Review Article

Ventral hernia and obesity: is there a consensus?

Raquel Maia[1,2,3], Hrishikesh Salgaonkar[1,2,3], Davide Lomanto[1,2,3], Asim Shabbir[1,2,3]

[1]Department of Upper GI Surgery, University Surgical Cluster, Singapore; [2]Minimal Invasive Surgery Centre, National University Hospital, Singapore; [3]Yong Loo Lin School of Medicine, Singapore

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Correspondence to: Raquel Maia. Advanced Surgical Training Centre, National University Hospital, Level 2, Kent Ridge Wing 2, 5 Lower Kent Ridge Road, 119074, Singapore. Email: raquelagripino@gmail.com.

Abstract: The prevalence of obesity worldwide is increasing. With it, obesity associated co-morbidities are also on the rise. On such complication concerning the abdominal wall is "hernia". Similarly, annually a high volume of abdominal laparotomies are performed worldwide, especially in young. Rising life expectancy, increasing prevalence of obesity and comorbidities like diabetes has ultimately led to an increasing prevalence of incisional hernias. When combined together, general surgeons and bariatric surgeons are faced with a new dilemma: an obese patient with an abdominal wall hernia. This review briefly summarizes the impact of obesity on the natural history of hernia, its associated complication, management strategies and options.

Keywords: Ventral hernia; incisional hernia; abdominal wall hernia; morbid obesity; mesh repair; bariatric surgery

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Introduction

Abdominal wall hernia repair is one of the commonest surgical procedures performed in surgical practice. For the purpose of the review, ventral hernia and incisional hernia will be referred to as abdominal wall hernia. Today surgical repair of abdominal wall hernia using a mesh is considered gold standard and universally accepted, except for very small defects. Over the years, surgeons and researchers have worked relentlessly to improve our understanding of hernia formation and its management. This has led to a reasonable standardisation of surgical technique. Our focus has now shifted towards improvement in mesh technology and modification of patient factors whereby we can reduce complications mainly recurrence.

Abdominal wall hernia by definition is a defect in the abdominal wall and may present at a variety of sites. In United States alone, 350,000 abdominal wall hernia repairs are performed annually (1). In United Kingdom, approximately 600,000 patients undergo laparotomy annually for some abdominal pathology. Subsequently, 10–20% of these will develop an incisional hernia, roughly amounting to 60,000 to 120,000 patients every year (2,3).

Obesity is defined as a body mass index (BMI) ≥30 kg/m^2 and morbid obesity—also termed class III obesity as BMI ≥40 kg/m^2. In Asian individuals, they are defined as BMI ≥27.5 and ≥37.5 kg/m^2 respectively. Obesity has gained epidemic proportions, and its incidence predicted to rise even further in young individuals. Even more concerning is that the prevalence of severe obesity is rising much exponentially when compared to moderate obesity (4). In United States alone, the prevalence of obesity is 35% and 40.4% in males and females respectively (5). Prevalence of obesity is also on the rise in Asians. A health survey from Singapore found the prevalence of obesity to be 24% in Malaysians, 16.9% in Indians and 7.9% in Chinese individuals (6). The longstanding consequence of severe obesity on abdominal wall is hernia formation and panniculus morbidus (7). Obesity itself is a risk factor for development of primary as well as incisional hernia (8).

Obese individuals are also more likely to have comorbidities, which significantly increase the peri-operative risks (5,9). Obese patients are at increased risk for re-admissions, blood transfusion, hospital acquired infections, wound healing issues and surgical site infections (SSIs) (10,11).

In obese patients, AWHR is challenging irrespective of the hernia site and defect size (9). In fact, AWHR in patients with high BMI are associated with wound complications rates of 48.7% and recurrence rates of 41.7% (12-14). Many obese patients will have a predominant "abdominal obesity" or a centralised distribution of subcutaneous fat. This is particularly challenging, and hence technical modifications are needed during surgery to limit wound related complications (15,16). There is paucity of data regarding comparative outcomes of AWHR in obese and non-obese patients. The limited data available, has significant heterogeneity within patient groups, the hernia defect size and location, follow up and the population (13,17-20). The large prevalence of hernia and its associated morbidity, the surgical costs, procedure related morbidity and loss of work hours adds a significant strain to any healthcare system, in addition to the impact on patient quality of life (21,22).

Hernia and obesity—the dilemma:

While dealing with obese patients with hernia, surgeons will frequently encounter these difficult scenarios:

- Patient referred for bariatric surgery and found to have a hernia. Here, patients' primary concern is the weight and its associated problems. Hernia may be asymptomatic or a secondary issue.
- Patient primarily referred for abdominal wall hernia but is a suitable candidate to consider bariatric surgery.

In both the scenarios, surgeons and the weight management team are faced with a common dilemma:

- Is bariatric surgery needed?
- Do we offer the patient concomitant weight loss and hernia repair surgery?
- Type of hernia repair?
- Whether to use mesh or not?
- If patient undergo only weight loss surgery—when is the optimal time to consider a hernia repair?
- If patient is unwilling for weight loss surgery, do we repair the hernia first?
- What is the optimal pre-operative weight loss before planning a hernia repair?
- What if the patient fails to lose weight?

Impact of obesity on hernia

Obesity is an independent risk factor for both primary and incisional hernia formation (8). Obesity also leads to an increased risk of perioperative complications and recurrence rates. Delayed wound healing, impaired pulmonary function, suboptimal control of comorbidities particularly diabetes and a higher intra-abdominal pressure are common reasons for hernia formation as well as recurrence (23). Mavros *et al.* reported higher mesh infection rates in obese patients following open ventral hernia repair (24).

In obese patients with hernia always expect the abdominal wall defect size to be larger than what is clinically apparent. Moreno-Egea *et al.* in their study demonstrated the correlation between obesity and hernia defect size. In their study, patients with BMI ≥30 kg/m^2, 35.1% of patients had a defect larger than 10 cm. However, in patients with defect size between 10–12 cm, 60% patients had a BMI ≥30 kg/m^2. When defect was more than 12 cm, 73.5% patients had ≥30 kg/m^2 (25). In the same study, they followed up patients of laparoscopic mesh repair of abdominal wall hernia. In patients with defect <10 cm the recurrence rate was 0.4%, defects between 10–12 cm it was 20% and 41.2% in patients with defect >12 cm. Similarly, on comparing the BMI between patients with recurrence and non-recurrence group, they reported a mean BMI of 36.3±6.3 and 29.5±5.9 kg/m^2 respectively. While 90% patients in the recurrence group had BMI ≥30 kg/m^2, it was only 37.9% in the non-recurrence group. This difference was found to be significant. Similarly, the mean defect size was 14.4 *vs.* 7.9 cm respectively in recurrence and non-recurrence group (P<0.001).

Operative approach for abdominal wall hernia repair in obese patients

The surgical approach for abdominal wall hernia depends upon multiple variables. Patient age, comorbidities, fitness for general anaesthesia, location of hernia, defect size, contents of hernia and loss of domain are some factors to be considered (*Figure 1*). The nature of surgery whether elective or emergency will also influence the decision-making process. In obese patients with hernia, panniculus morbidus, impaired pulmonary function, higher intra-abdominal pressure, skin infections, delayed wound healing and obesity associated comorbidity need to be considered.

Figure 1 Complex abdominal wall hernia in morbidly obese.

Laparoscopic repair

A meta-analysis of multiple randomised controlled trials, comparing laparoscopic abdominal wall hernia repair with open repair showed significant reduction in wound infection rates, reduced mesh removal rates with laparoscopy (26). They also reported that laparoscopic repair was safe and feasible with fewer complications, shorter hospital stays and operative times, although the post-operative pain and recurrence rates were similar to open repair. A Cochrane database review by Sauerland *et al.* reported significant lower local wound infection rates of 3.1% *vs.* 13.4% in laparoscopic group when compared to open repair (27). In the event of a local infection, they reported a significantly lower mesh removal rates in laparoscopic group 0.7% *vs.* open group 3.5%. Pierce *et al.* in their analysis of pooled data comparing 4,582 laparoscopic and 758 open abdominal wall hernia repairs (28). They reported a significantly higher wound complication rate of 16.8% in open technique, as compared to 3.8% in laparoscopic group. Laparoscopy by reducing the wound complication rates offers an added advantage in obese individuals who have a higher risk of wound related complications. A meta-analysis by Mavros *et al.* which analysed multiple cohort studies, demonstrated higher mesh infection rates after open ventral hernia repair in obese patients (24). Obese patients with incisional hernia, the surgeon should always expect a larger hernia defect as explained previously (25).

Novitsky *et al.* from US studied patients undergoing laparoscopic ventral hernia repair (LVHR). Total 163 obese patients who underwent LVHR over 5 years were evaluated. 8 patients in this group were super obese with a BMI ≥50 kg/m^2, with the highest BMI of 67 kg/m^2. They demonstrated an overall complication rate of 12.3%, with seroma being the most common. Mean hospital stay was 2.6 days and recurrence documented in 2 pts (5.5%). They concluded that LVHR in obese patients with complex hernias is safe and feasible with minimal peri-operative morbidity, low rate of conversion to laparotomy with a success rate of 94.5%. These results suggested an improved efficacy with LVHR when compared to historical outcomes among control patients subjected to an open repair (29). Similarly, Marx *et al.* demonstrated a recurrence rate of 3.8% at a mean follow up of 18 months in patients with BMI >35 kg/m^2 (30). In another study, Raftopoulos *et al.* followed up a heterogeneous group of 27 LVHR patients with a mean BMI of 46.9 kg/m^2 (31). The patients had a wide variety of case mix from primary, incisional, recurrent hernia as well as patients subjected to concomitant laparoscopic Roux-en-Y gastric bypass (LYRGB) and hernia repair. An intra-peritoneal mesh was used in all cases and fixed to the abdominal wall with transfascial sutures and circumferential tackers. A 4 cm overlap was achieved in all cases. Incidence of 30-day complications was 25.9% which included wound infection, pneumonia, small bowel obstruction, bladder injury. Recurrence rate was 18.5% at a mean follow up of 15 months.

The degree of obesity has a significant effect on the recurrence rate. Bower *et al.* in their study of 100 consecutive LVHR demonstrated 73% complications in patients with BMI >30 kg/m^2. All the recurrences were seen in obese patients only (32). Similarly, another study demonstrated a recurrence rate of 2.9% in normal BMI patients *vs.* 8.3% in those with BMI ≥40 kg/m^2 (16). Both these studies reported a shorter time for hernia recurrence when BMI was high.

Open repair

A National database review of inpatients and discharge records from US investigated the outcomes of LVHR with open repair in 47,000 obese patients (33). They concluded that LVHR was associated with shorter hospital stay, reduced hospitalisation cost, lesser wound complications, pulmonary complications, unintentional injury to viscera.

Krpata *et al.* reported a series of open retro-muscular incisional hernia repair with 63% patients having a BMI >30 kg/m^2 (34). At a mean follow up of 17 months, they reported an overall wound complication rate of 16% and recurrence rate of 5%. In 2008, Moore *et al.* in their series of open retro-muscular hernia repair, documented a

recurrence rate of 5.5% and wound complications in 18.8% patients. The mean follow-up was 50 months (35). In another series of 131 open umbilical hernia repair, patients with normal BMI had a recurrence rate of 5% *vs.* 18% in patients with BMI >25 kg/m^2 at 32 months mean follow-up (36).

Though laparoscopy may be preferred in obese, certain scenarios may warrant a surgeon to consider open mesh repair. Emergency surgery for hernia related complications, very large defects with need for component separation techniques, loss of domain and the need for resection of panniculus are few scenarios, although with advanced skills and experience laparoscopy may still be attempted on a case to case basis.

Incisional hernia repair with resection of panniculus

A commonly performed procedure during open hernia repair, panniculectomy may be needed to improve cosmesis, remove redundant and dystrophic skin or hernia sac. Excising the panniculus may also be needed to remove the pendulous effect on the incision. Panniculectomy can be challenging in severely obese patients. In their series of 10 patients with morbid obesity subjected to hernia repair and panniculectomy, Okusanya *et al.* reported a recurrence rate of 10% and a 40% overall wound complication rate at mean follow-up of 12 months (37). Warren *et al.* reviewed patients subjected to open incisional hernia repair with or without panniculectomy. In both the groups, mean BMI was 34.3 kg/m^2. Both groups had similar wound infection rates and hernia recurrence rate, suggesting that addition of panniculectomy did not worsen the wound related complications (38).

In a randomised controlled trial, Moreno-Egea *et al.* compared incisional hernia repair patients with or without abdominoplasty. Although the operative times were longer in the abdominoplasty group, no differences were found in early and delayed morbidity. In fact, patients who underwent hernia repair and a concomitant abdominoplasty, reported improved quality of life scores (39).

Concomitant laparoscopic hernia repair and bariatric or metabolic surgery

When surgeons are confronted with an obese patient with abdominal wall hernia, the dilemma faced is—what do we treat first? Obesity, hernia or both. The challenge may be compounded if the patient has undergone a bariatric surgery with significant weight regain and also developed a hernia. Due to paucity of data in literature, we lack a consensus of the best way to manage these patients. Most surgeons or specialised centres will develop departmental protocols or customized approach based on hernia symptoms and characteristics, patients weight loss goals, BMI and associated comorbidities (40). Depending upon surgeon experience and if hernia is suitable for laparoscopic repair, bariatric surgery and concomitant hernia repair may be attempted laparoscopically.

Eid *et al.* was the first to report a series of 85 patients with abdominal wall hernia and planned for LRYGB (41). Following LRYGB, 55 patients underwent primary suture repair, biological mesh was used in 12 and in 14 patients, hernia repair was deferred. All patients were followed up for minimum 6 months. They reported a recurrence rate of 22% in primary suture repair group, none in mesh repair group during a mean follow up of 26 months. Out of the 14 patients in whom hernia repair was deferred, 38% developed intestinal obstruction due to hernia incarceration. Based on the findings, they concluded that mesh repair is preferable in obese patients with hernia and deferring hernia repair may lead to hernia related complications.

Our prime concern while planning concomitant hernia repair and bariatric surgery is the fear of mesh contamination, though a number of retrospective case series have demonstrated safety of mesh implantation during stapled bariatric surgery. In a series, Datta *et al.* repaired 26 abdominal wall hernia identified during LRYGB and repaired with a polypropylene mesh. They did not report any mesh infections (42). Similarly, Schuster *et al.* did not report any mesh infections in patients subjected to combined LRYGB and ventral hernia repair with polyester or polypropylene mesh (43). Chan *et al.* in their series of 45 patients subjected to simultaneous laparoscopic bariatric surgery and ventral hernia repair with polypropylene or polytetrafluoroethylene mesh (44). They reported 2 patients with mesh infection, both managed conservatively without need to explant mesh. Similar results and outcomes were reported by other studies, documenting safety of implantation of mesh simultaneously with wide variety of bariatric or metabolic surgery (45,46). In one study, Sharma *et al.* followed up 159 patients who had undergone combined bariatric surgery and ventral hernia repair (47). Out of 159, 44 patients underwent mesh repair with biological or synthetic mesh and 115 offered primary suture repair. They reported wound infection in 9 patients, no mesh infections and 3 patients with recurrence. They suggested that primary suture repair if feasible, may be

acceptable in selected cases during bariatric surgery.

In 2015, Spaniolas *et al.* reviewed 17,000 LYRGB and sleeve gastrectomy patients from the National Surgical Quality Improvement Program (NSQIP). In these, 503 patients were subjected to concomitant ventral hernia repair. While these patients had a slightly higher odds ratio of SSI, no significant differences were found in the 30-day morbidity and mortality rates (48). In the absence of any randomised trials or long-term prospective studies, it is very difficult to reach any definitive conclusion while managing these complex groups of patients.

Bariatric surgery followed by hernia repair at a later date

An upfront bariatric surgery for weight loss as a first stage surgery, followed by hernia repair at a later date although sounds feasible, but may not be practical clinically. The risks associated with not addressing the hernia at the time of bariatric surgery are documented (41). Also, convincing a patient who has primarily come for a non-bariatric surgery, to consider weight loss surgery as first stage, may not be acceptable to the patient. Patient counselling with regards to additional costs of bariatric surgery and its associated morbidity and mortality are paramount. In the 18 patients reported by Hidalgo *et al.* who were subjected to sleeve gastrectomy prior to a non-bariatric procedure, only 1 had an abdominal wall hernia (49). The mean BMI reduced from 45 to 36 kg/m^2, with minimal morbidity. Similarly, Newcomb *et al.* in his retrospective review of 27 patients who were offered gastric bypass as a first stage surgery prior to hernia repair. Twenty-two patients underwent open gastric bypass and 5 LRYGB. They documented a mean BMI reduction from 51 to 33 kg/m^2 over an average period of 1.3 years. Only one patient needed emergency surgery while waiting for elective hernia repair (50). Further randomised trials incorporating this strategy are needed before deriving any conclusions.

Other weight loss modalities before elective hernia repair

Though weight loss is desirable in obese patients prior to elective hernia repair, not all patients may be suitable candidates to offer weight loss surgery either concomitant or as a first stage. Patients with large defect hernia, incarcerated hernias with bowel as contents, loss of domain, extensive bowel adhesions, overlying skin issues e.g., ulceration, fungal infections etc., recurrent hernias with previous mesh are complex scenarios, while some patients may not be keen to consider bariatric surgery. Hence in order to achieve weight loss possible management options are:

- Medically supervised low-calorie diets;
- Pharmacotherapy;
- Intra-gastric balloon therapy.

The success rates of any such strategy are yet to be defined. Patient compliance is a major deterrent. Yet in patients who are unfit or unwilling for weight loss surgery, it may be worthwhile attempting a weight loss with one of the above non-surgical modalities.

Guidelines on obesity and abdominal wall hernia management

The International Endo-hernia Society Guidelines (IEHS) (51) recommended that:

- Laparoscopy should be the preferred approach for managing ventral and incisional hernia in obese patients due to lower wound infection and complication rates.
- In obese patients defect size is significantly larger.
- In obese patients with defect larger than 8–10 cm, use more overlap, greater mesh fixation and defect closure.

Hence in patients with BMI >30 kg/m^2 particularly those with defects more than 8–10 cm anticipate larger defect and possible higher recurrence rates. As surgeons we need to make technical modifications like more extensive overlap of the defect with mesh, stronger mesh fixation and defect closure.

Similarly, the European Association for Endoscopic Surgery (EAES) and European Hernia Society (EHS) collaboration guidelines on ventral and incisional hernias stated that laparoscopic repair offers an acceptable alternative to open repair and is recommended in obese patients with ventral and incisional hernias by virtue of shorter hospital stay and reduced wound complications (52).

Recently, the American Society for Metabolic and Bariatric Surgery and the American Hernia Society consensus guideline on bariatric surgery and hernia surgery recommended that (53):

- Obesity is a risk factor for development of primary as well as incisional hernia;
- Abdominal wall hernia in obese are more likely to present with complications e.g., obstruction, strangulation;
- Obesity is risk factor for hernia recurrence as well as

post-operative complications;
- ❖ In severely obese patients with hernia amenable to laparoscopic repair, concurrent hernia repair and bariatric surgery may be safe with good short-term outcomes;
- ❖ There is lack of evidence, with regards to the safety of use of mesh in the setting of combined bariatric surgery and hernia repair;
- ❖ Weight loss prior to hernia repair in obese is desirable and will improve outcomes.

Conclusions

Abdominal wall hernia is commonly associated with obesity. Laparoscopic repair is preferred over open repair in obese patients. Similarly, mesh repair is better than primary repair in obese patients. There is insufficient evidence to conclude the best management strategy for obese patients with abdominal wall hernia who are suitable candidates for bariatric surgery. While weight loss prior to hernia repair is desirable and known to improve outcomes, there is paucity of data to conclude the best timing for hernia repair in patients subjected to bariatric surgery. Use of prosthesis during bariatric surgery or deferring a hernia repair carries its own set of complications. In the authors' opinion, until further randomised control trials can be performed, an individualised case approach based upon patient symptoms, hernia characteristics, type of bariatric surgery and patient preferences needs to be considered.

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