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Predictors of hernia recurrence after Rives-Stoppa repair in the treatment of incisional hernias: a retrospective cohort

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Abstract

Background Rives-Stoppa retromuscular repair (RSR) has been traditionally used to provide adequate coverage for large abdominal wall defects and appears to be more advantageous compared to other surgical techniques concerning complications and recurrence rates. The aim of this study was to identify the independent predictors associated to hernia recurrence after RSR in the treatment of incisional hernias.

Methods This is a retrospective observational study of 213 patients who underwent RSR between June 2007 and January 2014 at a tertiary centre. Main inclusion criteria were adults with midline hernia classified as M1, M2, M3, M4, or M5, according to EHS classification. All the cases presented a transverse hernia defect measurement greater than 5 cm (grades W2 and W3). Recurrence rate was determined by clinical examination plus confirmation by abdominal CT scan.

Results At a median of 57.6 months (range 46–75 months) of postoperative follow-up, we reported 15 cases of recurrence (7.1%). Recurrences occurred after a mean period of 19.4 months (range 2–49 months). On multivariate analysis, steroid or immunosuppressive drugs use (OR 2.02; CI 1.16–3.95, $p=0.004$), the development of postoperative hematoma (OR 2.9; CI 1.55–4.10, $p=0.001$), and needing surgery for the hematoma (OR 2.1; CI 1.21–3.29, $p=0.004$) were predictors of recurrence after RSR. There was no significant difference in recurrence rate among obesity, smoking, urgent repair, type of mesh fixation, operative time, type of prosthesis, or concomitant procedures.

Conclusions In our current study, using immunosuppressive drugs, the development of postoperative hematoma and needing surgery for the hematoma were associated with increased risk of hernia recurrence after RSR.

Keywords Incisional hernia · Retromuscular repair · Rives-Stoppa repair · Hernia recurrence

Incisional hernias (IH) are a common problem in abdominal surgery that contributes to chronic pain, decreased quality of life, and significant healthcare costs. Recurrence rate after primary repair of a large IH is 20–30%, and after secondary repair of a recurrent IH as high as 30% [1].

Rives-Stoppa retromuscular repair (RSR) has been traditionally used to provide adequate coverage for large abdominal wall defects, especially within the midline, and appears to be more advantageous compared to other surgical techniques concerning complications and recurrence rates [2–5]. Although the efficacy of this approach has been established, hernia recurrence poses a difficult problem. In fact, several risk factors of recurrence after RSR have been reported, related to mesh placement technique or the type of mesh [6]. Therefore, it would be interesting to analyse different factors, apart from those previously reported, related to recurrence after this procedure to try to prevent it.

The aim of this study is to present our experience with RSR using a synthetic mesh in patients with midline IH and to identify the independent predictors associated to hernia recurrence after this procedure.

Materials and methods

Between June 2007 and January 2014, patients who underwent elective open repair of midline incisional defects were considered for our study. Only patients undergoing

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mesh-based repairs using a retro rectus approach (RSR) were included. So, a retrospective cohort study was performed at a tertiary Hospital. The main inclusion criteria were adults with midline hernia classified as M1, M2, M3, M4, or M5, according to the European Hernia Society (EHS) classification [7]. All the cases had a transverse hernia defect greater than 5 cm (grades W2 and W3). All hernias were diagnosed based on clinical examination, and a CT scan was performed in all the patients. The widest separation of the medial aspect of the rectus muscles was recorded using the digital radiology system measurement tools, as was the craniocaudal dimension of the hernia defect. All the laparoscopic approaches and hernias not involving the midline, such as isolated flank and parastomal defects, were excluded. Patients' electronic hospital records and outpatient office notes were reviewed for operative details and follow-up information. The present study was approved by the ethics committee of our Hospital.

Technique

All the patients were preoperatively evaluated by an anaesthesiologist, and respiratory tests were carried out in some cases. Patients received thromboembolic prophylaxis using enoxaparin, sequential compression devices, and antibiotic prophylaxis 1 h prior to skin incision. All patients underwent abdominal repair under general anaesthesia. Nasogastric tube was selectively employed in cases where an intestinal repair or resection was performed. All the surgical reparations were performed by five surgeons dedicated to hernia repair and members of a Unit of the Abdominal Wall Surgery.

Every operation started with a limited midline incision, excising the previous scar back to healthy skin and exposing the hernia sac and its associated fascial defect. Hernia sac dissection was performed in all the patients, followed by lysis of intraperitoneal adhesions; this sac was preserved to provide another layer of autogenous tissue between intraperitoneal contents and the posterior surface of the prosthesis. The fascial level between the rectus muscle and the posterior sheath (or, when below the arcuate line, the transversalis fascia) was dissected to create space for the mesh, usually 5–10 cm from the margins of the hernia. During the dissection we preserved the epigastric vessels and the nervous pedicle; depending on the size of the hernia and the presence or condition of the rectus muscle, dissection may become more complex. The posterior fascia and peritoneum were closed using a slow-absorbable suture.

A polypropylene (PPL) or polyvinylidene fluoride (PVDF) mesh was placed using the sublay technique over the posterior sheath of the abdominis rectus muscle and was fixed in four quadrants through the muscle with non-absorbable sutures or, in other cases, with cyanoacrylate. When the hernia defect included M5, the mesh was fixed on Cooper's ligaments and potentially on the pubis with a large overlap. The anterior fascia was closed using a slowly absorbable suture. In all the cases two or three Jackson-Pratt drainage tubes were used: one subcutaneous drain, and depending on every case, one or two drains were placed in the retromuscular space. Drains were removed once the output had decreased markedly. Removal of excess skin and subcutaneous tissue was performed prior to closing the incision. Finally, the patient used an adjustable abdominal binder during next 4–6 weeks after repair.

Hernia recurrence was determined by clinical examination (a palpable mass at the site of the previous hernia repair) plus confirmation by abdominal CT scan. Patients were followed up at 1 month, 6 months, and 1 year after surgery (and subsequent annual follow-up consultations). Long-term readmission or referral to another hospital was checked through the hospital database. We carried out an analysis of all the factors related to recurrence after RSR, and a comparative study was performed between patients with and without recurrence during the follow-up. Demographic variables and following medical comorbidities were reported: BMI, chronic obstructive pulmonary disease (COPD), immunosuppression, diabetes mellitus, smoking history and American Society of Anaesthesiologists (ASA) score. Types and sizes of mesh were identified using physician-abstracted operative notes. Other intraoperative and postoperative characteristics collected included the number of previous hernia repairs, size and location of the IH at operation (according to EHS classification), suture material, mesh fixation, operative length, concomitant procedures (whether another surgical procedure was performed at the same time as hernia repair), length of hospital stay, surgical site events (wound hematoma, seroma, infection or skin necrosis), mesh infection, mortality, and length of follow-up. "Needing surgery for the hematoma" was defined as the clinical situation (symptoms may include abdominal pain, tenderness, discomfort, and ultrasound image confirming the finding) of using the surgical intervention for the hematoma resolution.

Statistics

Statistical analysis was performed with the SPSS statistical software package (IBM SPSS for Windows, Version 21.0). Continuous variables were expressed as mean ± standard error of the mean (± SD) or range, and categorical variables were presented as *n* (%). Univariate analysis was performed using "*t*-Student" test to explore quantitative variables and "X^2" (or Fisher test) if they were dichotomous. Patients lost to follow-up and deceased patients were censored. Variables with associated p values < 0.05 were included in a multivariate analysis to obtain the OR and their 95% confidence

intervals (95% CI) for all risk factors associated with a higher likelihood of IH recurrence. Kaplan–Meier survivor analysis was used to assess time to hernia recurrence.

Results

Over the 7-year study period, 690 IH repairs (462 midline hernias, 228 lateral hernias) were performed at our Hospital. Of them, a total of 213 (30.8%) patients with midline IH were treated by RSR at a tertiary Hospital between June 2007 and January 2014. Seven patients who underwent laparoscopic approach and hernias not involving the midline were excluded. Patient demographics and preoperative factors of recurrence are described in Table 1. The median postoperative follow-up period was 57.6 months (range going from 46 to 75 months).

Among all the 213 patients, 15 cases of recurrence were reported (7.1%) after a median of 57.6 months of postoperative follow-up (range 46–75 months). 31% of recurrences were detected during the first year of follow-up, and by the end of the third year, 89% of recurrences had been reported. All in all, hernia recurrence appeared after a mean of 19.4 months, range going from 2 to 49 months. The most frequent location for hernia recurrence was suprapubic, 60% of all recurrences appeared in this area (9 patients), subxiphoid recurrence occurred in one-third of the cases (5 patients) and only one patient developed a hernia lateral to the mesh (6.6%).

Table 1 Preoperative predictors of recurrence after Rives-Stoppa technique (RSR)

Variables	No recurrence (%) ($N=198$)	Recurrence (%) ($N=15$)	Univariate *P*	OR (95% CI)	Multivariate *P*
Average age (SD)	51.6 (23.2)	51.3 (19.4)	0.135	1.21 (0.91–1.49)	0.121
Gender					
Male	101 (51)	7 (46.6)	0.252	2.04 (0.97–4.69)	0.172
Female	97 (49)	8 (53.4)			
Obesity (BMI > 30)					
Yes	60 (30.3)	5 (33.4)	0.092	1.54 (0.68–2.75)	0.193
No	138 (69.7)	10 (66.6)			
Smoking					
Yes	39 (19.7)	4 (26.6)	0.012	1.06 (0.38–2.67)	0.930
No	159 (20.3)	11 (73.4)			
Diabetes					
Yes	41 (20.7)	3 (20)	0.091	1.81 (0.96–3.46)	0.097
No	157 (79.3)	12 (80)			
COPD					
Yes	30 (15.1)	3 (20)	0.232	1.23 (0.46–2.23)	0.116
No	168 (84.9)	12 (80)			
Immunosuppression					
Yes	39 (19.7)	7 (46.6)	0.022	2.02 (1.16–3.95)	0.004
No	159 (20.3)	8 (53.4)			
Anticoagulant therapy					
Yes	36 (18.2)	3 (20)	0.105	1.11 (0.44–1.33)	0.198
No	162 (81.8)	12 (80)			
ASA scale					
I, II	98 (49.5)	8 (53.4)	0.320	0.57 (0.19–1.57)	0.089
III, IV	100 (50.5)	7 (46.6)			
Prosthetic previous repair					
Yes	150 (75.7)	10 (66.6)	0.490	1.07 (0.42–2.45)	0.321
No	48 (24.3)	5 (33.4)			
Average defect transverse diameter (SD)	9.3 (3.9)	11.9 (4.2)	0.001	1.11 (0.74–2.33)	0.088
Average defect longitudinal diameter (SD)	21.4 (7.9)	22 (8.6)	0.230	1.50 (0.65–2.99)	0.332

Univariate and multivariate analysis

SD standard deviation, *OR* odds ratio, *COPD* chronic obstructive pulmonary disease, *BMI* body mass index

At a median of 57.6 months (range 46–75 months) of postoperative follow-up, 15 cases of recurrence were reported (7.1%). Recurrences occurred after a mean period of 19.4 months (range 2–49 months); 31% occurred within the first year following repair and by the end of the third year, 89% were reported (Fig. 1). Hernia recurrence location was suprapubic in 9 patients (60%), subxiphoid in 5 patients (33.3%) and lateral to the prosthesis in 1 (6.6%).

All IH were located in the midline and mean transverse and longitudinal defect diameters were 10.1 ± 3.7 cm and 21.8 ± 8.9 cm, respectively. The most frequent type of hernia according to EHS classification was M3M4M5-W2. The preoperative risk factors for developing a ventral hernia after surgery that were statistically significant in the univariate analysis were "smoking" ($p = 0.012$) "steroid and immunosuppressive drugs use" ($p = 0.022$) and "average transverse defect diameter" ($p = 0.001$) (Table 1).

The operative and follow-up data related to hernia recurrence are shown in Table 2. Three patients were lost during the follow-up due to several causes, although they completed the first 2 years controls: two patients were missing (inability to locate by phone) and another one died by natural causes. Seven patients were readmitted during the period of study, due to postoperative surgical site occurrences (SSO), the most frequent causes of readmission were seroma and wound infection.

Complete fascial closure was possible in all the patients. Median operative time was 139 ± 38 min. In most of the procedures, the size of the mesh was 30×15 cm (84.5%); there were few patients with smaller defects, where a mesh of 20×15 cm could be placed in order to gain a minimum overlap of 5 cm. In 4 patients, intestinal resection was planned in a concomitant procedure with RSR (partial or complete colectomy in 2 cases, small bowel surgery in 2 patients).

SSO included seroma ($n = 25$; 11.7%), hematoma ($n = 12$; 5.6%), and wound infection ($n = 6$; 2.8%). Most patients with wound infection were treated with antibiotics and local wound care, only needing surgical debridement and negative pressure wound therapy in three cases. Seroma was treated with percutaneous puncture in 8 cases, and 5 patients with postoperative hematoma needed a re-operation to evacuate it. Other complications related to hernia repair included mesh infection ($n = 3$; 1.4%) that required re-operation with total or partial mesh excision in 2 patients. Some operative and postoperative factors associated to recurrence were identified in the univariate analysis such as "urgent repair" ($p = 0.002$), "development of a postoperative hematoma" ($p = 0.001$), and "needing surgery for the hematoma" ($p = 0.002$) (Table 2).

The average hospital length of stay was 6.9 days, with a range of 4–17 days. Twelve (80%) of the patients who experienced a recurrence underwent an additional repair, most experienced anterior component separation ($n = 8$) and some posterior component separation with transversus abdominis release (TAR) ($N = 4$). Three patients refused an additional

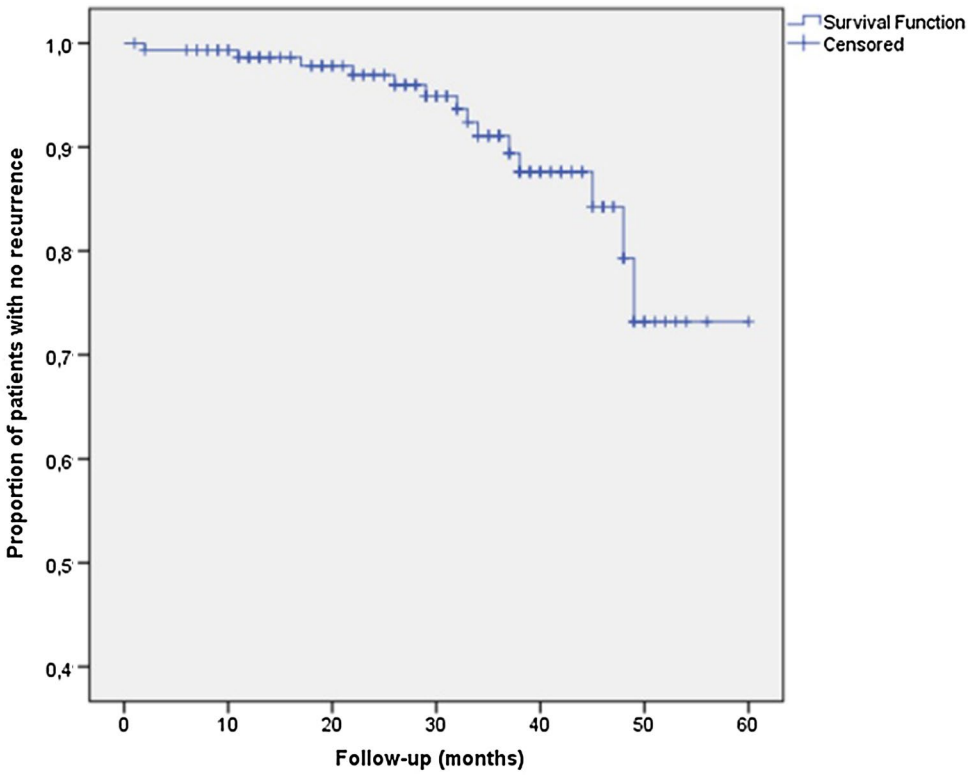

Fig. 1 Kaplan–Meier curve for hernia recurrence after RSR

Table 2 Intraoperative and postoperative predictors of recurrence after Rives-Stoppa technique (RSR)

Variables	No recurrence (%) ($N=198$)	Recurrence (%) ($N=15$)	Univariate *P*	OR (95% CI)	Multivariate *P*
Type of repair					
Urgent	20 (10.1)	4 (26.6)	0.002	3.06 (0.21–5.86)	0.076
Elective	178 (89.9)	11 (73.4)			
Prosthesis					
PPL	139 (64.7)	10 (66.6)	0.101	1.66 (0.32–2.89)	0.092
PVDF	69 (35.3)	5 (33.3)			
Type of mesh fixation					
Cyanoacrylate	40 (20.2)	3 (20)	0.098	1.99 (0.87–3.11)	0.343
Sutures	149 (79.8)	12 (80)			
Another concurrent intra-abdominal procedure					
Cholecystectomy	3 (1.4)	0	0.112	0.90 (0.31–1.99)	0.176
Nephrectomy	1 (0.4)	0	0.544	1.12 (0.89–1.32)	0.322
Abdominoplasty	2 (1)	0	0.611	1.32 (0.35–1.98)	0.123
Intestinal resection	4 (2)	0	0.543	1.81 (0.20–2.22)	0.688
Average surgical time (SD)	130 (39)	142 (41)	0.091	2.11 (0.89–4.32)	0.187
Postoperative complications					
Seroma	22 (11.1)	3 (20)	0.100	2.01 (0.55–3.89)	0.434
Hematoma	7 (3.5)	5 (33.3)	0.001	2.9 (1.55–4.10)	0.001
Infection	5 (2.5)	1 (6.6)	0.211	0.90 (0.31–1.99)	0.104
Wound necrosis	3 (1.4)	0	0.091	1.23 (0.55–2.35)	0.072
Intestinal fistula	1 (0.5)	0	0.334	1.41 (0.45–3.20)	0.122
Biofilm	3 (1.4)	0	0.322	0.69 (0.23–1.43)	0.190
Needing surgery to solve the hematoma	1 (8.3)	4 (26.6)	0.002	2.1 (1.21–3.29)	0.004
Average Hospital length of stay	7.1 (3.1)	6.8 (2.9)	0.101	1.21 (0.25–2.11)	0.434

Univariate and multivariate analysis

SD standard deviation, *OR* odds ratio, *PLP* polypropylene, *PVDF* polyvinylidene difluoride

Table 3 Treatment in patients with recurrence after Rives-Stoppa repair (RSR)

Treatment	Patients ($N=15$)
Posterior component separation (TAR) technique	4 (26.6)
Anterior component separation (ACS) repair	8 (53.3)
Refuse	3 (20.1)
Advanced age	
Absence of symptoms	

repair surgery due to advanced age or an absence of symptoms (Table 3).

On the multivariate analysis, "steroid or immunosuppressive drugs use" (OR 2.02; CI 1.16–3.95, $p=0.004$) and "development of postoperative hematoma" (OR 2.9; CI 1.55–4.10, $p=0.001$) and "needing surgery for the hematoma" (OR 2.1; CI 1.21–3.29, $p=0.004$) were predictors of recurrence after RSR. There was no difference in recurrence rate among obesity, smoking, COPD, diabetes, urgent repair versus elective reparation, type of mesh fixation, operative time, type of prosthesis, or concomitant procedures, even planned or unplanned enterotomies.

Discussion

RSR has been demonstrated to accomplish primary closure of the hernia defect, while maintaining the normal anatomy and physiology of the abdominal wall to solve large IH, where re-approximating the rectus muscles in the midline is difficult [8]. In fact, the main benefits of this technique are the low recurrence rate (0–8.5%), the protection of intraperitoneal organs from the mesh, and protection of the mesh in case of SSO, especially wound infection [6, 9].

According to the literature, recurrence rates for IH repair using retromuscular mesh placement vary greatly between studies [2–4, 10]. In our series, recurrence rate after RSR was 7.1%, which is consistent with previous studies. Recurrence occurred after a mean period of 19.4 months (range 2–49 months): 31% occurred within the first year and 89% occurred by the end of the third year. Nearly identical results

have been published by other surgical investigators [11, 12]. In addition, it is essential to consider the important differences between clinical and radiological recurrences, and the anticipated increase in recurrence rate with longer follow-up periods. Therefore, as our group advocates, at least a minimum of 5-year follow-up should be provided for every patient to prevent significant underestimation of recurrence rate [13]. Besides, regular clinical controls and a CT scan must be performed, to confirm the absence of recurrence at the end of the scheduled follow-up period.

Recurrence location is difficult to classify. Three patients with recurrence refused an additional surgical repair. During the surgical abdominal wall reconstruction for recurrence, especial care was put into correcting the inaccuracies, miscalculations and weaker spots that may have been the cause for recurrence. Thus, 9 cases relapsed right above the pubic bone (60%), 5 recurrences were subxiphoid (33.3%), and only one case was found to relapse lateral to the prosthesis (6.6%). According to our results, an important cause for recurrence may have been that the longitudinal mesh overlap was not sufficient, since most recurrences were observed at either the cranial or caudal edge of the mesh. The reason for not achieving adequate mesh overlap in the xiphoid or pubic region might be mesh shrinkage, added to the fact that the elected mesh may have not been large enough for the size of the hernia defect. According to literature, when the hernia defect includes M5, the mesh should largely overlap the defect, and the difficulty stands in fixing the lower part of the mesh [14].

Our study reports treatment with corticosteroids or immunosuppressive agents as a predictor for recurrence, which becomes relevant due to the significant and increasing incidence of IH repairs after kidney, pancreatic or hepatic transplantation [15]. Developing a hernia after abdominal organ transplantation is becoming an issue, as patients are placed on immunosuppressive medications postoperatively, which may increase the risk of IH formation due to an associated impairment in the wound healing process. In fact, as its effect becomes an overall reduction in the immune response, this medication may also facilitate the development of bacterial biofilm, an essential factor in resistance of microorganisms to antibacterial mechanisms [16].

Postoperative hematoma after RSR also represents a risk factor for recurrence, according to our results. Hematoma after AWHR is an infrequent complication that can cause significant patient discomfort and delayed postoperative recovery. In RSR, postoperative hematomas occur between 0.5 and 7% [2, 3, 5, 6]. An increasing risk of hematoma has been reported in patients who were on anticoagulant therapy, associated with cessation and resumption of anticoagulation after surgery. However, anticoagulant therapy was not relevant for recurrence in our study, since there were no significant differences about use of anticoagulant therapy in terms of recurrence (18.2% vs. 20%). Possible risk factors for postoperative hematoma after hernia repair may include hernia location, acenocumarol usage, hernia characteristics and heparin bridging [17]. In our multivariate analysis, needing surgical intervention to evacuate postoperative hematoma was also found to be an independent predictor of recurrence after RSR. These findings highlight the importance of meticulous and thoughtful dissection, particularly in patients undergoing anticoagulant therapy, as well as the need to remain vigilant of thorough hemostasis, especially in patients presenting with incarceration or urgent repair [18].

Eight patients who experienced recurrence underwent an anterior component separation (CST). This technique allows hernia sac reduction and primary fascial closure without tension by releasing the external abdominal oblique muscle to re-establish the rectus muscles to their original orientation. Hence, the advancement of the patients' vascularized myofascial tissue to close the midline results in covering the entire abdominal cavity by functional, muscular components, so the abdominal musculature provides dynamic support with its innervated tissue to redistribute the stress applied from intra-abdominal forces. Our group has reported excellent results using a modified CST during the last 9 years [19], so this technique was more often performed in cases of hernia recurrence. In 4 patients, transversus abdominis release (TAR) was performed with acceptable functional and esthetic results. This repair may in fact be one of the best approaches available since it avoids large skin flaps while allowing for significant medial advancement of all the components of the abdominal wall [20]. Currently, reports of AWHR using TAR yielded equivalent fascial closure rates as compared to conventional CST, indicating similar myofascial advancement with both techniques [21].

Possible risk factors should be preoperatively diminished in an effort to mitigate postoperative complications and possibilities of future recurrences. Although modifying immunosuppression treatment before hernia repair remains difficult, the surgeon should anticipate and perform intraoperative maneuvers to minimize the possibility of developing postoperative hematoma. Hence, a meticulous dissection might be essential, particularly in patients with history of previous hernia operations or with anticoagulant therapy, as well as the use of suction drains after repair and extraction under direct vision (to avoid rectus muscle damage while removing the drain). Our group also recommends the adequate closure of subcutaneous space with sutures or fibrin glue, avoiding dead spaces; and finally, the use of adjustable abdominal binder during the next 4–6 weeks after repair. Finally, selecting the suitable mesh size for every hernia defect is critical to accomplish ample overlap so as to reduce hernia relapse.

This study was not performed without limitations. Retrospective chart review is limited by the information placed

in the patients' medical history as well as the observer bias of the reviewers. According to our criteria, the follow-up period was sufficient; but we would like to remark that 3 patients did not complete the entire period, although they completed the two first years of controls, and no recurrence was detected during this period. Furthermore, it is also significant to notice the homogeneity of our outcomes, because of the fact that all the procedures were performed by five specialized hernia surgeons, decreasing errors due to lack of experience or different applications of the same technique.

In conclusion, RSR is an effective resource for managing large IH, especially in midline defects, with an acceptable recurrence rate. Using steroid or immunosuppressive drugs, developing a postoperative hematoma and needing surgical evacuation for hematoma were predictors of recurrence after this procedure.

Compliance with ethical standards

Disclosures Drs. Jose Bueno-Lledó, Antonio Torregrosa, Raquel Jiménez-Rosellón, Providencia Garcia, Santiago Bonafé, José Iserte have no conflicts of interest or financial ties to disclose.

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