passing through the deep inguinal annulus for at least 7 cm. Measurement was achieved by intracorporeal evaluation using a ruler and always obtaining pictures from that. Inclusion criteria were male gender and age above 16 years old with ISH as defined above. Patients with previous preperitoneal surgery (prostatectomy, previous laparoscopic or robotic inguinal hernia repair) were excluded from our sample. Patients with concurrent pelvic surgery were also excluded from the sample.

All patients were repaired using a transabdominal preperitoneal approach (TAPP), either laparoscopically or robotically assisted, using the standard technique described elsewhere [6, 8]. During intraoperative evaluation, the surgeon decided to perform primary abandon of the sac based on patient and hernia characteristics. First step of the surgery is to perform a circular incision, 360°, in the peritoneum at the level of the deep inguinal annulus (Fig. 1). In this way, the distal part of the hernia sac is "disconnected" from the peritoneum that covers the inguinal region. By abandoning the distal hernia sac there is no need to dissect the cord structures deep inside the inguinal canal, thus avoiding any potential harm to them. It's important at this time to pay attention to the elements of the spermatic cord running inferiorly and to inferior epigastric vessels located superiorly (inverted Y) (Fig. 1b). Tracing the peritoneum during dissection will help to "detach" it from the structures, thus reducing the risk of injury. Another important trick is that in the medial part, the peritoneum tends to be more thickened/fibrotic, probably due to recurrent entrapment.

As the next step, two different techniques were used to peritoneal flap opening. The "pirate-eye-patch" technique described previously by Morrell et al. in which the surgeon opens the peritoneum superiorly, laterally e medially in V-shape, from the circular incision or the Circular Primary

Abandon of Hernia Sac Technique (C-PAS) [9]. In this modification, after the circular incision of the peritoneum around the deep inguinal ring, and disconnection (abandon) of the hernia sac, peritoneal flap is created by incision it 4–5 cm above the deep ring, from superior iliac spine to the medial umbilical fold as described for standard TAPP surgery (Fig. 2) [6–8]. Following the dissection, the surgeon "falls" over the incision previously made, which not only avoids extensive dissection but also facilitates the recognition of anatomical elements (Fig. 3). At the end of the procedure, it will be necessary to suture the "hole" created in the peritoneum (Figs. 4).

It is important to stress that the decision to abandon the sac occurs early, as a planned technique, before any dissection. Demographic data, including patient and hernia characteristics were obtained, as well as intraoperative data regarding surgical time and technique, intraoperative complications, conversion to open surgery and length of stay (LOS). We have assessed general postoperative complications (Clavien-Dindo) and specifically searched for seroma and hematoma formation, as well as ischemic orchitis or other local complications related to the procedure itself such as recurrence and chronic pain. Since we could not find a specific classification for inguinal hernia seromas, we defined four stages as stated: 1- absent/incipient, 2- inguinal seroma, 3- scrotal seroma, 4- inguinoscrotal. Follow up (FU) was defined to occur at 7 days, 30 days, and 3 months after surgery.

Statistical analysis was carried out using the SPSS version. Median and interquartile ranges were used for continuous variables and Chi-square or Exact Fisher's test for categorical ones when indicated.

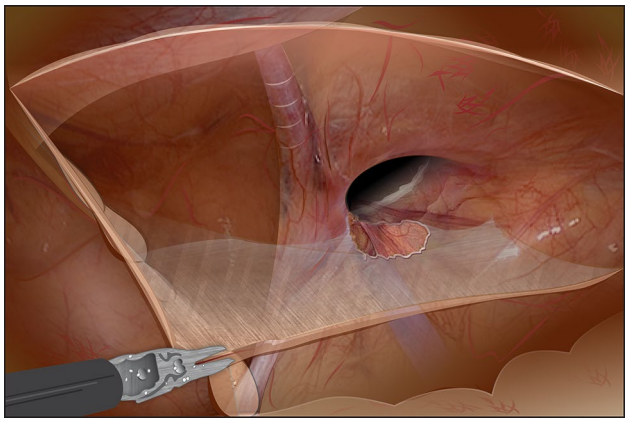

Fig. 3 Dissection of preperitoneal space in which the surgeon reach the previous circular incision. No extensive dissection is required and anatomical landmarks are easily recognized

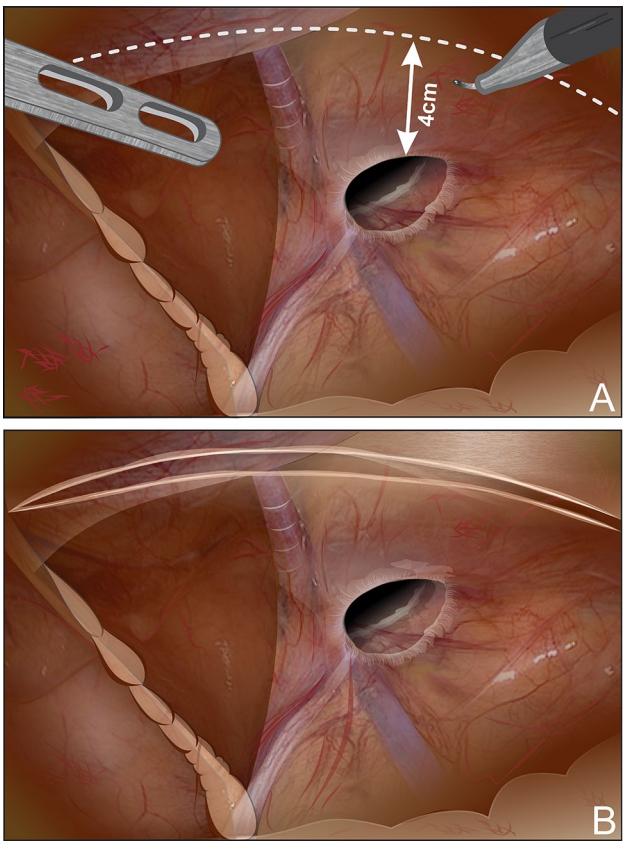

Fig. 2 **A**, **B** Opening of peritoneal flap 4–5 cm above the deep inguinal ring from anterior iliac crest to medial umbilical fold

Results

Patient characteristics

A total of 76 minimally invasive inguinal hernia repairs were performed from March 2021 to July 2022. Patient characteristics are as listed in Table 1. Median

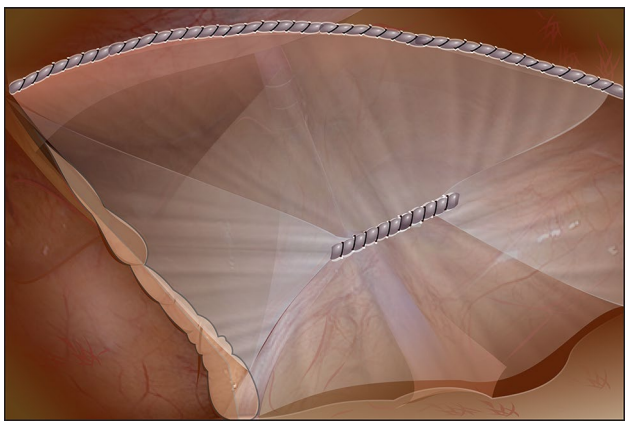

Fig. 4 Peritoneal flap is closed in standard way. Extra hole due to circular incision is also sutured

Table 1 Demographic characteristics

N = 76	*N* (%)
Median age (IQR)	68 (50.3–75)
Median BMI[a] (IQR)	25.5 (23.8–27.8)
Hypertension	34 (44.7)
DM	8 (10.5)
CVA	15 (19.7)
DLP	19 (25)
Anticoagulants	20 (26.3)
ASA	
I	21 (27.6)
II	39 (51.3)
III	15 (19.7)
IV	1 (1.3)
Hernia side	
Left	19 (25)
Right	35 (46.1)
Bilateral	22 (28.9)
Previous repair	10 (13.2)
NYHUS classification	
II	38 (50)
IIIB	33 (43.4)
IV B	5 (6.6)
EHS classification	
L2	22 (28.9)
L3	54 (71.1)

BMI body mass index, *IQR* interquartile range, *DM* diabetes mellitus *CVA* Cardiovascular accident, *DLP* Dyslipidemia, *ASA* American Society of Anesthesiologists, *EHS* European Hernia Society

[a]In kg/m^2

Table 2 Perioperative outcomes

N = 76	*N* (%)
Emergency case	4 (5.3)
Mesh type	
Polypropylene flat	32 (42.1)
Polypropylene anatomic	39 (51.3)
Polyester self fixating	5 (6.6)
Mesh gramature	
High	15 (19.7)
Medium	60 (78.9)
Low	1 (1.3)
Median hernia ring (IQR)	3 (2.5–3.5)
Median hernia sac (IQR)	9.5 (8–10.8)
Mesh fixation	
No fixation	4 (5.3)
Tackers	30 (39.5)
Self fixating	3 (3.9)
Glue	2 (2.6)
Suture	37 (48.7)
Median operative time	70 (56–96)
Drain	
No drain	72 (94.7)
Preperitoneal	3 (3.9)
In the hernia sac	1 (1.3)
Flap closure	
Suture	76 (100)
LOS	
< 12 h	22 (29.7)
12–24 h	46 (62.2)
> 24 h	6 (8.1)

IQR interquartile range, *LOS* length of stay

age was 68 (IQR 50.3–75) and median BMI was 25.5 (IQR 23.8–27.8) kg/m^2. Most patients were ASA II (39; 51.3%), 35 (46.1%) had a right inguinal hernia, 19 (25%) left inguinal hernia and 10 (13.2%) patients had a previous repair. Thirty-four (44.7%) patients had hypertension, eight (10.5%) diabetes mellitus, 19 (25%) dyslipidemia and 20 (26.3%) were taking anticoagulants. (Table 1).

Operative details

In 70 patients (92%). C-PAS was used as the technique to abandon the sac while in the remaining 6 patients, "pirate-eye-patch" technique was used. Thirty-nine patients (51.3%) had an anatomic polypropylene mesh and 32 (42.1%) a flat polypropylene mesh. Median hernia ring was 3 (IQR 2.5–3.5) cm and median hernia sac was 9.5 (8–10.8) cm. Median operative time was 70 min (IQR 56–96). Mesh fixation was mainly done by suture in 37 (48.7%) patients followed by tackers in 30 (39.5%) patients and self-fixating mesh in 3 (3.9%) patients. Operative details are as listed in Table 2.

Postoperative outcomes

Length of Stay (LOS) was between 12 and 24 h in most of the patients ($n = 46$; 62.2%). LOS was lower than 12 h in 22 (29.7%) patients. Seroma was present in 22 (28.9%) patients 7 days after surgery. (Table 3) Most had seroma only in the inguinal area ($n = 19$; 25%). Two patients presented with hematoma 7 days after surgery. One in the scrotal area and the other in the umbilical incision. Thirty days after surgery, 12 (15.8%) patients still had seroma in the inguinal area and 6 (7.9%) in the inguinoscrotal area. Ninety days after surgery, four (5.3%) patients had inguinal seroma, 2 (2.6%) scrotal seromas and 3 (3.9%) inguinoscrotal seromas. One

Table 3 Complications

N = 76	7 days *n* (%)	30 days *n* (%)	90 days *n* (%)
Seroma			
No	54 (71.1)	56 (73.7)	67 (88.2)
Inguinal	19 (25)	12 (15.6)	4 (5.3)
Scrotal	1 (1.3)	2 (2.6)	2 (2.6)
Inguinoscrotal	2 (2.6)	6 (7.8)	3 (3.9)
Hematoma			
No	74 (97.4)	75 (98.7)	75 (98.7)
Scrotal	1 (1.3)	1 (1.3)	1 (1.3)
Inguinoscrotal	0 (0)	0 (0)	0 (0)
Umbilical port	1 (1.3)	0 (0)	0 (0)
Ischemic orchitis	1 (1.3)	0 (0)	0 (0)

patient had ischemic orchitis. There was no recurrence at 90 days in our cohort.

When comparing patients with hernia sac smaller than 10 cm and equal or bigger than 10 cm regarding seroma formation there was no difference between the groups in 7 days ($P = 0.369$), 30 days ($P = 0.995$) and 90 days ($P = 0.682$) (Table 4).

Multivariate analysis

Multivariate logistic regression was performed to control for confounding variables regarding seroma formation 7 days after surgery. Factors that we believed could be possible confounding variables were included in the model. Analysis is as listed in Table 5. The size of the hernia sac was not associated with seroma formation 7 days after surgery (OR 1.06; 95% CI 0.89–1.2; $P = 0.461$). BMI was also not associated with seroma formation (OR 0.8; 95% CI 0.74–1.06; $P = 0.2$).

Table 5 Logistic regression to evaluate seroma formation 7 days after surgery

	OR	95% CI	*P* value
Age	1.02	0.98–1.05	0.27
BMI	0.8	0.74–1.06	0.2
Diabetes Mellitus	1.1	0.16–7.7	0.925
Anticoagulants	1.06	0.3–3.7	0.917
Bilateral hernia	1.3	0.4–4.2	0.652
Previous repair	1	0.22–4.6	0.994
Size hernia sac	1.06	0.89–1.2	0.461

OR odds ratio, *CI* confidence interval, *IQR* interquartile range, *LOS* length of stay

Discussion

Repair of inguinal hernias is one of the most performed surgical procedures around the world, but still many controversies persist and advances have been made [1, 2]. Laparoscopic surgery for inguinal repairs, which initially encountered a lot of resistance among surgeons, nowadays shows superiority in terms of postoperative pain and recovery when compared to open/conventional repairs [10]. Associated with this, the robotic platform applied to abdominal hernia repairs has significantly increased the adoption of MIS approach to inguinal repairs.

However, some conditions are still considered controversial or contraindications for MIS techniques, such as patients with restriction for general anesthesia or with previous pelvic surgery, especially preperitoneal dissection. Another group are patients with large inguinal hernias or ISH [3, 5]. These cases represent a relevant percentage of patients with inguinal hernias who seek surgical treatment [5]. ISH represent a challenge even to experienced surgeons because they are associated with higher morbidity compared with non-complex groin hernia repair [9, 11]. Due to surgical

Table 4 Seroma formation according to hernia sac size

	7 days			30 days			90 days		
	Hernia sac < 10 cm *n* = 40 (%)	Hernia sac ≥ 10 cm *n* = 36 (%)	*P* value	Hernia sac < 10 cm *n* = 40 (%)	Hernia sac ≥ 10 cm *n* = 36 (%)	*P* value	Hernia sac < 10 cm *n* = 40 (%)	Hernia sac ≥ 10 cm *n* = 36 (%)	*P* value
N = 76									
Seroma			0.369			0.995			0.682
No	29 (72.5%)	25 (69.4%)		30 (75%)	26 (72.2%)		36 (90%)	31 (86.1%)	
Inguinal	10 (25%)	9 (25%)		6 (15%)	6 (16.6%)		1 (2.5%)	3 (8.4%)	
Scrotal	1 (2.5%)	0 (0%)		1 (2.5%)	1 (2.8%)		1 (2.5%)	1 (2.8%)	
Inguinoscrotal	0 (0)	2 (5.6%)		3 (7.5%)	3 (8.4%)		2 (5%)	1 (2.8%)	

complexity, mainly related to greater difficulty in dissecting the hernia sac using MIS techniques, these patients are preferably considered for open/conventional treatment [1, 5, 12].

More recently, both due to a better understanding of the posterior anatomy of the inguinal region and standardization of technical steps, as well as the improvement in the surgeon's skills and the help of the robotic platform, cases of ISH (and other complex situations) have been repaired via MIS [6, 8]. Although TEP has been used by few authors, transabdominal approach seems to be the best option for this cases [5]. The principle generally used by surgeons is to attempt complete reduction of the hernia sac. The abandonment of the hernia sac has only been used as an unplanned maneuver during cases of difficult dissection, the same as with open repairs. However, the attempt at reduction, and abandonment of the hernia sac only in cases of greater difficulty, may be associated with a higher rate of complications [13]. The main complications described in these cases are scrotum hematoma, cord elements injury and ischemic orchitis, all of which are directly or indirectly related to extensive dissection of the hernia sac.

Recently, the primary abandon of the sac in ISH has been advocated as a planned tactic by few authors [6, 7, 9]. Advantages are not only transforming a more complex case into a simpler surgery, but mainly reducing perioperative complications. In our series, no relevant intraoperative complications were reported and bleeding was negligible in all cases. Median operative time was 70 min (28.9% bilateral repair) similar to that reported for MIS repairs in cases of non-large inguinal hernias [8, 14]. Although few studies published comparing complete sac dissection versus sac abandon have not shown a difference in operative time, perioperative complications or pain scores, most of the patients included in the studies had not large hernias sacs that is, without "major" dissection of the hernia sac [15]. We did not find any study that compared complete dissection versus sac abandon specifically for ISH. We believe that operative time similar to repairs for non-complex hernias, relatively short, is not only due to the experience of the surgeons, but mainly to the technique of primary abandon of the sac, which significantly reduces the need for dissection.

Likewise, 92% of patients were discharged in 24 h or less. The median age of the patients was 68 years, and can be considered high compared to most studies [16]. In addition, 54% of patients had comorbidities and a quarter of patients had a history of recent use of antiplatelet agents or anticoagulants. These factors could be related to major operative complications.

Unlike inguinal hernia where the EHS Classification is widely accepted, there is currently no generally accepted classification for ISH hernias [5]. For our study, we defined the hernia sac size greater than 7 cm from the deep inguinal annulus as a criterion. Another important aspect, in addition to the size of the sac itself, is the fibrosis of the hernia sac within the scrotum, which can be assessed by trying to reduce it by pulling it with the forceps in a movement of invagination of the sac. We can notice that most of these large hernia sacs are associated with fibrosis, probably due to the chronicity and episodes of incarceration, which can make even more difficult to reduce it. The median size of the hernial sac in our study was 9.5 cm.

Two techniques, with minor differences, were used to open the peritoneum flap. The technique originally described as "pirate-eye-patch" in which the peritoneum is opened superiorly, laterally and medially (V-shape) from the circular incision or the C-PAS modification, used in most patients in this series. In C-PAS technique, after the circular incision of the peritoneum around the deep inguinal ring, and disconnection (abandon) of the hernia sac, peritoneal flap is created by incision it 4–5 cm above the deep ring, from superior iliac spine to the medial umbilical fold. While the first has the advantage of not needing to close the hole resulting from the circular incision, the second has the advantage of being the standard technique for dissection of the peritoneum in the TAPP technique, already known by most surgeons and allows adequate overlapping of the mesh and its coverage by the peritoneum when closing the flap. However, in this case, the surgeon needs to close the "hole" created during the circular incision of the peritoneum.

Questioning about abandon the hernia sac is the potential greater risk of postoperative seroma or pseudohydroceles [3]. Seroma is one of most common complications after MIS inguinal hernia repair and it can mimic an early recurrence. [17]. Although it is considered a minor complication, seroma can be associated with worse pain scores and postoperative quality of life [18, 19]. Other seroma-related problems are misperception with hernia recurrence and seroma infection, a rare but severe complication [20]. A recent meta-analysis included the four papers published until 2020 that compare complete sac dissection versus abandon of the sac and reported a significantly higher seroma rate for hernia sac abandon (OR 2.41; 95% CI 1.39 to 4.17, $P=0.002$) [15]. On the other hand, if we compare only the RCTs the incidence of seroma was similar [18, 21]. Another recent publication, in a retrospective comparation showed significant higher seroma formation after hernia sac abandon. But once again, this studies do note consider the size of the sac and the decision of abandon was done after difficult dissection [22].

In our series, the seroma rate was 28.9% and 26.5% after 7 and 30 days postoperatively, respectively. Vast majority of seromas disappeared by the end of 3rd month of follow-up. In our series only 11.8% of the patients presented seroma at this time, demonstrating the tendency for their resorption, as previously reported [1, 5]. Most seromas that persisted

after 3 months were located in the inguinal region and only 2 patients (2.6%) presented inguino-scrotal seromas. Among the other complications reported, one patient (1.3%) had ischemic orchitis after 7 days PO, which was resolved with conservative measures, and another patient (1.3%) had scrotal hematoma. No patient required puncture or any surgical intervention. Although there is little literature, it seems postoperative seroma after hernia sac abandon does not seem to have worse evolution than in complete dissection [18].

Size of the sac was not a factor related to seroma formation after C-PAS. Comparing hernias sac between 7 to 10 cm versus bigger than 10 cm, seroma formation was 27.5% vs 30.6% on the 7th PO; ($P=0.369$); 15% versus 25.1% on the 30th PO ($P=0.308$) and 0% versus 5.6% ($P=0.511$) after 3 months FU, respectively.

Some theories have been used to explain the occurrence of seroma. Authors argue that the sac into the scrotum could play a role in producing and not reabsorbing the accumulated liquid [22]. In our opinion, seroma formation is the consequence of the fluid produced by the inflammatory process from surgical trauma. In ISH, regardless of the complete reduction or not, there will potentially be a large dead space for the accumulation of this liquid. We even believe that extensive dissection of the sac in the scrotum may increase the production of this fluid. However, whether the permanence of the sac can interfere with the reabsorption of this liquid is something that needs to be better evaluated.

Physical examination may not be accurate in detecting all cases of seroma. Use of imaging tests can increase these percentages, but probably without any clinical relevance. For this reason, in accordance with most authors, physical examination was our criteria.

Some tactics have been described to decrease the risk of seroma during MIS repairs for indirect hernias such as fixation of distal part of the sac, the filling of the dead space with fibrin glue, light meshes etc. but no one proved to be really effective [22, 23]. Another topic that can be discussed in relation to seroma is the use of drains. We do not believe that it is effective in reducing seroma or at least that the need for prolonged use for effectiveness is not justified. Most published studies on this topic are in line with our approach [5, 24]. In only one patient drainage was left inside the hernia sac, while in 3 (3.9%) patients the drain was placed in the dissection space, preperitoneal, in cases at risk of bleeding due to the use of antiplatelet agents. In these cases, the drain was removed after 48 h.

Other variables have been correlated with seroma after inguinal hernia repair. In a logistic regression, neither age, BMI, antiplatelet agents or anticoagulants, bilateral hernia or size of hernia sac were related with higher rate of seroma formation after C-PAS.

Limitations of the study

Limitation of our study is the lack of a control group. Likewise, a longer follow-up may answer some questions such as the long-term evolution of seromas and the possible risk of pseudo hydrocele.

Conclusions

MIS approach to inguinal hernia repair has gained more and more supporters and its indication has been extended even to more complex cases. Inguino-scrotal hernias represent a greater challenge for surgeons and are associated with a higher risk of recurrence and complications, mainly due to the difficulty in dissecting the hernia sac. Planned abandon of the hernia sac appears to be an interesting alternative in these cases, not only because it reduces the technical difficulty of the surgery, but mainly because it is associated with a low rate of complications and acceptable seroma formation. We do not support this approach for every hernia but for large sacs. Even the question of what size itself can benefit with this approach should be better evaluated.

Declarations

Disclosures Christiano Claus MD PhD—discloses consulting fees from Medtronic. Flavio Malcher MD MSc—discloses consulting fees from BD, Intuitive & Medtronic, outside the submitted study. Pedro Trauczynski MD—discloses Consulting fees from BD, Medtronic and CMR. Alexander Charles Morrell MD, Andre Luiz Gioia Morrell MD—discloses consulting and speaker fees from Intuitive and Medtronic. Marcelo Furtado MD—discloses speaker fees from Medtronic Medtronic, BD and Ethicon J&J. Leandro Totti Cavazzola MD PhD—disclosure consulting fees from BD. João Rafael Bora Ruggeri MD, Diego L. Lima MD MSc—disclose no financial relationships with industry or conflicts of interest.

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