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Internal hernias after bariatric surgery and their risk factors: a systematic review

Hernias Internas posteriores a cirugía bariátrica y sus factores de riesgo: revisión sistemática

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Abstract

Las hernias internas posteriores a cirugía bariátrica constituyen complicaciones graves que pueden desencadenar un cuadro de abdomen agudo bariátrico. El objetivo de esta investigación fue identificar los factores de riesgo asociados a su desarrollo. Se realizó una revisión sistemática siguiendo la declaración PRISMA 2020, con artículos obtenidos de MEDLINE, Embase, CENTRAL y Web of Science. La pregunta de investigación planteada fue: ¿Qué factores influyen en la aparición de hernias internas tras una cirugía bariátrica? Se incluyeron ensayos clínicos aleatorizados, estudios observacionales y metaanálisis relacionados con el tema. Los resultados evidencian que el cierre de los defectos mesentéricos reduce de manera significativa la incidencia de hernia interna y obstrucción intestinal hasta 10 años después de la intervención, en comparación con la ausencia de cierre. Asimismo, se observó un mayor riesgo de hernia interna en pacientes fumadores. La hernia de Petersen estrangulada durante el embarazo se reporta con frecuencia, mientras que la hernia de hiato posterior a cirugía bariátrica se presenta con mayor prevalencia tras la gastrectomía en manga (6 %), seguida del bypass gástrico de Roux-en-Y (2 %) y del bypass gástrico con anastomosis (1 %). En la práctica clínica, se reconocen otros factores de riesgo adicionales para el desarrollo de hernias internas y sus complicaciones, tales como bridas, adherencias, estenosis y bezoares.

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Resumen

Internal hernias after bariatric surgery are serious complications that can trigger acute bariatric abdomen. The objective of this research was to identify the risk factors associated with its development. A systematic review was carried out following the PRISMA 2020 statement, with articles obtained from MEDLINE, Embase, CENTRAL, and Web of Science. The research question posed was: What factors influence the appearance of internal hernias after bariatric surgery? We included randomised clinical trials, observational studies and meta-analyses related to the topic. The results show that the closure of mesenteric defects significantly reduces the incidence of internal hernia and intestinal obstruction up to 10 years after the intervention, compared to the

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absence of closure. An increased risk of internal hernia was also observed in smoking patients. Strangulated Petersen hernia during pregnancy is frequently reported, while hiatal hernia after bariatric surgery occurs most prevalently after sleeve gastrectomy (6 %), followed by Roux-en-Y gastric bypass (2 %) and gastric bypass with anastomosis (1 %). In clinical practice, additional risk factors for the development of internal hernias and their complications are recognized, such as flanges, adhesions, stenosis, and bezoars.

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Introduction

Internal hernias after bariatric surgery represent the most frequent cause of acute bariatric abdomen and are highly serious complications. Its recognition is essential, given that there are still aspects that have been little explored, such as the risk factors associated with its development. Prevention, diagnosis and treatment are of great relevance, since these are frequent complications and of variable presentation[1].

In the United States, gastric sleeve was the most performed procedure in 2022, with a prevalence of 57 %, followed by Roux-en-Y gastric bypass (RYGB) 22.2 % and revision bariatric surgery 11 %. Other procedures included biliopancreatic diversion with duodenal switch (BPD-DS), single anastomosis sleeve duodenoileostomy (SADI), gastric bypass of an anastomosis (OAGB), and endoscopic sleeve gastroplasty (ESG)[2]. The incidence of internal hernias after laparoscopic Roux-en-Y gastric bypass (LRYGB) reached 4.8 %, with a cumulative incidence of 12 % at 13 years (95 % CI: 11.30-12.70 %)[3]. 59 % of cases of acute obstructive abdomen in bariatric surgery are related to Petersen's hernia, the overall incidence of which varies between 0.2-9 % according to different studies[4-7]. The anatomical spaces generated after surgery include the mesenteric space in the jejunum-jejunostomy, the Petersen space between the transverse mesocolon and the mesentery of the Roux-en-Y branch, and the defect in the transverse mesocolon in patients with retrocolic branch[8,9]. Consequently, four types of internal hernias are described: Petersen's hernia, mesenteric defect hernia[10,11], paradoxical internal hernia at Brolin's anti-obstruction point, and post-bariatric hiatal hernia[12,13], whose presentation can be early or late.

Smoking is a relevant risk factor, associated with a greater need for reoperation and complications such as anastomotic leaks, although its direct relationship with internal hernias still requires more evidence[14-17]. Current guidelines recommend discontinuing the habit at least six months before surgery, since smoking during the previous year increases mortality[18]. Perioperative cessation programs, such as that of the Canadian Cancer Society, have shown its efficacy, with 28.6 % of patients quitting smoking compared to 11 % of controls (RR 2.6; 95 % CI: 1.2-5.5; p = 0.008)[19].

Pregnancy after bariatric surgery also increases the risk of internal hernias, especially in the third trimester, due to increased intra-abdominal pressure[20]. Clinical manifestations include signs of intestinal obstruction, with an incidence of 23 % in patients with open defects versus 12 % in those with closed defects, with a higher frequency observed in the group without closure after five years of follow-up (p = 0.014)[21]. Other less common presentations include recurrent gastrointestinal bleeding due to bleeding

ectopic varices[22].

The imaging diagnosis is based on plain and contrasted abdominal tomography; the sign of the swirl in the mesenteric vessels has a sensitivity of 66.7 %. The highest specificity (99.7 %) corresponds to the visualization of the small intestine behind the superior mesenteric artery, the absence of which rules out Petersen's hernia[23].

Surgical treatment includes intestinal repositioning and, in cases of necrosis, resection with eventual small bowel transplantation[24,25], non-absorbable sutures, staples or clips are used to close defects[26]. Primary closure is associated with a significant reduction in the incidence of internal hernias (15.5 % without closure vs. 6.5 % with five-year closure)[27], although recurrences have been reported even after primary closure[28].

The scientific problem lies in the fact that, despite the advances in laparoscopic and robotic bariatric surgery in the management of obesity and type 2 diabetes mellitus, internal hernias continue to be a frequent complication, acute or chronic, whose risk factors remain insufficiently characterized.

The objective was to determine the risk factors associated with the development of internal hernias after bariatric surgery.

Material and methods

A systematic review was carried out following the PRISMA 2020 statement, using a PRISMA flowchart (Figure 1), the identification, inclusion and exclusion of articles obtained from the MEDLINE, Embase, CENTRAL and Web of Science databases was carried out. The research question asked was: *What factors influence the appearance of internal hernias after bariatric surgery?* We included randomised clinical trials, non-randomised studies and meta-analyses that evaluated factors associated with the development of internal hernias.

Eligibility criteria. Inclusion and exclusion criteria were established to form a population of patients with internal hernias after bariatric surgery.

Inclusion: i) studies on advances in the management of internal hernias after bariatric surgery; (ii) articles describing the types of internal hernias; iii) research on associated risk factors.

Exclusion: (i) studies on hernias not related to bariatric surgery; ii) articles that do not address the characterization of internal hernias in this context; (iii) studies with unavailable results; (iv) ongoing research without published data.

Sources of information. Articles published between 2005 and 2025 were consulted in the bases mentioned for the important development of bariatric surgery during this period of time, focused on risk factors associated with post-bariatric internal hernias.

Search strategy. Boolean operators and specific terms were applied: *internal hernias in bariatric surgery*, *Brolin hernia*, *management of internal hernias after bariatric surgery*, *bariatric smoking*, *complications of bariatric smoking*.

Selection of studies. Articles that met the inclusion criteria were reviewed and selected jointly by the authors.

Data extraction. Manual stratification was used according to date of publication, type of study and intervention. The results were analysed in working groups to minimize selection biases.

Data and materials. Sample design, instruments, software, protocols, and questionnaires are available from the corresponding author. The primary outcome was the identification of risk factors associated with internal hernias after bariatric surgery.

Main variable. Presence of internal hernias of any type as a postoperative complication.

Risk of bias assessment. The RoB 2 tool was applied for individual studies.

Measures of effect. Risk Ratio (RR), Odds Ratio (OR), Relative Risk (RR), Confidence Interval (CI), Incidence Rate Ratio (IRR), Absolute Risk (AR) and *p-value* were calculated. Patients with and without internal hernias were compared in relation to quality of life and complications.

Synthesis of results. The included studies were analyzed using descriptive statistics, in an Excel table, prioritizing randomized clinical trials to strengthen methodological rigor.

Publication bias. A critical analysis of the evidence was performed, considering only randomised controlled trials to reduce randomization bias.

Certainty of evidence. The GRADE methodology was applied to rate the robustness of the recommendations. The evidence was high regarding the closure of mesenteric defects, low to intermediate in relation to smoking and pregnancy as risk factors.

Results

Selection of studies. We selected 3 randomized studies and a meta-analysis on the research topic regarding defect closure, 4 observational case studies, case series, and reviews on the topic due to the limited randomized evidence that evaluated the population, intervention, comparison, and frequent outcomes associated with PICO internal hernias.

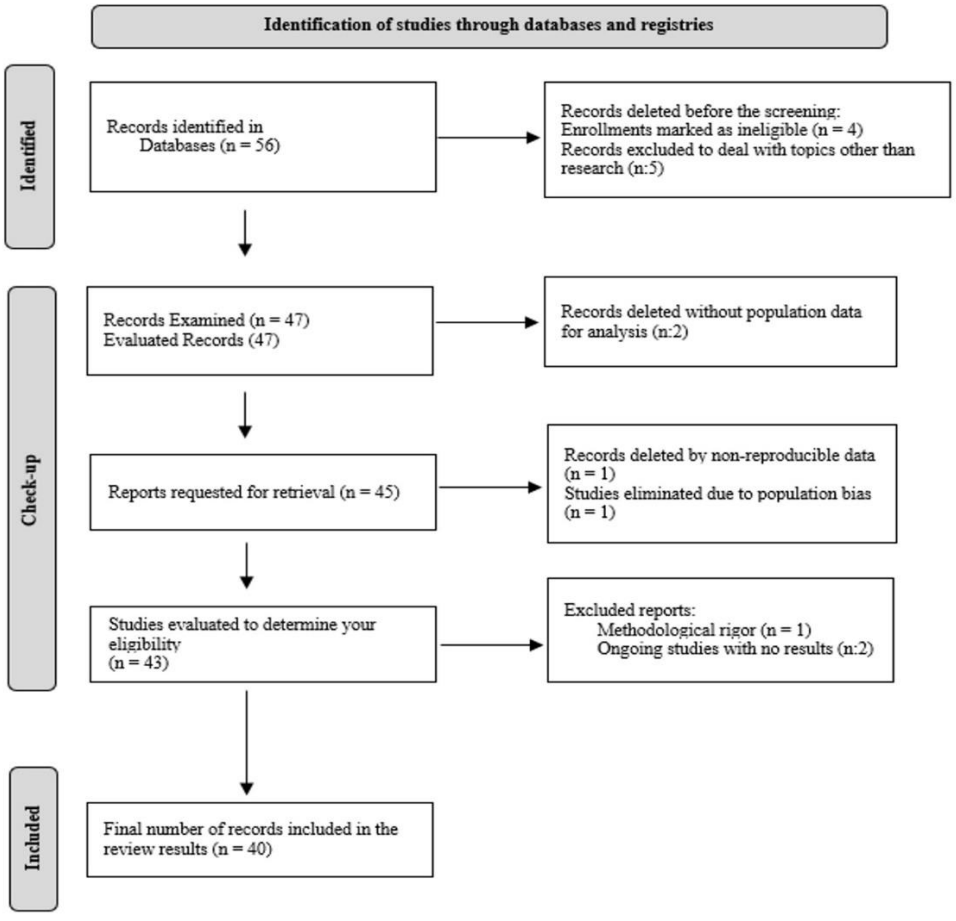


Figure 1 Flow chart of the research according to the PRISMA 2020 statement. 40 published records on the research topic included at the end were obtained. All records that did not meet the inclusion criteria were excluded

Study characteristics. We included observational and randomized studies based on the evidence available at the time of the research.

Risk of bias of individual studies. The main bias was dependent on statistical heterogeneity because few randomized studies were used, which adds a level of selection bias; In the review, a randomized analysis of the available results was performed, including observational studies, because some are rare pathologies.

Table 1 Important risk factors for the development of internal hernias after bariatric surgery

Author	Intervention	Population	Results	Level of evidence
Stenberg et al.[29]	Closure of the mesenteric defect compared to non-closure and its effect on quality of life.	Laparoscopic gastric bypass with or without closure of mesenteric defects.	Patients with or without closure of mesenteric defects, with no significant difference in the relationship with intestinal obstruction (open defects: 22 ± 24.9 versus closed defects: 20 ± 23.8; p = 0.093). Current or former smokers who did not report bariatric surgery-related quality of life were a significant group (35.9 % vs. 30.3 %, p = 0.008).	RCTs
Stenberg et al.[30]	Long-term efficacy of closure of mesenteric defects in laparoscopic gastric bypass surgery.	Internal hernias with obstruction of the small intestine for LRYGB bariatric surgery.	185 patients without closure (10-year cumulative incidence, 14.9 %; 95 % CI, 13.0-16.9 %) and in 98 patients with closure (10-year cumulative incidence, 7.8 %; 95% CI, 6.4-9.4 %).	RCTs
Murakami et al.[31]	Closure of mesenteric defects for the prevention of internal hernias after bariatric surgery.	Internal hernias after Roux-en-Y gastric bypass in bariatric surgery.	Closure of defects during RYGB may reduce the incidence of internal hernias with bowel obstruction within 10 years compared to no closure (RR 0.32, 95 % CI 0.24-0.42; p < 0.00001).	Meta-analysis
Bossen et al.[32]	Internal hernias complication of laparoscopic Roux-en-Y gastric bypass (BGYR-L).	Smoking as a risk factor for internal hernias after gastric bypass surgery.	The risk of internal hernias was significantly higher among patients who smoked before surgery (hazard ratio [HR]: 2.4; 95 % CI: 1.3-4.5; p = 0.005). Smoking doubled the risk of posterior internal hernias.	RCTs
Calderón et al.[33]	Petersen's hernia in pregnancy.	Pregnancy as a risk factor for internal hernias. The gravid uterus elevates the intestine, increasing intra-abdominal pressure.	A strangulated Petersen hernia diagnosed by laparoscopy required resection, gastric reservoir closure, intestinal anastomosis and Stamm's gastrostomy plus laparotomy closure of the space after exploratory cesarean section.	Case Presentation
Petrucciani et al.[34]	50 cases of acute bariatric abdomen during pregnancy.	Internal hernias in 26 cases of intestinal obstruction after bariatric surgery.	Internal hernias were >50 %, the most frequent cause of acute obstructive abdomen.	Case Series
Dave et al.[35]	59 patients with internal hernias during pregnancy after RYGB.	Internal hernias in pregnant women with Roux-en-Y gastric bypass.	The laparoscopic approach represented 92.16 % and open 7.84 %, the antecolic orientation of the Roux-en-Y branch represented 61.91 % and the retrocolic placement was 38.09 %, the results showed previous closure of the defects in 8.47 %.	Systematic review
Bonouvrie et al.[36]	A 26-year-old female, 30 + 3 weeks pregnant, was referred to a tertiary referral center for acute abdominal pain and vomiting with suspected internal hernias.	Internal hernias during pregnancy after Roux-en-Y band gastric bypass.	Internal herniation of the food loop through the adjustable gastric band ring during pregnancy is an exceptional complication. For treatment, diagnostic laparoscopy was performed, conversion to laparotomy, the hernia was reduced by removing the gastric band after excising the silicone ring.	Case Presentation

Results of individual studies. As it is a current research topic, there were non-randomized observational studies, meta-analyses, systematic reviews, case presentations; The most reported risk factors for the development of internal hernias after bariatric surgery were chosen, finding evidence of variable level due to the lack of more randomized studies on current issues of internal hernias during pregnancy, a large number of observational studies were observed that associate it as an increasing risk factor Table 1.
Description This review describes the risk factors associated with internal hernias and their level of evidence, there are studies of high level of evidence regarding the closure of defects as a predisposing risk factor for internal hernias after bariatric surgery, other factors of lower quality level of evidence include pregnancy after bariatric surgery is strongly related to internal hernias, a new factor was smoking, which was identified as an additional significant risk factor for the development of internal hernias.

Resultados de síntesis

Internal hernias following bariatric surgery are significantly associated with lack of prophylactic closure of defects, a variety of factors including smoking as a cause of the increased clinical risk of internal hernias, pregnancy after bariatric or metabolic surgery represents an additional factor with intermediate and low levels of evidence. Among the factors mentioned, it is important to indicate as exceptional situations that include a risk of hernia through the adjustable gastric band or Brolin's point hernia, which exists even when the defects are closed prophylactically, the risk persists due to the presence of other external factors that need further investigation.

Publication biases. Bias depends on statistical heterogeneity due to the lack of more clinical trials because they are factors that have been little studied.
Certainty of evidence. There is high-quality evidence for the outcome regarding closure of defects as a protective factor for internal hernias after bariatric surgery, unlike there is low- and intermediate-quality evidence for a repetitive outcome that was the presence of internal hernias after bariatric surgery associated with increased fertility in this population.

Discussion

The general interpretation of the results confirms the association of various risk factors with the appearance of internal hernias after bariatric surgery, with varying levels of evidence. Among the most relevant are the prophylactic closure of mesenteric defects, pregnancy after bariatric surgery and smoking, all linked to an increased risk of internal hernias.
In agreement with other evidence, a meta-analysis of 14 studies involving 20 553 patients reported that the rate of herniation of mesenteric defect after laparoscopic Roux-en-Y gastric bypass ranges from 2 % in patients with primary closure to up to 6 % in those without closure, with the need for reoperation between (2-10 %)[37] Likewise, a review indicated that post-bariatric hiatal hernia occurs more frequently after sleeve gastrectomy (63 %), followed by Roux-en-Y gastric bypass (21 %) and gastric bypass with anastomosis (16 %), and surgical repair was possible using the round ligament for hiatal reconstruction[38].
Compared to the results summarized in Table 1, it is observed that the closure of mesenteric defects is a significant factor compared to non-closure (RR 0.32; 95 % CI: 0.24-0.42; $p < 0.00001$)[33]. However, some studies indicate that closure alone does not guarantee

risk reduction, since the incidence of internal hernias in patients with closure (2.84 %) did not differ significantly from those without closure (2.80 %)[39].

The limitations of this review are related to the paucity of research on emerging aspects, such as fertility and specific complications after bariatric surgery, which require further exploration[40]. In addition, additional factors such as flanges, adhesions, stenosis, and bezoars are recognized, reported as causes of acute bariatric abdomen[10].

The heterogeneity of the metrics used in the included studies conditions the quality of the evidence, which comes from both randomized trials and observational studies. Therefore, research with a higher level of evidence is required to consolidate the conclusions about the complications evaluated.

In clinical practice, the interpretation of results depends on multiple factors, including surgical technique and individual patient characteristics. Bariatric surgery is known to increase fertility and the chance of pregnancy in women with obesity, underscoring the need to identify other risk factors that have not yet been studied.

Conclusion

The present systematic review shows that internal hernias after bariatric surgery are a relevant complication, with a significant clinical impact on the evolution of patients. The results highlight that the prophylactic closure of mesenteric defects is the most important factor in reducing the incidence of internal hernias and intestinal obstruction in the long term. Likewise, other risk factors such as smoking and pregnancy after bariatric surgery were identified, which increase the probability of complications, although they require further research to consolidate their causal relationship.

The review also acknowledges the existence of additional understudied factors, such as flanges, adhesions, stenosis, and bezoars, which may contribute to the development of acute bariatric abdomen. The heterogeneity of the included studies and the variability in the metrics used reflect the need for research with a higher level of evidence, especially randomized clinical trials, to establish more robust recommendations.

Finally, this research provides relevant information for clinical practice, underlining the importance of prevention, timely diagnosis and surgical management of internal hernias in patients undergoing bariatric surgery. The identification of risk factors is an essential step to optimize surgical results, reduce morbidity and guide future lines of research in this field.

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Conflicts of interest

The authors declare that they have no conflicts of interest in this research.

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Ethical considerations

It does not apply, as it is a systematic review, it does not require informed consent to participate.

Limitations in research

A very limited topic because it is something infrequent.

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Contribution of the authors in the article

Javier Aquiles Hidalgo Acosta, conceptualization and resources. *Alberto Lenin Rivera Macanchi*, methodology. *Zambrano Muñoz Lady Lucia*, software and formal analysis. *Leticia del Pilar Barberán Astudillo*, data curation. *Liz Milena Mendoza Arteaga*, writing the original draft. *Sonnia Paola Díaz Cepeda*, revision and editing of the original draft. *Olga Italia Montufar Benítez*, visualization. *Javier Aquiles Hidalgo Acosta*, research. *Jonathan Gabriel Cobeña Vera*, supervision. *Alberto Lenin Rivera Macanchi*, project management. *Zambrano Muñoz Lady Lucia*, writing the final draft. *Leticia del Pilar Barberán Astudillo*, revision of the final manuscript. *Liz Milena Mendoza Arteaga*, final acceptance. *Javier Aquiles Hidalgo Acosta*, acquisition financing.

Use of artificial intelligence

No type of artificial intelligence was used for this research

Availability of data, codes, and other materials

Data, protocol, and other materials are available from the corresponding author.

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