



A multi-center study on recurrent inguinal hernias: assessment of surgeons' compliance to guideline-based repair and evaluation of short-term outcomes

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Received: 6 June 2020 / Accepted: 17 August 2020
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Abstract

Introduction As patients with recurrent inguinal hernia (RIH) are at a higher risk of perioperative complications, international guidelines have been developed to mitigate these risks by recommending the reverse approach for repair. We aim to study the characteristics of RIH, compliance to guidelines-based repair (GR) and determine factors influencing compliance to guidelines.

Methods A retrospective study of patients with RIH was carried out at two tertiary institutions in Singapore, over 10 years from January 2010 to 2020.

Results There were 16 patients with bilateral recurrences and 214 patients with unilateral recurrences. The characteristics of patients with non-guidelines-based repair (NGR) versus GR were similar, $p > 0.05$. GR was performed for 128 (52.1%) hernias as compared to NGR for 118 (47.9%) hernias. The open approach was more common in NGR than GR, 115/118 (89.8%) versus 58/128 (45.3%), $p < 0.001$. Forty ($n = 40$, 16.3%) RIH presented emergently, of which 37 underwent NGR while 3 underwent GR, $p < 0.0001$. More consultants were present during GR 103/128 (80.5%) as compared to NGR 78/118 (66.1%), $p = 0.018$. Emergency presentation of hernia recurrence, OR 7.74 (CI 6.11–9.20), $p = 0.005$, and open repair during the index repair were significantly associated with NGR, OR 6.63 (CI 4.42–8.84), $p = 0.01$. Median length of stay was shorter in the GR 1 day (IQR 1–2 days) versus 2 days (IQR 2–5 days) in the NGR group, $p = 0.02$.

Conclusion The compliance rate of GR for RIH is 52%. NGR for RIH had acceptable short-term outcomes. For elective presentation of RIH, GR should be encouraged given a shorter length of hospital stay.

Keywords Recurrent inguinal hernia; · Guideline-based repair · Laparoscopic hernia repair · Open hernia repair · Hernia recurrence

Introduction

A surgeon can do more for the community by operating on hernia cases and seeing that his recurrence rate is low than he can by operating on cases of malignant disease—Sir Cecil Wakely. An inguinal hernia is a common surgical condition with up to 15% recurrence rates [1, 2]. An expert

collaboration group, the HerniaSurge Group, consisting of the European Hernia Society (EHS), the International Endohernia Society (IEHS), and the European Association for Endoscopic Surgery (EAES), jointly developed the International Guidelines for Groin Hernia Management in 2014 [3] and recommended 'reverse' approach for recurrent inguinal hernia (RIH) repair. The reverse approach is based on the principle of performing repair through undisturbed tissue planes. If the index repair with mesh is by an anterior approach (open), a posterior approach (laparoscopic) is recommended for recurrence and vice versa.

RIH repair surgery is one of the most challenging tasks since scarring from index surgery makes tissue dissection precarious with a higher risk of injury to cord structures and neurovasculature in the groin. Also, recurrence is usually a function of muscular weakness and chronic elevation of

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intra-abdominal pressures. A surgeon needs to consider these issues during the repair. Patients with RIH are at a higher risk of perioperative complications, further recurrences, and chronic pain [4]. As such, guidelines have been introduced to mitigate these risks for RIH. However, clinical herniology is diverse, and there is no ‘one-size fits all’ approach. The experience and comfort level of surgeons influences the choice of repair for RIH. A recent study by Kockerling et al. showed that the compliance to guideline-based repair was only 38.5%, and non-guideline-based repairs had higher intraoperative complication rates, seroma formation, and re-recurrences [4]. Hitherto, there remains a paucity of data on this subject. Furthermore, an open approach can be completed under local or regional anesthesia, while the laparoscopic approach requires general anesthesia. Hence, patient comorbidity and fitness for anesthesia may influence compliance to guidelines. Therefore, this study aims to examine RIH and assess compliance to guidelines-based repair (GR) and determine factors influencing adherence to guidelines. Secondary aims include a comparison of short-term outcomes of RIH for patients who undergo GR versus non-guidelines-based repair (NGR).

Methods

A retrospective study of patients with RIH was carried out at two tertiary institutions, Tan Tock Seng and Khoo Teck Puat Hospital in Singapore, over 10 years from January 2010 to 2020. Inclusion criteria were all RIH that underwent both elective and emergency surgical repair during the study period. We excluded patients with RIH who did not undergo surgery. Data on baseline demographics, comorbidities, clinical presentation, hernia characteristics, type of surgical repair, and common postoperative complications were collected. Ethics approval by local institutional review board (IRB) was obtained. For patients with bilateral hernias, each hernia was considered independent, and one patient was assigned to have two hernias. We perform elective repairs as day surgery. We perform emergency surgery for obstructed or a strangulated hernia by open technique. Mesh repair is routinely used in the absence of contamination within the surgical field during the index operation or operation for recurrence. The choice of weight, porosity, and size of the mesh is at the discretion of the operating surgeon. Our units do not use biologic meshes for RIH surgery. The mesh is routinely sutured to the pubic tubercle and inguinal ligament by non-absorbable polypropylene suture during an open repair. Darning and pure tissue repair are performed at the discretion of the surgeon and reserved for patients with contamination. We offered laparoscopic repair since 2009 for patients with RIH or bilateral hernia and extended this for unilateral

repairs since 2011. Totally extraperitoneal (TEP) approach is the conventional technique for laparoscopic repair, and we routinely anchor mesh to the pubic bone and abdominal musculature with anchoring devices.

The demographic and clinical profile of patients with RIH was retrieved from electronic medical records. Operative records, discharge documents, and repeat admission diagnosis codes were accessed and recorded. Short-term outcomes collected include total length of hospital stay, postoperative complications such as hematoma, seroma, acute retention of urine, superficial wound infection and recurrences up to 6 months postoperatively. Hernias were classified into four categories based on their index surgery and subsequent surgery for recurrence (Fig. 1). Group 1: index surgery was via an open anterior approach, and repair of recurrence was via a laparoscopic posterior approach. Group 2: index surgery was via a laparoscopic posterior approach, and repair of recurrence was via an open anterior approach. Group 3: index surgery was via an open anterior approach, and repair of recurrence was via an open anterior approach. Group 4: index surgery was via a laparoscopic posterior approach, and repair of recurrence was via a laparoscopic posterior approach. Groups 1 and 2 were defined as guideline-based repair (GR), while Groups 3 and 4 were defined as non-guideline-based repair (NGR).

We compared patients who underwent GR with patients who underwent NGR. Statistical analysis was performed with SPSS version 22. Parametric data were reported in mean and standard deviation. Non-parametric data were reported in median and quartiles. Categorical variables were compared with the Chi-square test, and continuous variables were compared with the Student’s *t* test. Multiple logistic regression was used to analyze factors associated with NGR. A *p* value < 0.05 was considered statistically significant.

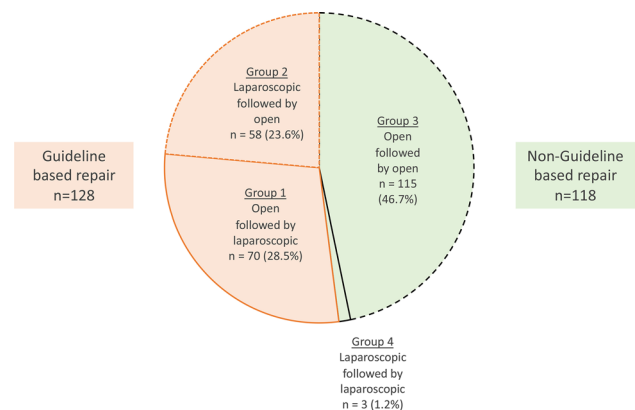


Fig. 1 Classification of hernias based on approach for index surgery and recurrence surgery

Results

Demographics

There were 16 patients with bilateral recurrences and 214 patients with unilateral recurrences. Of a total of 246 inguinal hernia recurrences, 218 were first-episode recurrences and 28 were second recurrences. The mean age of patients was 64.1 (64.1 ± 12.2) years at the time of index operation. The majority were males ($n = 183$, 79.6%) and smokers ($n = 26$, 11.3%). Median body mass index (BMI) was 23 (21–26.5) kg/m². Diabetes mellitus ($n = 28$, 12.2%), obstructive airway disease ($n = 17$, 7.4%), long-term steroid use ($n = 6$, 2.6%), ischemic heart disease ($n = 6$, 2.6%), stroke ($n = 3$, 1.3%) and end stage renal disease ($n = 2$, 0.87%) were the common comorbidities (Table 1).

Index inguinal hernia

At the index operation, the majority of hernia ($n = 176$, 71.5%) repairs were performed in an emergency setting.

A total of 185 (75.2%) hernias repairs were performed via an open approach, while 61 (24.8%) were performed by a laparoscopic approach. For open surgery, the majority were Lichtenstein mesh repair ($n = 170$, 91.9%), followed by primary repair with sutures ($n = 8$, 4.3%) and darning ($n = 7$, 3.8%). The primary repair and darning methods were performed due to the presence of contamination in emergency settings. The majority of laparoscopic repair during the index surgery was performed via TEP ($n = 55/61$, 90.2%), and the remainder ($n = 6/61$, 9.8%) were repaired by the transabdominal preperitoneal approach (TAPP). Intraoperatively, 204 (82.9%) were indirect hernias, while 42 (17.1%) were direct during the index operation. All cases were done under general anesthesia except for nine (3.7%) open repairs under regional anesthesia. These cases were performed by consultants ($n = 149$, 60.6%) and trainees ($n = 97$, 39.4%). All consultants were scrubbed in for laparoscopic cases. Most common postoperative complication from the index operation include seromas ($n = 86$, 35%), scrotal hematomas ($n = 2$, 0.8%), superficial surgical site infections ($n = 1$, 0.4%) and acute retention of urine ($n = 2$, 0.8%). The median length

Table 1 Univariate analysis comparing factors between NGR vs GR for recurrent hernias

Demographics/comorbidities	NGR, $n = 118$ (48%)	GR, $n = 128$ (52%)	<i>p</i> value
Age, mean (SD)	66.5 (58.2–74.5)	63 (56–72.3)	0.276
Male gender n (%)	88 (74.6)	95 (74.2)	0.533
Smoking n (%)	13 (11.0)	13 (10.2)	0.471
Diabetes mellitus n (%)	10 (8.5)	18 (14.1)	0.249
Pulmonary disease n (%)	8 (6.8)	9 (7.0)	0.888
Ischemic heart disease n (%)	5 (4.2)	1 (0.8)	0.212
End-stage renal disease n (%)	0 (0.0)	2 (1.6)	NA
Stroke n (%)	2 (1.7)	1 (0.8)	0.706
Long-term steroids n (%)	3 (2.5)	3 (2.3)	0.897
Body mass index (weight/height ²)	23.0 (21.6–25.3)	23.8 (20.8–27)	0.274
Index surgery	Open 115 (97.5)	Open 70 (54.7)	<0.001*
Open vs. laparoscopic repair n (%)	Laparoscopic 3 (2.5)	Laparoscopic 58 (45.3)	
Medium time from index surgery to recurrence of hernia (IQR)	32 (13–70)	18 (8–39)	0.048*
Emergency vs elective (surgery for recurrence) n (%)	Emergency 37 (31.4) Elective 81 (68.6)	Emergency 3 (2.3) Elective 125 (97.7)	<0.001
Indirect sac recurrences n (%)	62 (52.5)	64 (50.0)	0.158
Repair of recurrence –	Open 115 (97.5)	Open 58 (45.3)	<0.001*
Open vs laparoscopic n (%)	Laparoscopic 3 (2.5)	Laparoscopic 70 (54.7)	
Consultant present during repair of recurrence n (%)	78 (66.1)	103 (80.5)	0.018*
Short-term outcomes n (%)			
Hematomas	6 (5.1)	3 (2.3)	0.252
Acute retention of urine	7 (5.9)	2 (1.6)	0.068
Seromas	3 (2.5)	5 (3.9)	0.363
Length of hospital stay, days (median, IQR)	2 (IQR 2–5)	1 (IQR 1–2)	0.02*

NGR non-guideline-based repair, GR guideline-based repair,

* p value < 0.05, statistically significant

of stay after the index operation was 2 days (interquartile range, IQR 1–3 days).

Recurrent inguinal hernias (RIH)

The median time to recurrence was 22 (9.7–48) months. The majority of the recurrences presented electively ($n=206$, 83.7%). GR was performed in 128 (52.1%) patients as compared to 118 (47.9%) who underwent NGR (Fig. 1). The open approach was performed in 173 (70.3%) recurrent hernias. Of those with open repair, Lichtenstein repair was performed in 169 (97.7%) cases, darning in 3 (1.7%) and primary repair in 1 (0.6%) case(s), respectively. For laparoscopic repair ($n=73$, 29.7%), TEP repair was performed in 65 (89%) patients and TAPP in 8 (11%) patients. There were 126 (51.9%) indirect sac recurrences. Two hundred and one (82.7%) consultants were scrubbed in operation for repair of the recurrences. The most common postoperative complications include scrotal hematomas ($n=9$, 3.7%), acute retention of urine ($n=9$, 3.7%) and seromas ($n=8$, 3.3%). There were no superficial surgical site infections.

Non-guideline-based repair (NGR) versus guideline-based repair (GR)

Demographics and comorbidities of patients who had NGR as compared to GR were similar, $p > 0.05$ (Table 1). The open approach at the index surgery was more common in patients who subsequently underwent NGR 55/118 (46.6%) as compared to GR 36/128 (28.1%), respectively, $p = 0.001$. The median time to recurrence of hernia was longer in those who underwent NGR, 32 (13–70) months as compared to GR, 18 (8–39) months, $p = 0.048$. Laparoscopic repair for recurrences was more common in GR 70/128 (54.7%) than NGR 3/118 (2.5%), and the open approach was more common in NGR than GR, 115/118 (89.8%) versus 58/128 (45.3%), $p < 0.001$. Forty ($n=40$, 16.3%) RIH presented emergently, of which 37 underwent NGR, while 3 underwent GR, $p < 0.0001$. Indirect sac recurrences were comparable in both groups, $p = 0.158$. More consultants were present during GR 103/128 (80.5%) as compared to NGR 78/118 (66.1%), $p = 0.018$. On multivariate analysis (Table 2), emergency presentation of hernia recurrence, OR 7.74 (CI 6.11–9.20), $p = 0.005$, and open repair during the

index repair were significantly associated with NGR, OR 6.63 (CI 4.42–8.84), $p = 0.01$.

There were no differences in short-term postoperative complications between NGR versus GR. There were no recurrences or wound infections in both groups. There were 6/118 (5.1%) versus 3/128 (2.3%) of scrotal hematomas in the NGR vs GR, respectively ($p = 0.25$), 7/118 (5.9%) versus 2/128 (1.6%) with retention of urine ($p = 0.068$) and 3/118 (2.5%) versus 5/126 (4.0%) with seromas, respectively ($p = 0.36$). The median length of stay was significantly shorter in the GR group 1 day (IQR 1–2 days) versus 2 days (IQR 2–5 days) in the NGR group, $p = 0.02$.

Discussion

“No disease of the human body, belonging to the province of the surgeon, requires in its treatment a better combination of accurate anatomical knowledge with surgical skill than Hernia in all its varieties”—Sir Astley Paston Cooper. The repair of inguinal hernia is a basic, yet fascinating surgical procedure due to the armamentarium of approaches available. However, dealing with hernia recurrences remain a challenge to many. The majority of the patients in our study with recurrent inguinal hernias (RIH) had an open emergency repair for obstructed or strangulated hernia in the index operation (71.5%). Up to 8.9% of patients did not have mesh placed during index surgery due to contamination. In addition to these factors, the etiology for RIH is multifactorial, and other factors have been reported (Fig. 2). Although recurrence rates are significantly lower with mesh repair, wound infection in the presence of an implanted mesh often results in significant morbidity and the need for mesh explanation. The 2017 guidelines by the World Society of Emergency Surgery for complicated emergency abdominal hernias recommends primary repair in contaminated–dirty surgical fields. If the direct suture is not feasible due to large defect size use of mesh, one may consider the use of biologic mesh [5]. However, in reality, not every surgeon may be confident of the biologic mesh properties given that the consequences of an infected mesh are catastrophic even in the hands of expert hernia specialists. Until the results of high-quality randomized controlled trials are available, it remains likely that there will be a significant proportion of

Table 2 Multivariate analysis of factors associated with the non-guideline-based repair

Factors	Odds ratio (CI)	<i>p</i> value
Emergency presentation of recurrence	7.74 (6.11–9.20)	0.005*
Index surgery was open approach	6.63 (4.42–8.84)	0.010*
Absence of consultant during repair of recurrence	1.61 (0.11–1.80)	0.422
Time from index surgery to recurrence of hernia	0.429 (0.23–1.81)	0.980

* *p* value < 0.05, statistically significant

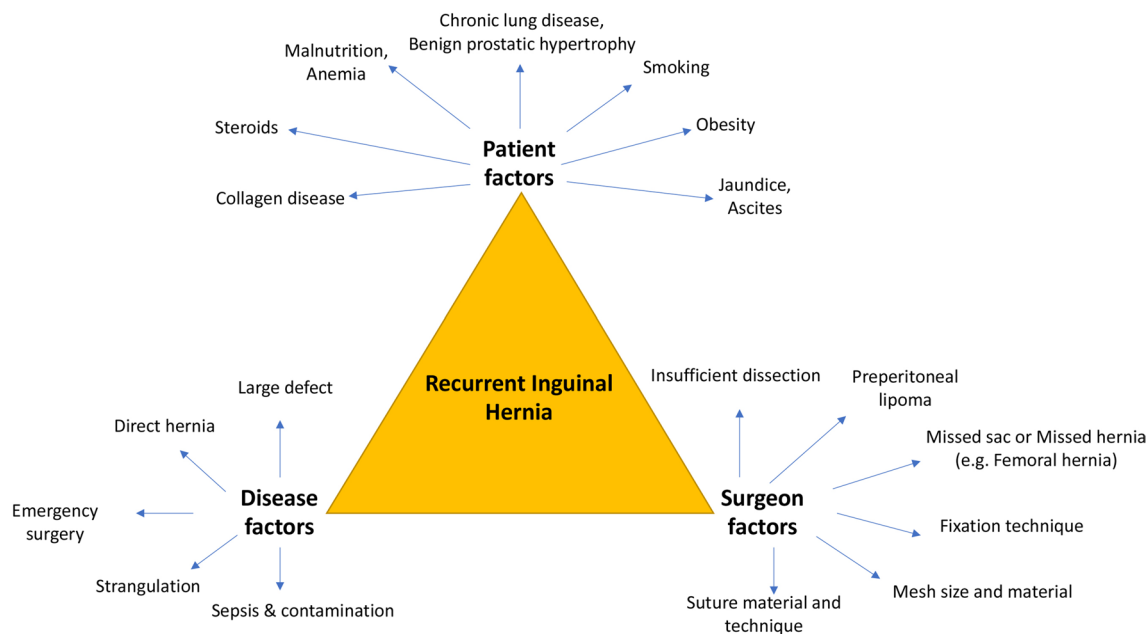


Fig. 2 Etiology and factors associated with recurrent inguinal hernia

surgeons who will prefer suture repair over mesh in the presence of a contaminated field, opting to repair any recurrence in a controlled elective setting than faced with a dreaded mesh complication.

Hernia recurrences in our study were mostly in patients aged 60 years and above with a median BMI of 23 kg/m² (overweight category based on the World Health Organization (WHO) Asian BMI cutoffs) [6]. As the majority of recurrences were found to be associated with an emergency repair in overweight patients, this group of patients may have benefitted from consultant supervision during their index surgeries. Also, up to 35% of patients with recurrences developed postoperative seromas from their index operation. Early postoperative hematomas or seromas may result in mesh lifting or folding away from tissues and may theoretically result in recurrence due to insufficient overlap of the defect. However, the current evidence for this is not conclusive [7, 8].

Furthermore, 39.3% of initial hernia repairs were performed by trainees without supervision by consultants. There is evidence to suggest that hernia repair performed by unsupervised junior trainees are associated with higher recurrence rates [9]. These emergency surgeries are often performed after office hours and without the supervision of consultants. Further, emergency surgeries are reserved for complications such as incarceration or strangulation, and this further adds to the technical difficulty. The attending consultant surgeon should exercise wisdom in deciding which trainee to entrust an emergency hernia repair depending

on the level of training and judgment of the trainee in the patient's best interest.

The compliance rate to GR for RIH is 52% in our study, comparatively higher than that reported by Kockerling et al. (38.5%) [4]. The majority (83.7%) of these recurrent hernias presented electively providing sufficient opportunity for GR. Comparing between the NGR and GR groups, there were more emergency presentations in the NGR group as compared to the GR group, which may suggest that in this group of patients where there is concern of bowel strangulation, we postulate that not all surgeons will be comfortable with laparoscopic bowel resection, hence electing to perform open surgery upfront regardless of index surgery. However, there are now proponents who suggest adopting a diagnostic laparoscopy approach to reduce and inspect the bowel contents, and proceeding with a TAPP inguinal hernia repair first while giving time and an opportunity for compromised bowel to recover, potentially avoiding laparotomy and bowel resection. Also, there were more trainees and fewer consultants scrubbed in the NGR group as compared to the GR group. Trainees tend to be involved in open emergency repair after office hours. On the other hand, elective laparoscopic repairs are mainly done by consultants or trainees under their direct supervision in both study institutes. Hence, the presence of a consultant who is well versed in laparoscopic repair may increase the likelihood of GR. The majority of the recurrences were within the first 2 years of the index operation. The median time to recurrence was longer in the NGR group than GR (32 vs. 18 months), but this

difference was not significant in multivariate analysis. Early recurrences (within 2 years) [10] are thought to be related to technical factors, while later recurrences are related to hernia biology, aging, or patient-related factors. Early recurrences may influence surgeons to choose the traditional safe open approach instead.

Although up to half of the RIH in our study were NGR, the short-term outcomes in terms of recurrence and postoperative complications were similar. In comparison, the rates of seromas are lower than those reported in the literature. This may be related to our routine application of external compression post-hernia repairs. Other methods described to reduce seroma rates include the application of fibrin sealant or insertion of a closed-suction drain in the preperitoneal space. However, these are not routinely performed in our institutes. Seromas were found to be thrice as common in NGR as compared to GR [3]. Hernias in the NGR group were postulated to be larger in size, where most repairs were performed by the open approach. Besides, the length of stay for GR was found to be significantly shorter than NGR. This could be attributed to the higher percentage of laparoscopic repair in the GR group (54.7%) as compared to the NGR (2.5%) group. Karthikesalingam et al. described that patients who underwent laparoscopic RIH repair had significantly lesser pain and shorter hospital stay as compared to open repairs [11]. Similarly, a local retrospective study of 144 laparoscopic TEP repairs of inguinal hernias found a low recurrence rate (1.4%), low postoperative pain (7.6%), and high satisfaction rates [12]. Other reported clinical advantages of laparoscopic repair include a faster return to daily activities and fewer superficial surgical site infections [13]. Although there were no re-recurrences in our study at 3 months, a longer duration of follow-up is required. Randomized trials of RIH with follow-up periods ranging from 2.5 to 5 years, reported re-recurrence rates of 8–19%, and 2–18% in patients who underwent laparoscopic and open repair, respectively [14]. To date, the recommendation remains unclear for RIH which have undergone repair via both anterior and posterior approach. Laparoscopic inguinal hernia repair is considered an advanced laparoscopic procedure with a steep learning curve. Experience with more than 250 laparoscopic herniorrhaphies is suggested to attain sufficient technical expertise for the repair of non-recurrent hernias [15]. However, this may not be sufficient for laparoscopic repair of recurrent hernias. Surgeons performing laparoscopic repair for RIH should be proficient with both TEP and TAPP techniques, as the risk of a peritoneal breach during a repeat TEP may be higher given the previous dissection of the preperitoneal plane.

The significant advantage that laparoscopic repair has over open repair is the ability to visualize and access all potential sites of hernia recurrences such as direct, indirect, and femoral recurrences. Femoral hernias have been

identified in some series and postulated as missed hernias from initial repair [16]. These recurrences might mimic inguinal hernias on clinical examination or imaging, resulting in inadequate repair of hernia recurrences if the open approach was employed without adequate dissection. A study by Heuvel et al. reported a 0% and 24% conversion rate for a repeated TAPP repair as compared to a repeated TEP repair for re-recurrence, with comparable complication rates to primary inguinal repair, suggesting that repeated TAPP is a feasible and safe procedure for RIH [17]. Further high-quality, large-scale studies are warranted to evaluate these outcomes.

Limitations

The inherent biases of a retrospective study exist. We do not have the total number of hernia surgeries over the study duration and hence unable to report exact recurrence rate. The surgeon's expertise and techniques are likely to change over the decade of study and could impact outcomes. Data such as the size of the hernia, type of meshes used, mesh sizes, and type of fixation methods are essential to evaluate for risk factors of recurrences. The reasoning for NGR could not be established clearly, and non-compliance to guidelines may be multifactorial due to a combination of surgeon's expertise, patient's preferences, comorbidity, and financial situation. Long-term follow-up is required to assess for recurrences in this group of patients, and our study does not address this issue. We believe that despite these limitations, the data add to the current evidence.

Conclusion

Index emergency repair in overweight patients is associated with recurrence. Half of the patients with RIH were treated by methods that are not per guidelines. Non-guideline-based repair seems safe and feasible for RIH with acceptable short-term outcomes. However, the length of hospital stay remains shorter for GR compared to NGR.

Author contributions All authors made substantial contributions to the conception or design of the work, and the acquisition, analysis and interpretation of data used in the work. All authors were involved in drafting the work and revised it critically for important intellectual content. All authors approved the version to be published and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding The authors have no funding to declare.

Availability of data and material Data collected were anonymized and would not be shared with the journal.

Compliance with ethical standards

Conflicts of interest Dr Goh, Dr Shelat, Dr Gong, Dr Chen, Dr Oh and Dr Chia declare that they have no conflict of interest.

Ethical approval The study protocol was approved by the National Health Group Domain Specific Review Boards (DSRB).

Human and animal rights This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this retrospective review, formal consent is not required.

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