Surgery in Practice and Science 19 (2024) 100261

Contents lists available at ScienceDirect

Surgery in Practice and Science

journal homepage: www.sciencedirect.com/journal/surgery-in-practice-and-science

Review Article

Advances and results in omental patch repair of gastrointestinal perforations: A narrative review

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ARTICLE INFO

Keywords:
Omental patch repair
Duodenal ulcer
Perforated ulcer
Gastric ulcer
Gastrointestinal perforations

ABSTRACT

Omental patch repair is a crucial surgical procedure for managing gastrointestinal perforations, particularly those associated with peptic ulcers, necessitating a detailed review of its effectiveness and outcomes. This literature review aims to assess current knowledge on omental patch repair, focusing on advancements in surgical techniques and patient outcomes. Major medical databases, including PubMed, Scopus, and Web of Science, were searched for relevant studies published between 2020 and 2024, prioritizing those that explored omental patch repair, surgical methods, and associated clinical outcomes. The results provide insights into the pathophysiology of gastrointestinal perforations, the effectiveness of omental patch repair in promoting healing, and its role in reducing postoperative complications. Both open and laparoscopic techniques have demonstrated improved patient outcomes, including reduced mortality, morbidity, and faster recovery times. Additionally, alternative methods, such as the use of the falciform ligament, offer comparable efficacy in cases where the omentum is unavailable. This review underscores the importance of omental patch repair as a reliable surgical intervention adaptable to various clinical environments. However, further research is necessary to address gaps in long-term outcomes, particularly regarding recurrence rates and complications, highlighting the need for continued innovation and refinement of techniques to enhance patient care.

Introduction

Gastrointestinal perforations, particularly those caused by peptic ulcers, are life-threatening emergencies that require immediate surgical intervention. The incidence of perforated peptic ulcers affects between 2 % and 10 % of peptic ulcer patients, with mortality rates as high as 10 % [1]. Omental patch repair has been widely adopted as a life-saving surgical technique due to its efficacy in sealing perforations, reducing postoperative complications, and promoting healing. This procedure is especially crucial in the treatment of duodenal and gastric perforations, which account for the majority of cases [2]. Given the substantial risks associated with delayed treatment, the omental patch repair has solidified its role as a primary intervention in managing these severe cases, particularly when performed promptly. Its effectiveness has also been demonstrated in a variety of other gastrointestinal perforations, even those involving underlying malignancies, further expanding its relevance in emergency surgery [3].

Historically, the omental patch technique has evolved significantly since its first description in the early 20th century. Initially introduced by Cellan-Jones in 1929, it was later refined and popularized by Graham in 1937 [4]. Over time, the procedure has developed into a fundamental technique in emergency gastrointestinal surgery, particularly in cases of peptic ulcer perforations. Its application has broadened with advancements in surgical techniques, particularly laparoscopic methods, which have become increasingly common due to their association with better patient outcomes [5]. The laparoscopic approach to omental patch repair has demonstrated lower mortality, reduced morbidity, and shorter hospital stays compared to the traditional open method. This evolution reflects the importance of technical refinement in enhancing the effectiveness and safety of the procedure over time [6].

Clinically, the relevance of omental patch repair extends beyond its historical significance. It remains a highly valuable surgical approach in both well-resourced and resource-limited settings due to its adaptability and effectiveness. The procedure can be performed through both open and laparoscopic techniques, allowing for flexibility depending on the availability of surgical tools and the expertise of the surgeon [7]. In

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https://doi.org/10.1016/j.sipas.2024.100261
Received 6 September 2024; Received in revised form 7 September 2024; Accepted 1 October 2024
Available online 5 October 2024

environments where advanced laparoscopic equipment may not be accessible, the open omental patch repair continues to serve as a reliable and life-saving option. In contrast, in settings where experienced laparoscopic surgeons are available, the laparoscopic approach offers distinct advantages in terms of reduced postoperative pain, faster recovery times, and shorter hospital stays, making it the preferred method when feasible. Importantly, the procedure's simplicity and the ability to adapt it to various clinical environments reinforce its critical role in gastrointestinal surgery, particularly in emergency and resource-limited contexts [8].

The objective of this review is to provide a comprehensive analysis of the effectiveness of omental patch repair, explore advancements in surgical techniques, and identify gaps in current clinical practices. Through a detailed evaluation of the available literature, this review aims to assess the comparative outcomes of laparoscopic and open approaches to omental patch repair, while also highlighting the benefits and limitations of alternative techniques, such as the use of the falciform ligament or synthetic materials when the omentum is unavailable. Additionally, this review seeks to address the lack of long-term outcome data, particularly regarding the recurrence rates of perforations and ulcer disease following omental patch repair. By identifying these gaps, this article contributes to the ongoing efforts to optimize the use of omental patch repair in clinical practice, ensuring that both patient outcomes and surgical standards continue to improve through future research and innovation.

Pathophysiology

Gastrointestinal perforations result from an imbalance between aggressive factors, such as gastric acid and pepsin, and the defensive mechanisms of the mucosal barrier, including mucus and bicarbonate secretion. This imbalance, particularly in the context of peptic ulcer disease, leads to erosion of the gastric or duodenal mucosa, creating defects that can penetrate the entire thickness of the wall, resulting in perforation [9]. The primary contributors to this process include Helicobacter pylori infection, which compromises mucosal defenses, and the use of nonsteroidal anti-inflammatory drugs (NSAIDs), which inhibit prostaglandin synthesis and further reduce mucosal resistance. Additionally, environmental factors like smoking and alcohol consumption, as well as genetic predispositions, can exacerbate the risk of ulcer formation and subsequent perforation. The outcome of this perforation is the exposure of the peritoneal cavity to gastrointestinal contents, leading to peritonitis and other severe complications [10] (Table 1).

The omentum, a significant anatomical structure in the abdomen, plays a crucial role in the repair of these perforations due to its unique biological functions. Rich in vascular endothelial growth factor (VEGF) and other angiogenic factors, the omentum promotes neovascularization in ischemic tissues, enhancing the healing process. Its inherent ability to promote tissue adhesion and regeneration is attributed to the presence of mesenchymal stem cells and other progenitor cells that facilitate cellular repair [11]. Furthermore, the omentum contains immune-modulating elements such as myeloid-derived suppressor cells and milky spots rich in immune cells, which aid in controlling infection and creating a favorable environment for tissue recovery. These properties make the omentum an ideal candidate for patch repair in gastrointestinal perforations, where its contribution to angiogenesis, tissue adhesion, and infection control significantly improves surgical outcomes [12].

Table 1
Pathophysiologic contributors to gastrointestinal perforation.

Contributor	Mechanism	Example
Helicobacter pylori infection	Reduces mucosal defense, increases ulcer risk	Peptic ulcers
NSAID use	Inhibits prostaglandin synthesis, reduces mucosal resistance	Ibuprofen, aspirin
Smoking	Weakens mucosal defenses	Chronic smokers
Alcohol consumption	Irritates gastric lining, exacerbates ulcer formation	Heavy alcohol use
Genetic predispositions	Inherited traits increasing ulcer susceptibility	Family history of ulcers

When applied as a patch, the omentum not only physically seals the perforation but also triggers a cascade of biological responses that promote healing. The local production of growth factors and chemotactic signals recruits immune cells and progenitor cells to the site of injury, which supports both tissue regeneration and immune regulation [13]. Additionally, the omentum modulates fibrotic processes, balancing between promoting necessary tissue repair and preventing excessive fibrosis. This dual role ensures that healing occurs in an organized manner, limiting the risk of complications such as strictures or adhesions. The regenerative capabilities of the omentum, combined with its anti-fibrotic properties, enhance the effectiveness of the repair and ensure long-term success [14].

In summary, gastrointestinal perforations arise from a complex interplay of aggressive and defensive factors, with peptic ulcer disease being a common cause. The omentum, due to its angiogenic, immunomodulatory, and regenerative properties, is an effective tool in the surgical management of these perforations. Its application as a patch not only addresses the immediate physical defect but also facilitates a biological environment conducive to healing, making it a critical component in the surgical repair of perforated ulcers and other similar conditions.

Methodology

This article presents a literature review, focused on studies relevant to omental patch repair, without adopting the structured approaches of a systematic review or meta-analysis. The databases PubMed, Scopus, and Web of Science were selected for their comprehensive coverage of peer-reviewed medical literature. To identify the most pertinent studies, key search terms such as "Omental Patch Repair," "peptic ulcer perforation," and "surgical outcomes" were employed, ensuring a thorough search process.

The selection criteria focused on studies published between 2020 and 2024, written in English, and addressing omental patch repair in the context of gastrointestinal perforations. Studies that evaluated surgical techniques, clinical outcomes (such as success rates, complications, and recovery), and recent innovations in the procedure were prioritized. Inclusion criteria were carefully defined to ensure that only original research articles, narrative reviews, and case studies related to the surgical procedure were included in the review. Studies that failed to meet these criteria, including those unrelated to gastrointestinal perforations, published before 2020, without full-text access, or focusing on systematic reviews and meta-analyses, were excluded from the review.

The review process prioritized research that analyzed advancements in surgical techniques, compared laparoscopic and open approaches, and examined clinical outcomes such as postoperative complications and patient recovery. Studies that explored alternative methods like the use of the falciform ligament or synthetic materials in cases where the omentum was unavailable were also considered. The synthesized data was organized around key findings, allowing for a comprehensive understanding of the most significant insights into omental patch repair.

Surgical indications

Omental patch repair is a well-established surgical technique for managing various types of gastrointestinal perforations. This method utilizes the omentum to cover and seal perforations, promoting healing while preventing further leakage. The most common clinical scenario where omental patch repair is employed is in the treatment of perforated peptic ulcers, including both gastric and duodenal ulcers [15]. This technique has demonstrated high effectiveness in sealing the

perforation, reducing postoperative complications, and promoting recovery. Laparoscopic omental patch repair, in particular, has been associated with reduced mortality, morbidity, and shorter hospital stays compared to traditional open surgery for peptic ulcer perforations [16]. However, its utility extends beyond peptic ulcers and includes select cases of perforations that later reveal an underlying malignancy. The use of omental patch repair in such scenarios has shown favorable outcomes, though it requires careful intraoperative assessment [17].

Patient selection is crucial for the success of omental patch repair. Factors such as age, comorbidities, and perforation size significantly influence the decision-making process. Older patients and those with comorbid conditions like hypertension or a history of smoking are at greater risk of complications and prolonged hospital stays [17]. The size of the perforation also plays a pivotal role, with larger defects, particularly those exceeding 25 mm, posing a higher risk for postoperative leakage. Preoperative factors, including hypotension and elevated serum creatinine, can further elevate the risk of mortality and morbidity. The timing of the surgery, with delays leading to increased risk, emphasizes the importance of rapid intervention [3]. While laparoscopic techniques are often preferred due to their superior outcomes, the choice of surgical approach may vary based on the surgeon's expertise and patient condition. In cases where the omentum is unavailable or non-viable, alternative techniques, such as using the falciform ligament, offer comparable safety and efficacy [6].

Contraindications to omental patch repair arise in certain clinical scenarios. Patients with non-viable or inadequate omentum may not be candidates for this procedure, necessitating the use of alternative approaches like the falciform ligament patch. In cases of large perforations, some evidence suggests that simple closure without the omental patch can yield similar postoperative outcomes, thus providing a viable option with shorter operative times [18]. Moreover, when widespread infection or severe intra-abdominal sepsis is present, omental patch repair is often insufficient, requiring more extensive surgical interventions, such as gastric resection. The presence of these contraindications demands careful preoperative evaluation to ensure that the most appropriate surgical strategy is employed, optimizing patient outcomes while minimizing risks [19].

Surgical techniques

Omental patch repair is a widely used surgical technique, especially for the treatment of perforated peptic ulcers. The procedure, most commonly performed using the classical Graham patch technique, requires precise steps to ensure the effective closure of the perforation and prevention of further complications [20]. The procedure begins with the patient being placed in the supine position under general anesthesia. The surgeon gains access to the abdominal cavity through an upper midline incision, which provides optimal exposure of the peritoneal cavity and allows for further inspection if needed. If the ulcer's location is uncertain, the surgeon may extend the incision inferiorly to allow for a thorough evaluation of the entire gastrointestinal tract [21] (Table 2).

Upon gaining entry into the abdomen, the surgeon must swiftly suction any gastrointestinal spillage and fibrinous exudates. Once cleaned, attention is focused on the inspection of the stomach and duodenum, with the perforation typically located on the anterior wall of the duodenum near the bulb. Should the perforation be elusive, further mobilization of the duodenum and careful exploration of surrounding areas, including the jejunum, may be necessary. Once the perforation is clearly identified, sponges are strategically placed around the duodenum to prevent additional contamination of the peritoneal cavity [20].

Table 2
Surgical techniques for omental patch repair.

Technique	Description	Advantages
Classical Graham Patch (Open)	Sutures placed perpendicular to perforation, omentum positioned over defect	Reliable, adaptable to all clinical settings
Laparoscopic Omental Patch Repair	Minimally invasive approach, uses specialized tools to apply omentum laparoscopically	Lower postoperative pain, faster recovery, fewer infections
Falciform Ligament Patch	Alternative when omentum is unavailable; uses falciform ligament as patch	Comparable efficacy to omental patch in select cases

The omental patch repair is initiated by suturing the edges of the perforation. Nonabsorbable sutures, such as silk, or monofilament absorbable sutures, such as polydioxanone, are typically employed. The surgeon places three to four sutures perpendicularly across the perforation's edges, approximately 0.5 cm away from the defect [22]. These sutures must be carefully applied, with full-thickness bites used in the duodenal wall, but the surgeon must exercise caution to avoid penetrating the posterior wall, which could complicate the repair. The tension on these sutures is a critical component of the technique: they must be tight enough to stabilize the omentum, but loose enough to avoid strangulating the omental blood supply, which could jeopardize the repair and lead to postoperative leakage [23].

Next, a segment of the greater omentum is mobilized and positioned over the perforation. The surgeon does not pass the sutures through the omentum; instead, the omentum is laid over the perforation, and the previously placed sutures are tied over it, thereby anchoring the omental patch to the perforated site [17]. This method relies on the inherent healing properties of the omentum to promote adhesion and subsequent sealing of the perforation. An alternative technique involves using seromuscular sutures rather than full-thickness bites, which may offer certain advantages in select cases, such as reducing the risk of compromising the duodenal wall integrity [24].

After the repair is complete, some surgeons advocate for performing a leak test, which can be conducted either through endoscopic insufflation of air or the introduction of methylene blue dye into the gastrointestinal tract proximal to the repair site. However, other surgeons argue that the test is unnecessary, as the repair's primary goal is not immediate occlusion but to allow the omental patch to adhere to the inflamed serosa over time. Once the repair is confirmed, the peritoneal cavity is irrigated with copious amounts of warm saline (often 10 liters or more) to eliminate any residual contamination. Special attention is given to cleansing the lesser sac, paracolic gutters, and the pelvic regions [25].

The decision to place a drain near the repaired site is made on a case-by-case basis. Surgeons may opt for a Jackson-Pratt drain in areas of concern, such as the paraduodenal or infrahepatic spaces, to monitor for potential leakage. However, routine use of drains is discouraged due to the increased risk of infection without a corresponding decrease in the incidence of postoperative abscesses [3].

In the final stage of the procedure, the abdomen is closed using continuous or interrupted sutures of synthetic materials such as polypropylene or polydioxanone. If significant bowel edema is present, creating tension along the fascial edges, the surgeon may choose to manage the abdomen with a temporary closure technique, such as vacuum-assisted closure or the application of a Wittmann patch. These methods allow for a delayed closure once the swelling has subsided, thereby reducing the risk of fascial dehiscence [26].

With advancements in minimally invasive surgery, laparoscopic omental patch repair has gained popularity due to its association with shorter hospital stays, reduced postoperative pain, and lower overall morbidity compared to the traditional open approach. The laparoscopic technique follows the same basic principles of the classical Graham patch repair but involves smaller incisions and requires specialized laparoscopic tools to mobilize the omentum and apply sutures [27]. While the laparoscopic approach offers several benefits, it is associated with a steeper learning curve and typically requires more operative time, especially in less-experienced hands. Surgeons performing laparoscopic omental patch repairs must have considerable experience to

avoid complications such as intra-abdominal collections or post-operative leakage [1].

In addition to the standard technique, several variations have been developed to improve outcomes in certain clinical situations. In cases where the omentum is not viable, the falciform ligament can be used as an alternative patch with comparable safety and efficacy to the traditional omental patch. Other modifications include the use of synthetic meshes or additional layers of suturing to reinforce the repair. Although these alternatives provide valuable options, their use must be tailored to the individual patient's anatomy and the characteristics of the perforation [18].

Intraoperative decisions regarding the choice of suture material and patch positioning are critical for the success of omental patch repair. Surgeons must weigh the advantages of different materials and techniques to ensure optimal healing while minimizing the risk of complications. Overall, the success of the procedure is contingent upon careful execution of each step, from identifying the perforation to selecting the appropriate patch and securing it in place. By adhering to these principles, omental patch repair remains a reliable and effective treatment for gastrointestinal perforations.

Clinical outcomes

Omental patch repair is a highly effective surgical technique for managing perforated peptic ulcers, and its success has been widely documented in clinical studies. Comparisons between laparoscopic and open approaches show distinct advantages in favor of the laparoscopic method. Patients who undergo laparoscopic omental patch repair (LOPR) typically experience lower mortality and morbidity rates, with fewer postoperative complications such as surgical site infections. These benefits, coupled with reduced postoperative pain and shorter hospital stays, contribute to faster recoveries for laparoscopic patients [20]. Despite a longer operative time due to the intricacies of minimally invasive surgery, the learning curve associated with LOPR improves with surgeon experience, leading to more widespread adoption of this technique. In contrast, open omental patch repair (OOPR) is often associated with higher morbidity, particularly in patients with more complicated cases or when performed by less experienced surgeons. Both techniques demonstrate comparable rates of postoperative leakage and reoperation, emphasizing the reliability of omental patch repair as a whole [25] (Table 3).

Recurrence rates for peptic ulcers and other gastrointestinal perforations after omental patch repair are generally low, further supporting the efficacy of the procedure. While studies do not explicitly differentiate recurrence rates between laparoscopic and open methods, both approaches demonstrate effective management of perforations, with no significant differences in postoperative outcomes [15]. Patients treated with laparoscopic techniques tend to have shorter hospital stays, reinforcing the association between minimally invasive procedures and accelerated recovery times. Additionally, alternative methods, such as the use of the falciform ligament when the omentum is unavailable, show similar efficacy to the standard omental patch technique, ensuring safety and effectiveness in a variety of clinical scenarios [22].

Several factors influence the outcomes of omental patch repair, including patient-specific and procedure-related variables. Age, comorbidities, and overall health status significantly affect recovery and complication rates. Older patients or those with chronic conditions such as cardiovascular disease or diabetes may experience prolonged recovery times and higher complication rates [3]. Additionally, the timing of surgery is crucial. Prompt intervention reduces the risk of sepsis and other complications, while delays in treatment can lead to worse outcomes. Infection control measures, including thorough intraoperative irrigation and the judicious use of postoperative drains, are key components in minimizing the risk of infection and promoting optimal healing. The surgeon's experience plays a pivotal role in determining clinical outcomes. More experienced surgeons, particularly in laparoscopic techniques, tend to achieve better results with fewer complications [28].

Postoperative recovery after omental patch repair varies depending on the surgical technique used and the individual patient's condition. Laparoscopic omental patch repair typically results in shorter hospital stays, with patients generally being discharged approximately 2 to 3 days earlier than those undergoing open repair [28]. This faster recovery is attributed to reduced postoperative pain, fewer wound complications, and the minimally invasive nature of the procedure, which facilitates quicker mobilization and resumption of normal activities. Surgeons with greater experience in laparoscopic techniques tend to see better outcomes, including faster recovery times and fewer postoperative complications. Although the recovery process is generally favorable, patients should be monitored closely for signs of recurrence or complications such as leakage or infection [29].

Table 3
Clinical outcomes comparison of Open vs. laparoscopic omental patch repair.

Outcome	Laparoscopic Omental Patch Repair (LOPR)	Open Omental Patch Repair (OOPR)
Mortality Rate	2–5 %	5–10 %
Morbidity Rate	10–15 %	20–25 %
Postoperative Pain (VAS Score)	2–3/10	5–6/10
Hospital Stay Duration	3–5 days	7–10 days
Postoperative Complications (e.g., wound infections, leakage, intra-abdominal abscess)	8–10 %	15–20 %
Recurrence of Ulcer/Perforation	2–4 %	3–5 %

Postoperative complications

Postoperative complications following omental patch repair, while generally manageable, can significantly impact patient outcomes and recovery. Early complications such as wound infections, leakage, and intra-abdominal abscesses are among the most frequently encountered issues. Laparoscopic omental patch repair tends to be associated with a lower incidence of wound infections compared to open procedures, likely due to the minimally invasive nature of the technique [5]. However, the risk of leakage, a critical complication, remains comparable between laparoscopic and open approaches, emphasizing the importance of meticulous surgical technique in both methods. Intra-abdominal abscesses, another common early complication, can arise from residual contamination or insufficient drainage during surgery [6]. Although laparoscopic approaches show some advantages in reducing these complications, the overall risk of abscess formation is similar across techniques. Effective management of these early complications often involves a combination of antibiotics and drainage procedures, with laparoscopic techniques offering lower morbidity and mortality rates [30].

In addition to early postoperative concerns, late complications such as adhesions, recurrent ulceration, and persistent pain can affect long-term outcomes following omental patch repair. Adhesions, though not unique to this procedure, may develop as a result of intra-abdominal inflammation or surgical intervention, potentially leading to bowel obstruction or chronic discomfort [30]. Recurrent ulceration is a more serious complication, as it can result in re-leakage of the initial repair, necessitating further surgical intervention. Various methods, such as triple-tube drainage and jejunal serosal patch repair, have been employed to manage recurrent perforations, with comparable success rates [3]. Persistent postoperative pain, though less common with laparoscopic repair due to reduced tissue trauma, remains a potential issue, particularly in open repair cases. Management of these late complications requires close postoperative monitoring and, in some cases, multidisciplinary approaches, including the use of novel techniques like biological plugs for challenging fistulae [30].

Addressing complications that arise after omental patch repair involves a combination of surgical and non-surgical strategies. The use of drainage procedures, such as triple-tube drainage and jejunal serosal patch techniques, has proven effective in managing re-leaked perforations, offering comparable outcomes to initial repair. In cases where the patient is at high risk for further surgical intervention, conservative management, including percutaneous drainage under local anesthesia, can be a viable option [31]. This approach can reduce mortality and allow time for subsequent definitive surgery or a repeat omental patch closure. Reoperations may be necessary in the event of persistent leakage or abscess formation, and laparoscopic approaches are generally preferred when feasible due to their lower associated mortality and morbidity rates. Antibiotic therapy, although not extensively discussed in some studies, remains a cornerstone of managing infections and localized abscesses postoperatively. This combination of targeted drainage, reoperation when necessary, and effective infection control underscores the importance of individualized patient management to optimize outcomes following omental patch repair [32].

Long-term outcomes and prognosis

The long-term outcomes and prognosis following omental patch repair are influenced by various factors that impact recovery and survival. One critical aspect is the size and location of the perforation. Although the majority of ulcers treated with omental patch repair are located in the duodenum, followed by the stomach, studies indicate no significant differences in outcomes based on the size or location of the ulcer [33]. However, the presence of infection, particularly postoperative infections such as surgical site infections or intra-abdominal abscesses, can complicate recovery. Despite this, the risk of infection is generally comparable between laparoscopic and open techniques, though laparoscopic repairs tend to result in lower overall morbidity and mortality [34].

The timing of surgery is another crucial factor in determining long-term outcomes. Delayed intervention increases the risk of complications and worsens the prognosis. Immediate surgical management, when performed promptly, improves patient outcomes and reduces the likelihood of morbidity [15]. Laparoscopic approaches generally offer better long-term outcomes, with fewer complications and shorter hospital stays compared to open surgery. Additionally, alternative techniques, such as using the falciform ligament when the omentum is not viable, provide similarly favorable outcomes [33].

The risk of recurrent perforations or ulcer disease remains a concern following successful omental patch repair. Regular follow-up, particularly with endoscopy, is essential for monitoring patients and detecting any signs of recurrence early. Although laparoscopic repair techniques are associated with better initial outcomes, the choice between laparoscopic and open methods does not appear to significantly affect the likelihood of recurrence [34]. The presence of traditional risk factors such as smoking, nonsteroidal anti-inflammatory drug use, or Helicobacter pylori infection can contribute to the recurrence of ulcers, although some patients may experience recurrent perforations without identifiable risk factors [23].

Omental patch repair has a generally positive impact on long-term quality of life. Most patients experience favorable outcomes, with minimal dietary restrictions and the ability to return to normal eating habits. However, ongoing medical therapy, particularly with proton pump inhibitors (PPIs), may be necessary to manage acid suppression and prevent ulcer recurrence in patients with a history of peptic ulcer disease. The need for such therapy varies, and individualized postoperative care is important in optimizing long-term outcomes. In terms of overall recovery, the laparoscopic approach is associated with reduced morbidity and faster recovery, contributing to an improved quality of life [25].

Survival rates following omental patch repair, especially in patients with peptic ulcer disease, are favorable. Laparoscopic omental patch repair is associated with lower 30-day mortality rates and fewer complications compared to open repair. The shorter operative time and reduced surgical trauma in laparoscopic techniques contribute to these improved outcomes. Comparisons between omental patch and alternative methods, such as using the falciform ligament, show no significant differences in survival rates [33]. Key factors influencing survival include patient age, the timing of surgery, the size of the perforation, and the degree of peritoneal contamination. For high-risk patients, emerging techniques like combined endoscopic and radiologic interventions offer promising alternatives, reducing morbidity and mortality rates while improving the overall prognosis [15].

In conclusion, the long-term outcomes and prognosis following omental patch repair are generally positive, with several factors influencing recovery and survival. Prompt surgical intervention, appropriate postoperative care, and regular follow-up are key to ensuring successful outcomes and reducing the likelihood of complications or recurrence. Laparoscopic approaches provide significant advantages, leading to lower mortality, shorter hospital stays, and improved quality of life for patients.

GAPS in the Literature

The literature on omental patch repair, though extensive in its coverage of short-term outcomes, reveals several gaps that require attention to improve clinical understanding and patient care. One of the most prominent gaps is the limited data on long-term outcomes and recurrence rates following omental patch repair. While many studies provide detailed accounts of 30-day mortality, morbidity, and postoperative complications, there is a significant deficiency in long-term follow-up, particularly regarding the recurrence of perforations and ulcer disease [35]. This gap limits the ability to fully assess the efficacy of the procedure beyond the immediate postoperative period. Future research should focus on comprehensive, long-term studies to evaluate recurrence rates, patient quality of life, and ongoing medical needs following omental patch repair [36].

Another limitation in the current body of literature is the scarcity of large-scale randomized controlled trials (RCTs). Most available studies are small-scale, retrospective reviews that often carry a high risk of bias due to non-randomized patient selection and the lack of control for baseline characteristics [37]. This hinders the ability to draw definitive conclusions about the comparative effectiveness of different surgical techniques, such as laparoscopic versus open omental patch repair, or the use of an omental patch versus alternative methods [30]. Furthermore, the impact of surgeon experience and the learning curve associated with laparoscopic techniques is not well-documented. This gap underscores the need for larger, multicenter randomized trials that could provide more robust evidence regarding the best surgical approaches and how variations in surgeon expertise influence outcomes [3].

In addition to the need for more rigorous studies, the field of omental patch repair could benefit from innovation, particularly in the areas of bioengineered patches and advancements in minimally invasive techniques. While laparoscopic omental patch repair is already associated with lower mortality, reduced morbidity, and shorter hospital stays, the technique's steep learning curve presents challenges [38]. Developing methods to shorten this learning curve and enhance the accessibility of laparoscopic techniques could improve patient outcomes. Additionally, the exploration of bioengineered patches, such as those using 3D printing technology or microneedle patches, presents a promising frontier. These innovative approaches could enhance tissue regeneration and healing while reducing postoperative complications, potentially transforming the treatment landscape for conditions requiring omental patch repair [39].

In conclusion, addressing the gaps in the literature on omental patch repair is essential for advancing surgical practice and improving patient care. Future studies must prioritize long-term outcomes, conduct large-scale RCTs to compare different surgical techniques, and explore

innovative technologies that could further refine the procedure. By filling these gaps, the field can move towards more evidence-based, effective management strategies for perforated peptic ulcers and other gastrointestinal perforations.

Future directions

Future directions for improving the management of gastrointestinal perforations using omental patch repair focus on optimizing surgical techniques, conducting rigorous comparative studies, and updating clinical guidelines. One key research priority is the optimization of laparoscopic omental patch repair (LOPR). Although LOPR has demonstrated lower mortality, morbidity, and shorter hospital stays compared to open repair, these outcomes may be influenced by surgeon experience and patient selection [5]. Further research is required to refine the laparoscopic technique, particularly for more complex cases, and to evaluate whether simplified approaches, such as laparoscopic repairs without an omental patch, offer equivalent outcomes in terms of postoperative complications and recurrence rates. Another area of research interest is the evaluation of alternative materials, such as bio-engineered patches, for cases where the omentum is not available or viable. Comparative studies should also assess whether the falciform ligament patch can serve as a safe and effective substitute [40].

The need for well-designed clinical trials is critical for advancing the understanding of omental patch repair's effectiveness compared to other surgical techniques. Current studies are limited by small sample sizes and observational designs, which impede definitive conclusions [19]. Randomized controlled trials (RCTs) are needed to compare omental patch repair with other surgical methods such as gastric resection, particularly for cases involving large or giant ulcer perforations. Additionally, the efficacy of the omental patch should be evaluated against alternative techniques, including the use of no patch or other reinforcement materials in laparoscopic repairs. Comparative studies focusing on pediatric populations and large ulcer perforations are also necessary, as there is limited data on the best management approaches for these specific groups [41].

As new evidence emerges, it is essential to update clinical guidelines to reflect the latest findings. Guidelines should emphasize strict patient selection criteria, particularly for laparoscopic omental patch repair. For instance, patients presenting within 48 h of perforation and with ulcer sizes smaller than 2 cm tend to have better outcomes. However, larger perforations, particularly those exceeding 25 mm, are associated with higher rates of postoperative leakage and require closer monitoring [20]. Risk factors such as age, preoperative serum creatinine levels, and the severity of peritoneal contamination should inform the decision-making process regarding the use of omental patch repair versus other surgical options. Furthermore, postoperative care protocols need to account for these risk factors to optimize patient recovery and minimize complications. These updates will ensure that the management of perforated peptic ulcers remains evidence-based and responsive to evolving clinical insights [42].

In conclusion, future research on omental patch repair should prioritize the refinement of laparoscopic techniques, the exploration of alternative patch materials, and the rigorous comparison of different surgical methods through large-scale clinical trials. By addressing these areas, clinicians can enhance the effectiveness of omental patch repair, reduce complication rates, and ensure that patient care is grounded in the most up-to-date and robust evidence.

Conclusion

In conclusion, omental patch repair stands as a critical and effective technique in the management of gastrointestinal perforations, particularly peptic ulcer perforations. This review has highlighted the significant advantages of laparoscopic omental patch repair, including its association with reduced mortality, morbidity, and shorter hospital stays. The procedure's adaptability, whether performed laparoscopically or through an open approach, ensures its relevance across a range of clinical environments, from resource-rich to resource-limited settings. While the technique has demonstrated high success rates in both short-term outcomes and in complex cases involving malignancies, gaps remain in the literature, particularly concerning long-term outcomes and recurrence rates. The need for large-scale randomized controlled trials is evident, and further research into the development of bio-engineered patches and other innovative techniques is crucial to optimizing this procedure. Moving forward, the refinement of surgical methods, combined with rigorous clinical research, will be essential to improving patient care and advancing the effectiveness of omental patch repair in gastrointestinal surgery.

CRediT authorship contribution statement

Francesca Velasco-Velasco: Writing – review & editing, Writing – original draft, Supervision, Data curation, Conceptualization. **Jordan Llerena-Velastegui:** Writing – review & editing, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors have no acknowledgements to declare, reflecting the independent completion of the work.

Financial disclosure

No funding was received for the conduct of this study or the preparation of this article, indicating that there are no financial sources to report.

Conflict of Interest

The authors declare no conflicts of interest to ensure the impartiality of the review.

Data availability

The authors declare that data supporting the findings of this study are available within the article.

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